

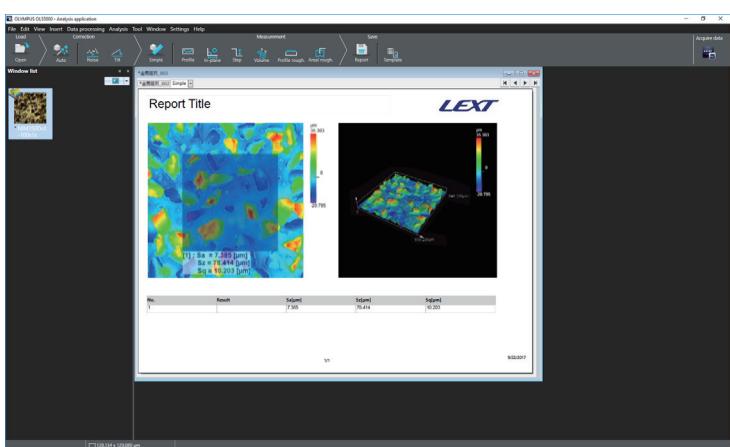
OLYMPUS®

Instructions

OLS5000

3D Measuring Laser Microscope

Analysis



Notes

This instruction manual is for the Olympus 3D Measuring Laser Microscope.

To ensure safety, obtain optimum performance and to familiarize yourself fully with the use of this product, we recommend that you study this manual thoroughly before operating this product, and always keep this manual at hand when operating this product.

Retain this instruction manual in an easily accessible place near the work desk for future reference.

Optical Microscope and Accessory



A X 9 2 4 9

Introduction

Configuration of instruction manuals

Read all the instruction manuals supplied with the units you purchased.

The following instruction manuals are prepared for the units to be used with this product.

Manual names	Main contents
OLS5000 instruction manual Hardware	Safety precautions and specifications of the microscope
OLS5000 instruction manual Data Acquisition	Data acquisition and system maintenance
OLS5000 instruction manual Analysis (this instruction manual)	Image view, image measurement analysis, image management and reports
OLS5000 Quick Reference Guide	Simple operations of the microscope

You can view the instruction manual "Data Acquisition" or "Analysis" in PDF format by selecting the corresponding menu from the [Help] menu of the data acquisition application or the analysis application.

The following symbols are used in this instruction manual.



: Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.



: Indicates a potentially hazardous situation which, if not avoided, may result in damage to the product or other property and/or may cause problems.



: Indicates a key point for acquiring highly accurate data.



: Indicates reference information on functions and operating procedures of this product.

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License

The USB license key controls the enabling/disabling of functions of the application. The functions of the analysis application are available without connecting the USB license key to the USB port (except optional functions).

Starting the analysis application by connecting the USB license key to the USB port allows you to use the following optional function.

- Advanced analysis software
- Film thickness measurement software
- Particle analysis software
- Auto measurement software
- Automatic sphere and plane angle analysis software
- Multi-data analysis software

You can use optional functions without connecting the USB license key to the USB port for 365 days from the date you started the application. When 365 days passes, the message appears. Connect the USB license key to the USB port to start the analysis application.

Configuration of this instruction manual

This instruction manual is composed of the following chapters.

1 Outline of OLS5000	Explanation of configurations and the outline of OLS5000
2 Basic operations	Explanation of starting/closing of analysis application, basic flow of measurement analysis and screen views
3 File operation	Explanation of opening/closing, saving, printing and reporting of the data file and exporting data to other file formats
4 Displaying image data	Explanation of the view setting of image data
5 Data processing	Explanation of the data processing
6 Simple measurement	Explanation of operating the step measurement, width measurement, areal roughness measurement, volume measurement, surface angle measurement and sphere measurement in simple procedures
7 Profile measurement*	Explanation of the profile measurement
8 Difference analysis*	Explanation of the difference analysis
9 Step height measurement*	Explanation of the step height measurement
10 In-plane measurement*	Explanation of the in-plane measurement
11 Volume measurement*	Explanation of the volume measurement
12 Profile roughness measurement*	Explanation of the profile roughness measurement
13 Areal roughness measurement*	Explanation of the areal roughness measurement
14 Histogram analysis*	Explanation of the histogram analysis
15 Film thickness measurement*	Explanation of the film thickness measurement
16 Particle analysis*	Explanation of the particle analysis
17 Auto edge measurement*	Explanation of the auto edge measurement
18 Sphere and plane angle measurement*	Explanation of the sphere and plane angle measurement
19 Multi-data analysis*	Explanation of the multi-data analysis
20 Tool menu	Explanation of the automatic correction of XY positions of data and the data transfer to OLYMPUS Stream
21 Window menu	Explanation of the display method of the data view window
22 Settings menu	Explanation of the shortcut bar, window list, showing/hiding of data processing history, language and configuration settings of the analysis application
Appendix	Explanation of auxiliary tools used in the profile measurement, the installation and uninstallation of the analysis application and the initialization of settings

* indicates an optical function.

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1

Outline of OLS5000

1-1 Configuration of applications

1

■Data acquisition application

This application observes the sample and acquires the image/measurement data by using the OLS5000 3D measuring laser microscope.

For details on the data acquisition application, see the instruction manual "Data Acquisition".

■Analysis application

This application displays, measures, analyzes, creates reports and manages the data acquired by the data acquisition application.

This instruction manual describes the analysis application.

1-2 Outline of the analysis application

1-2-1 Configuration of the analysis application

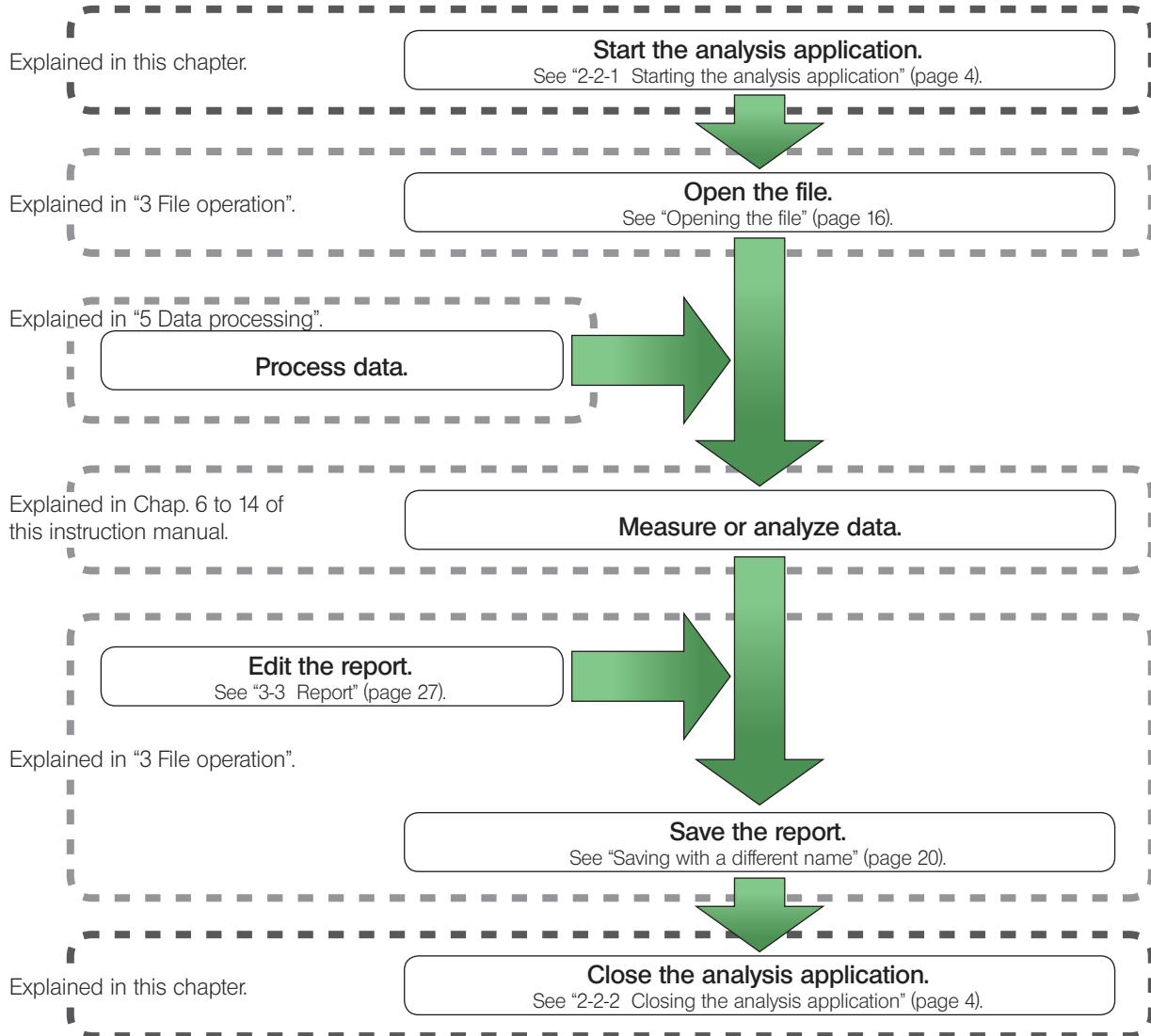
The OLS5000 analysis application is composed of the basic application and the advanced application.

Type	Name	Product name	Outline
Basic application	Analysis application		This is a basic application including data processing and simple measurement functions.
Advanced application	Advanced analysis software	OLS50-S-AA	The profile measurement, difference analysis, step height measurement, in-plane measurement, volume measurement, profile roughness measurement, areal roughness measurement and histogram analysis are available.
	Film thickness measurement software	OLS50-S-FT	The film thickness measurement is available.
	Particle analysis software	OLS50-S-PA	The particle analysis is available.
	Auto measurement software	OLS50-S-ED	The auto edge measurement is available.
	Automatic sphere and plane angle analysis software	OLS50-S-SA	The sphere and plane angle measurement is available.
	Multi-data analysis software	OLS50-S-MA	The multi-data analysis is available.

2 Basic operations

2-1 Operation flow

2-1-1 Measurement analysis



2-1-2 Same measurement analysis (using the template)

Creating the template

Explained in this chapter.

Start the analysis application.

See "2-2-1 Starting the analysis application" (page 4).

Explained in "3 File operation".

Open the file.

See "Opening the file" (page 16).

Explained in
"5 Data processing".

Process data.

See "5 Data processing" (page 79).

Explained in Chap. 6 to 18 of
this instruction manual.

Measure or analyze data.

Explained in "3 File operation".

Edit the report.

See "3-3 Report" (page 27).

Explained in this chapter.

Save the template.

See "Saving the template" (page 22).

Close the analysis application.

See "2-2-2 Closing the analysis application" (page 4).

Applying the template

Explained in this chapter.

Start the analysis application.

See "2-2-1 Starting the analysis application" (page 4).

Explained in "3 File operation".

Apply the template to open the file.

See "Opening the file by applying the template" (page 18).

Explained in Chap. 6 to 14 of
this instruction manual.

Measure or analyze data.

Explained in "3 File operation".

Edit the report.

See "3-3 Report" (page 27).

Explained in this chapter.

Save the report.

See "Saving with a different name" (page 20).

Close the analysis application.

See "2-2-2 Closing the analysis application" (page 4).

2-2 Starting and closing the analysis application

2-2-1 Starting the analysis application

There are two methods to start the analysis application as described below.

Automatic start

If the automatic start of the analysis application is enabled on the data acquisition application, the [Analysis application] screen appears on the front automatically when the data acquisition is completed on the data acquisition application. The image data saved on the data acquisition application is displayed on the data view window in the main window of the analysis application.

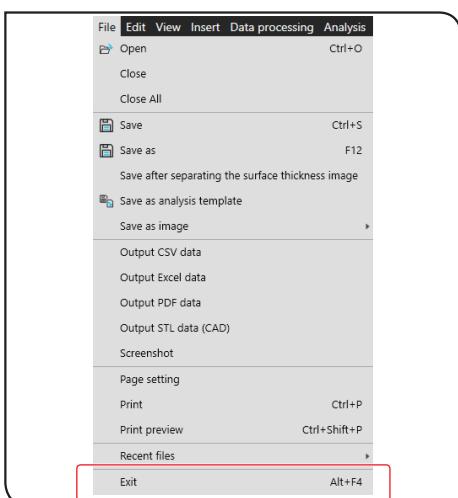
Manual start

There are three methods to manually start the analysis application as described below.

- Double-click the [OLS5000 analysis application] icon  on the desktop.
- Select [OLYMPUS OLS5000] from the start menu and then select [Analysis application]. (When using Windows 10)
Select [All programs] from the start menu, and then select [OLYMPUS OLS5000] and [Analysis application].(When using Windows 7)
- Select [Switch to analysis application] from the [Tool] menu of the data acquisition application.

2-2-2 Closing the analysis application

This section describes the procedure to close the analysis application.



- 1 Select [Exit] from the [File] menu.

If you did not save acquired image data or data that was processed or measured/analyzed in the file, save data according to the displayed message as needed.

TIP You can also close the analysis application by clicking the [Close] button in the upper right area of the [Analysis application] screen.

2-3 Windows of the analysis application

2-3-1 Windows

There are following types of windows used with the analysis application.

Main window

This window appears when you start the analysis application. The data view window is displayed on this window.

Data view window

This window displays data. You can change the view between image data and the report using the tab.

Data processing window

This window is used for a variety of data processing.

Measurement analysis window

This window is used for a variety of measurement analysis.

Main window

The main window appears when you start the analysis application.



[a] Menu bar

Displays the menu to perform various functions.
Opening data displays the available menu.

[b] Shortcut bar

The buttons for frequently used functions are laid out.
Opening the file allows you to use all buttons.

The frequently used functions related to the file operation, data processing, measurement analysis and saving of measurement analysis results are assigned to buttons.

The buttons are laid out from the left according to the typical operation flow: Open the image, correct the image, perform the measurement analysis and save the report.

[c] Window list view area

All image files currently opened are displayed in thumbnail. Clicking the thumbnail displays the data view window of the clicked image file on the front.

[d] Data view window view area

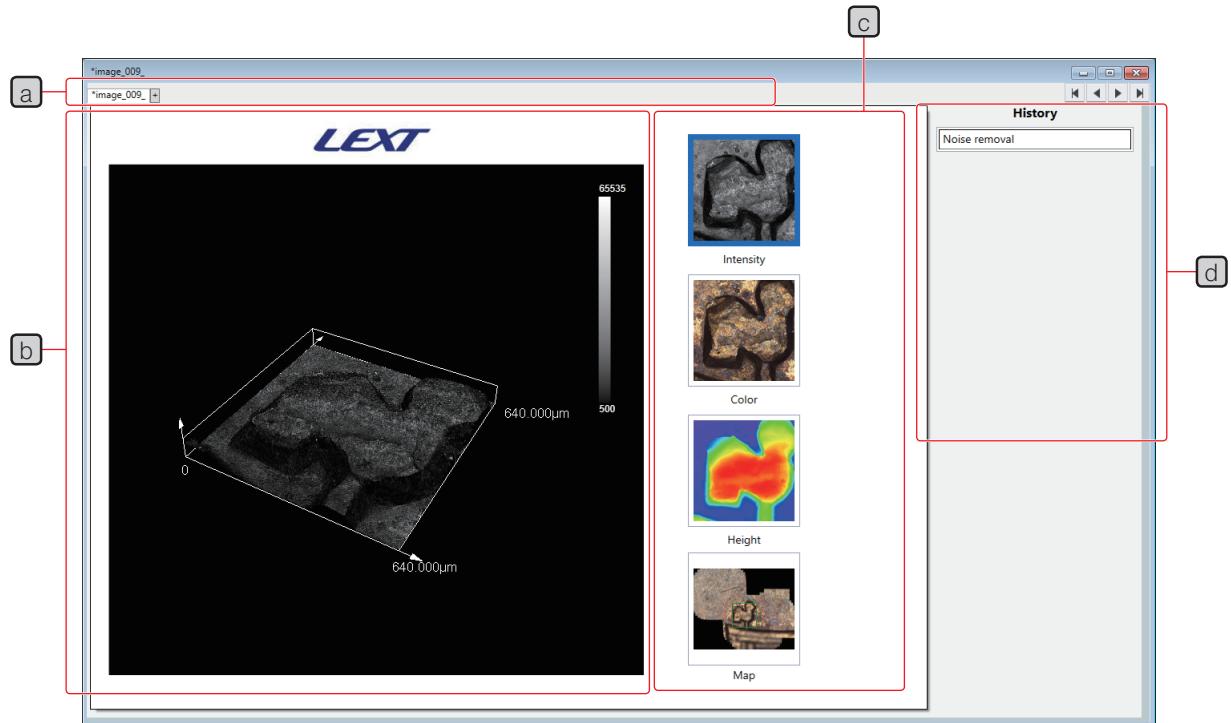
Displays the data view window.

[e] Status bar

Displays the image size of image data.

Data view window

The data view window appears when you open the data file.

**[a] Tab**

Displays the data file name. Performing the measurement analysis to data creates the new tab and displays the report.

[Height]

Displays height data in thumbnail.

TIP

The display of the thumbnail changes depending on the data file. The file containing no color image is not displayed in thumbnail in [Color].

[b] Image view area

Displays the image in the image data file in 2D or 3D.

[d]**Data processing history view area**

Displays the history of the data processing performed to image data.

TIP

To show or hide the data processing history view area, select [Show data processing history] from the [Settings] menu.

[c] Thumbnail view area

Displays images of data in thumbnail by type.

Clicking the thumbnail image displays the image on the image view area.

[Map]

Displays map images in thumbnail.

[Color]

Displays color images in thumbnail

[Intensity]

Displays laser intensity images in thumbnail.

Tab

- Clicking the [Plus] button **a** on the right end of the tab allows you to newly create a blank report.
- You can change the tab name by right-clicking on the tab to display the menu and selecting [Change name].
(The tab at the left end is a file name. You cannot change the tab name.)
- You can delete the tab name by right-clicking on the tab to display the menu and selecting [Delete].
If you delete the tab, the report is also deleted.
(The tab at the left end is image data. You cannot delete it.)
- Clicking the button **b** at the right end of the data view window allows you to scroll the tab.

Opening the data view window

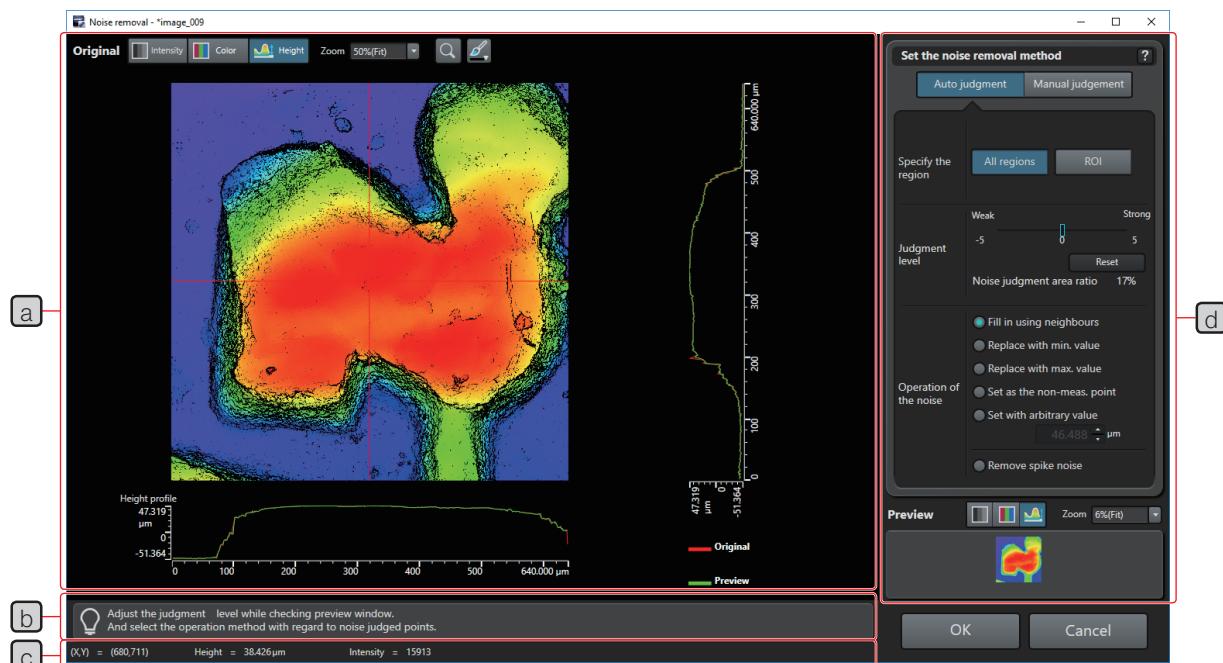
There are four methods to open the data view window as described below.

- Double-click the image file (POIR file format) on Windows Explorer.
- Drag the files (POIR file format, LEXT file format, JPEG file format, BMP file format, SDF file format, STL file format, CSV file format, REP file format or SERIES file format) to the window list view area on the main window of the analysis application.
- Select [Open] from the [File] menu of the analysis application, and specify the file.
- Click the [Open] button of the shortcut bar of the analysis application, and specify the file.

Data processing window

You can display the data processing window by selecting the data processing item from the [Data processing] menu in the menu bar. Set the contents of the data processing to image data displayed on the data view window, and perform the data processing.

TIP The contents displayed on the data processing window differ depending on data processing items. The following shows the [Noise removal] screen.



a 2D image view area

Displays the 2D image. Displays the profile or the histogram depending on data processing items. Select either the laser intensity image, the color image or the height image.

Rotating the mouse wheel on the image zooms in or out the image.

b Operation explanation area

Displays the processing contents and the procedures of the data processing.

c Status bar

Displays information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area.

d Data processing setting area

Buttons and parameters used for setting the data processing are laid out.

Type of the data processing window

There are following types of data processing windows.

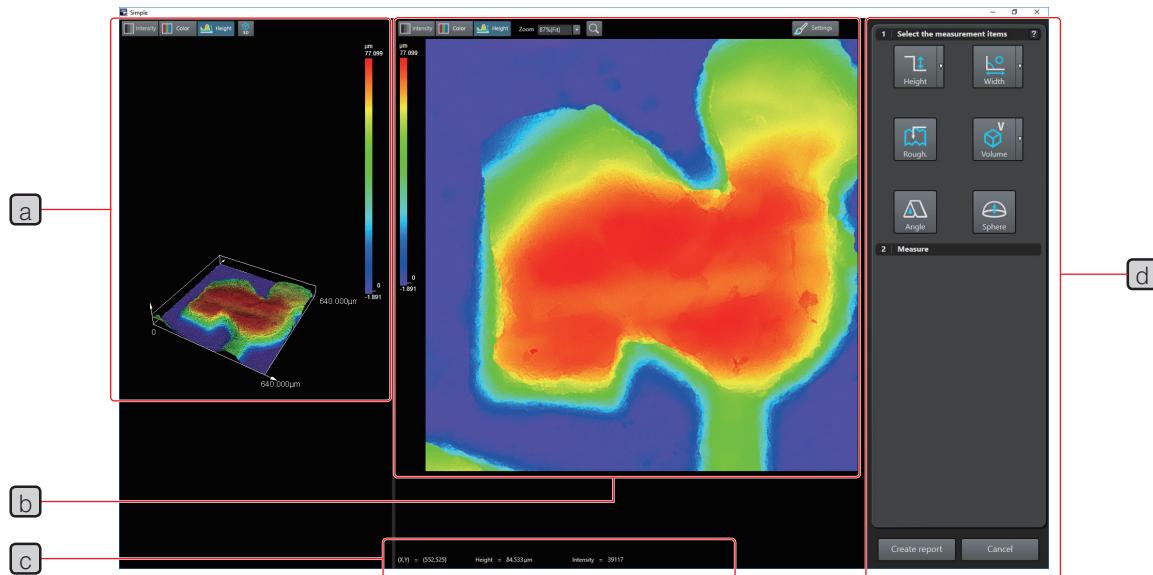
Screen	Outline of functions	Page
[Noise removal]	Removes the noise from height data.	82
[Tilt removal]	Removes the tilt of height data.	86
[Form removal]	Removes the form (sphere, cylinder) from height data.	91
[Filter]	Removes the noise from data, highlight the edge, performs the smoothing, etc.	97
[Image quality adjustment]	Highlights the contrast.	101
[Data processing]	Inverts the image or deletes the unnecessary part from the image.	104
[Stitching]	Connects multiple images acquired and creates a large single image.	111

Measurement analysis window

You can display the measurement analysis window by selecting the data measurement analysis item from the [Analysis] menu in the menu bar.

Set the contents of the measurement analysis to image data displayed on the data view window, and perform the measurement analysis.

TIP The contents displayed on the measurement analysis window differ depending on measurement analysis items. The following shows the [Simple] screen.



a **3D image view area**

Displays the 3D image.
Select either the laser intensity image, the color image or the height image.
Dragging the image allows you to change the angle to display the image.
Rotating the mouse wheel on the image zooms in or out the image.
Dragging the image while holding down the right button of the mouse allows you to move the view position.

b **2D image view area**

Displays the 2D image.
Select either the laser intensity image, the color image or the height image.
Rotating the mouse wheel on the image zooms in or out the image.

c **Status bar**

Displays information of the mouse pointer position (X coordinate, Y coordinate) on the 2D image view area.

d **Measurement analysis setting area**

Displays the setting screens required for the measurement analysis.

TIP

The profile, histogram or measurement analysis results, etc. are displayed on the 3D image view area and the 2D image view area depending on measurement analysis items.

Type of the measurement analysis window

There are following types of measurement analysis windows.

Screen	Outline of functions	Page
[Simple]	Performs the basic measurement of height data. (Width, height, areal roughness, volume, surface angle, sphere)	116
[Profile] ^{*1}	Measures the dimension from the cross-sectional profile.	139
[Difference] ^{*1}	Analyzes the difference between profiles of two data. (Surface, cross-sectional profile)	172
[Step height] ^{*1}	Measures the step between two planes.	202
[In-plane] ^{*1}	Measures the dimension on the plane.	208
[Area/Volume] ^{*1}	Measures the surface area, cross-sectional area or volume of the three-dimensional shape.	233
[Profile roughness] ^{*1}	Measures the roughness of the cross-sectional profile.	243
[Areal roughness] ^{*1}	Measures the areal roughness of height data.	270
[Film thickness] ^{*2}	Measures the thickness of the transparent film or the film thickness shape.	297
[Histogram] ^{*1}	Analyzes histogram data.	289
[Particle] ^{*3}	Binarizes the image and measures the region extracted from the image.	322
[Auto edge measurement] ^{*4}	Measures the pattern width or the height having regularity such as semiconductor, etc. automatically according to the conditions specified in advance.	335
[Sphere/Plane angle] ^{*5}	Measures the radius, residual error or plane angle of the sample having the repetitive shape.	362

*1 The advanced analysis software OLS50-S-AA should have been installed on the controller or the PC in advance.

*2 The film thickness measurement software OLS50-S-FT should have been installed on the controller or the PC in advance.

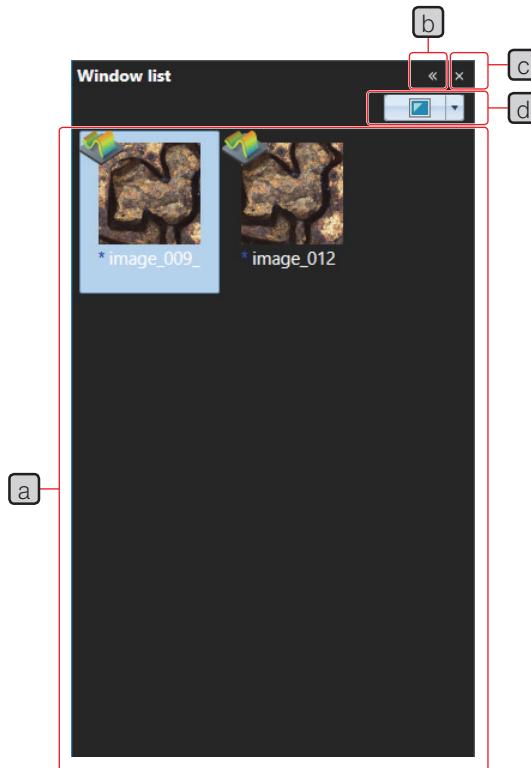
*3 The particle analysis software OLS50-S-PA should have been installed on the controller or the PC in advance.

*4 The auto measurement software OLS50-S-ED should have been installed on the controller or the PC in advance.

*5 The automatic sphere and plane angle analysis software OLS50-S-SA should have been installed on the controller or the PC in advance.

2-3-2 Window list

You can view all files currently opened in the window list displayed on the main window.



a Image list view area

Displays all files currently opened in a list.

The data type is displayed at the top left of the image with an icon.

■3D data

■2D data

■Single line data

■Surface film thickness data

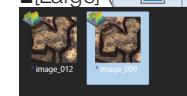
c Close button

Closes the window list. You can display the window list you closed again by selecting [Show window list] from the [Settings] menu.

d List view selection dropdown list

Select the view method of the image list view area. Select [Large], [Small], [List] or [Detail].

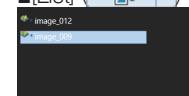
■[Large] (



■[Small] (



■[List] (



■[Detail] (

Image name	Created date/time	Up
image_009	6/6/2017 7:07:14 AM	1/1
image_012	6/6/2017 7:29:24 AM	1/1

b Minimize button

Minimizes the window list. You can display the window list you minimized again by clicking the [Maximize] button.

TIP

• To change between showing and hiding the window list, select [Show window list] from the [Settings] menu.

2-3-3 Shortcut bar

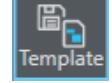


The buttons for frequently used functions are laid out on the shortcut bar.

If you open data, all buttons become available.

- TIP**
- While the data processing window or the measurement analysis window is displayed, the shortcut bar is not available.
 - You can change between showing or hiding the shortcut bar. For details, see "22-1 Shortcut bar" (page 388).

Button	Outline of functions	Page
	Opens image data.	16
	Removes the tilt of the image and removes the noise from the image automatically.	81
	Displays the [Noise removal] screen.	82
	Displays the [Tilt removal] screen.	86
	Displays the [Simple] screen.	116
	Displays the [Profile] screen.	139
	Displays the [In-plane] screen.	208
	Displays the [Step height] screen.	202
	Displays the [Area/Volume] screen.	233
	Displays the [Profile roughness] screen.	243

Button	Outline of functions	Page
 Areal rough	Displays the [Areal roughness] screen.	270
 Multi-data	Changes between starting and closing the multi-data analysis mode.	372
 Report	Saves measurement analysis results as a report.	20
 Template	Saves measurement analysis results as a template.	22
 DAQ	Displays the [Data acquisition application] screen on the front. (The [Data acquisition application] screen is displayed when the data acquisition application is installed on the controller or the PC.)	-

3 File operation

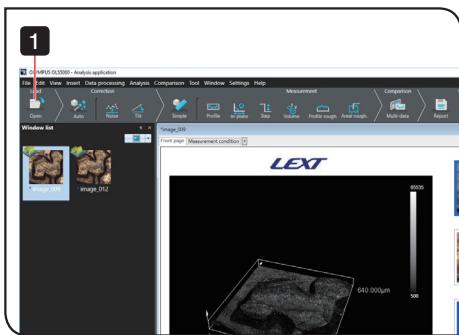
This section describes the procedures to operate, print and report the file and also procedures to export data to the file.

3-1 Operating the file

This section describes the main file operations, such as to open, close , save the file, etc.

3-1-1 Opening/closing the file

Opening the file



- 1 Click the [Open] button of the shortcut bar.

TIP

You can also open the file by the following procedure.

- Select [Open] from the [File] menu.
- Double-click the file (POIR file format or LEXT file format) on Windows Explorer.
- Drag the file (POIR file format or LEXT file format) from Windows Explorer to the window list view area on the main window.

The [Open] screen appears.

- 2 Select the file format you want to open from the [File type] dropdown list.

OLS5000 image file (POIR file format)

This is a file acquired and saved on the OLS5000 data acquisition application.

You cannot open this file on the OLS4000, OLS4100 or OLS4500 application.

OLS5000 multi point image file (MPOIR file format)

This is a file where the data is acquired in multiple areas and saved on the OLS5000 data acquisition application.

You cannot open this file on the OLS4000, OLS4100 or OLS4500 application.

DSX series image file (DSX file format)

This is a file acquired and saved with the DSX series.

OLS4000, OLS4100 or OLS4500 image file (LEXT file format)

This is a file acquired and saved on the OLS4000, OLS4100 or OLS4500.

CSV file format

This is a text data file separated by comma.

Image file (BMP file format, JPEG file format)

This is a general-purpose image file. This is opened as a color image.

Report file (REP file format)

This is a dedicated file to OLS5000 that includes image data, data processing and measurement analysis results.

Multi report file (MREP file format)

This is a dedicated file to OLS5000 that includes multiple image data, their data processing and measurement analysis results.

- 3** Select the folder where the file is saved.

- 4** Select the file from the file list.

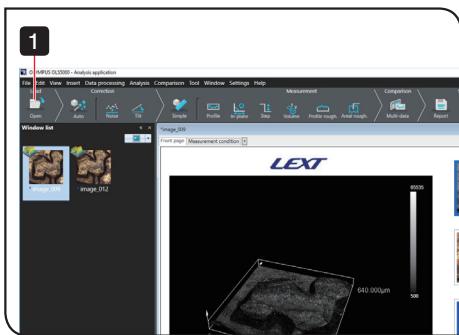
TIP You can open multiple files at a time by selecting files while holding down the **Shift** key or the **Ctrl** key of the keyboard.

- 5** Click the [Open] button.

The image of the specified file is displayed on the data view window.

Opening the file by applying the template

You can open the file by applying the template. The contents of the data processing and the measurement analysis saved in the template are performed, and image data and the report are displayed.



- Click the [Open] button of the shortcut bar.

TIP You can also open the file by the following procedure.

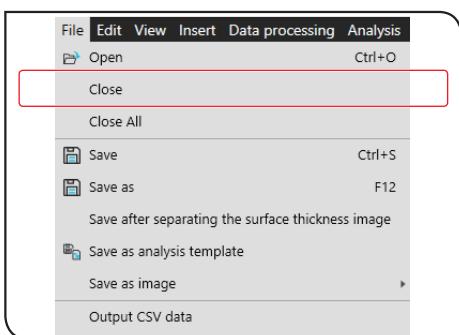
- Select [Open] from the [File] menu.

The [Open] screen appears.

- Select the format of the file you want to open from the [File type] dropdown list.
 - Select the folder where the file is saved.
 - Select the file from the file list.
- TIP** You can open multiple files at a time by selecting files while holding down the **Shift** key or the **Ctrl** key of the keyboard.
- If you apply the new template, click the [Browse] button to display the [Open] screen, and select the template file (TPL file format).
 - Select the template you want to apply from the [Template] dropdown list.
 - Click the [Open] button.

The file where the template is applied is displayed on the data view window.

Closing the file



- Select [Close] from the [File] menu.

If you did not save acquired image data or data that was processed or measured/analyzed in the file, save data according to the displayed message as needed.

TIP

- You can also close the file by clicking the [Close] button in the upper right area of the data view window.
- To close all files, select [Close All] from the [File] menu.

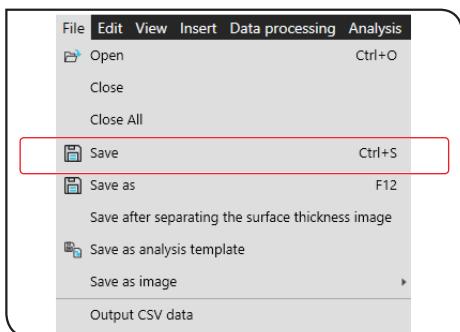
3-1-2 Saving the file

Overwriting

TIP

The file format you can overwrite is the report file (REP file format) or the multi report file (MREP file format). Files in other formats cannot be overwritten.

To save the files other than the report file or the multi report file, follow the procedures "Saving with a different name" (page 20) described next.

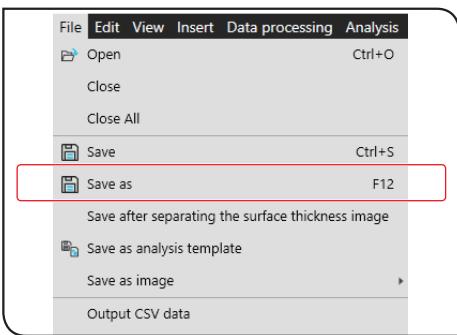


- 1 Select [Save] from the [File] menu.

The file is overwritten.

Saving with a different name

You can save the file in the image file format or the report file format.



- 1 Select [Save as] from the [File] menu.

The [Save as] screen appears.

- 2 Select the format of the file you want to save from the [File type] dropdown list.

OLS5000 image file (POIR file format)

This is a file acquired and saved on the OLS5000 data acquisition application.

You cannot open this file type on the OLS4000, OLS4100 or OLS4500 application.

OLS4000, OLS4100 or OLS4500 image file (LEXT file format)

This is a file acquired and saved on the OLS4000, OLS4100 or OLS4500.

RAW file format

This is a file that can save image data only. The information regarding the image is not added.

SDF file format

This is binary data composed of three parts: header information describing the data outline, actual height data and history information such as creation date, etc. This file is used for information regarding the height measurement, e.g. roughness data, etc.

Rich text file (RTF file format)

This is a text file that includes the format information.

Report file (REP file format)

This is a dedicated file to OLS5000 that includes image data, data processing and measurement analysis results.

Multi report file (MREP file format)

This is a dedicated file to OLS5000 that includes multiple image files, their data processing and measurement analysis results.

- 3 Select the file save destination.

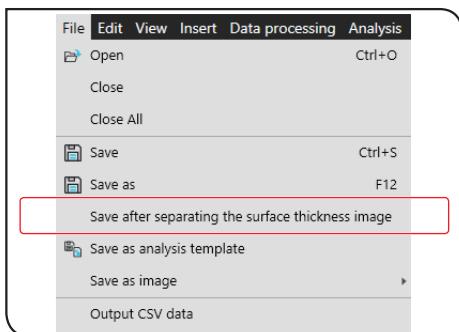
- 4 Input the file name in the [File name].

- 5 Click the [Save] button.

The file is saved.

Saving the surface film thickness data after separating to layers

You can save up to three layers of surface film thickness data in image file format after separating data to the top layer, middle layer and bottom layer automatically.



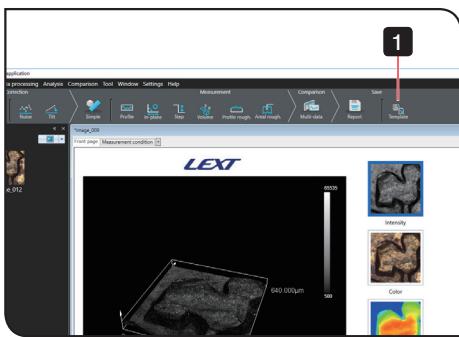
- 1** Display the data view window of surface film thickness data on the front.
- 2** Select [Save after separating the surface thickness image] from the [File] menu.
The [Save as] screen appears.
- 3** Make sure that [POIR(Image)(*.poir)] is selected in the [File type] dropdown list.
- 4** Select the file save destination.
- 5** Input the file name in the [File name].
- 6** Click the [Save] button.

The data where "_TOP", "_MIDDLE" or "_BOTTOM" is added to the end of the file name is saved.

Saving the template

3

You can save the settings of the data processing, measurement analysis and the report layout as a template.



- 1 Click the [Template] button on the shortcut bar.

TIP You can also display the [Save as] screen by selecting [Save as analysis template] from the [File] menu.

The [Save as] screen appears.

- 2 Make sure that [Template(*.tpl)] is selected in the [File type] dropdown list.
- 3 Select the file save destination.
- 4 Input the file name in the [File name].
- 5 Click the [Save] button.

The settings of the data processing, the measurement analysis and the report layout are saved as a template.

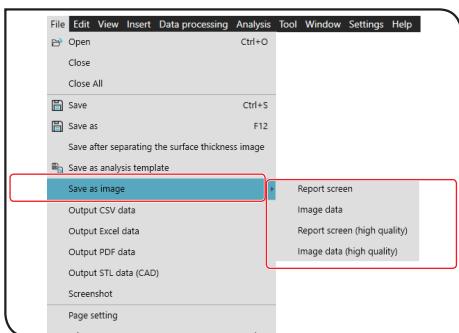
TIP You can always apply the same template to data when you transfer data acquired on the data acquisition application to the analysis application. For applying the template, see "22-6 Template" (page 392).



Saving the image

You can save image data or the report displayed on the data view window as image data.

3



- 1** Select [Save as image] from the [File] menu, and select the output format.

You can select [Report screen], [Image data], [Report screen (high quality)] or [Image data (high quality)].

[Report screen]

Saves the report displayed on the data view window as image data.

[Image data]

Saves only the image displayed on the data view window as image data.

[Report screen (high quality)]

Saves the report displayed on the data view window as image data (high quality).

[Image data (high quality)]

Saves only the image displayed on the data view window as image data (high quality).

TIP The number of pixels of the saved image depends on the page setting.

The [Save as] screen appears.

- 2** Select the format of the file you want to save from the [File type] dropdown list.

BMP file format

Saves the image or the report screen in BMP file format.

JPEG file format

Saves the image or the report screen in JPEG file format.

TIFF file format

Saves the image or the report screen in TIFF file format.

- 3** Select the file save destination.

- 4** Input the new file name in the [File name].

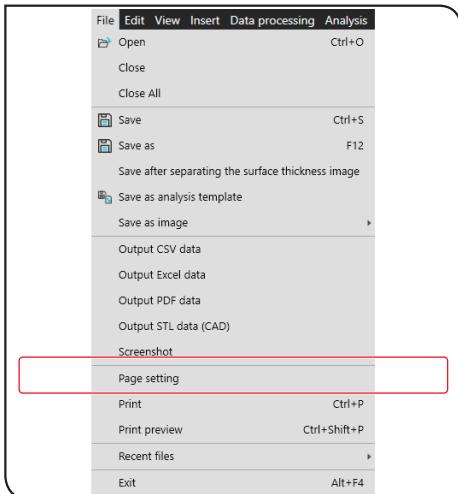
- 5** Click the [Save] button.

The image or the report screen is saved in the selected file format.

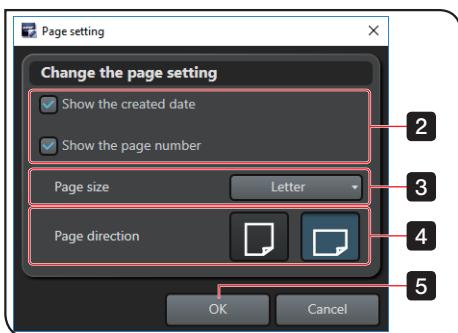
3-2 Printing

3-2-1 Page setting

You can change the settings of items you want to display on the footer of the report and of the size or the direction of the page.



- 1 Select [Page setting] from the [File] menu.

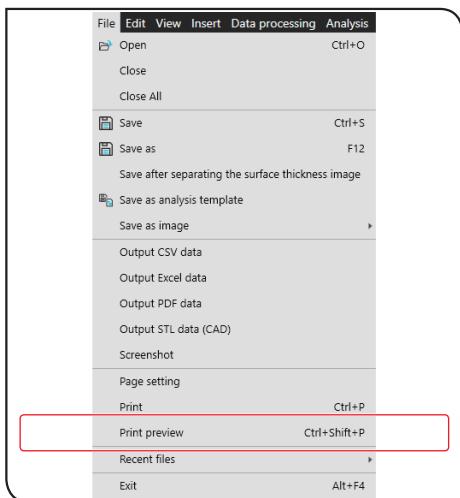


The [Page setting] screen appears.

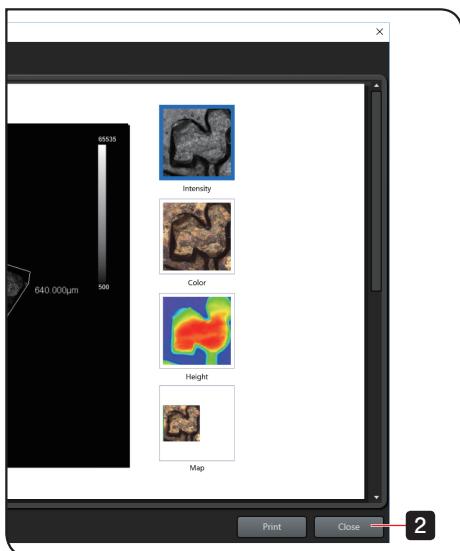
- 2 Check the checkbox of the item you want to display on the footer of the report.
 - [Show the created date]: Displays the date when the report is created in the form of "YYYY/MM/DD".
 - [Show the page number]: Displays the page number of the report in the form of "Page number/Total number of pages".
- 3 Select the page size from the dropdown list.

You can select the A4 size or the letter size.
- 4 Select the page direction.
- 5 Click the [OK] button to close the [Page setting] screen.

3-2-2 Displaying the print preview



- 1 Select [Print preview] from the [File] menu.



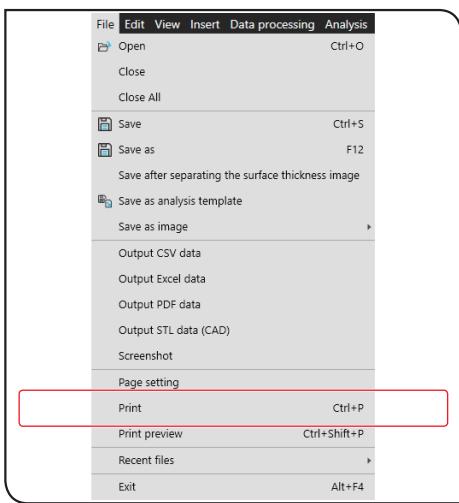
The [Print preview] screen appears.

- 2 When you check the print preview, click the [Close] button.

3-2-3 Printing

You can print the image or measurement analysis results displayed on the data view window.

TIP Before printing, connect the printer to the controller or PC and install the printer driver in advance.



1 Select [Print] from the [File] menu.

The [Print] screen appears.

2 Select the printer from the [Select printer] box.

3 Set [Page range] and [Number of copies] if necessary.

4 Click the [Print] button.

The image and measurement analysis results are printed.

3-3 Report

3-3-1 Creating the report

When you measure or analyze the image displayed on the data view window, the report tab is created with the name of the measurement analysis you performed.

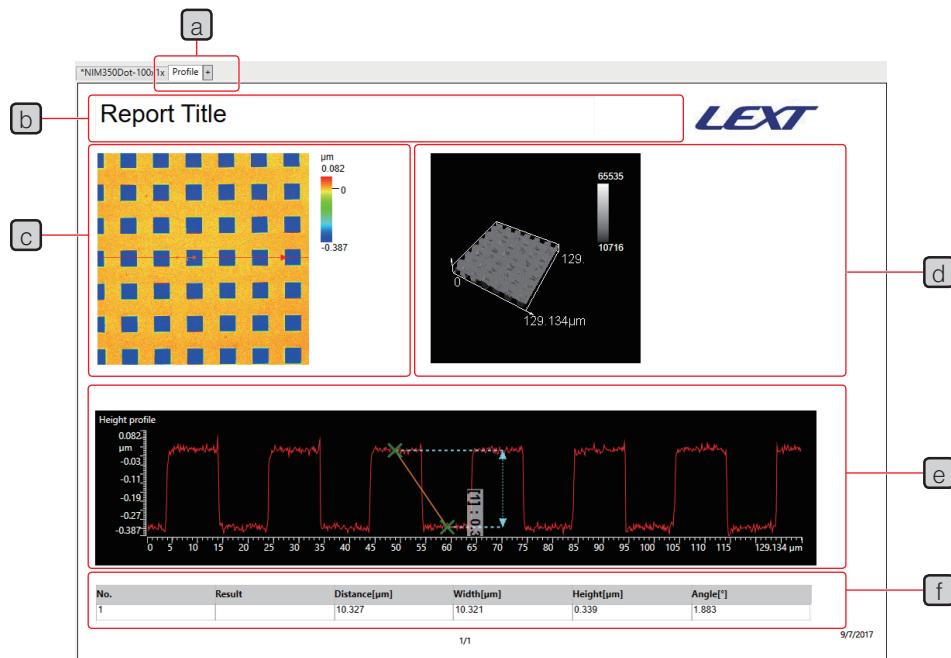
The 2D image, the 3D image or measurement analysis results (table, profile etc.) are displayed on the report.

Report layout

The layout of data (image, profile, measurement analysis results, etc.) displayed on the report is adjusted automatically by measurement analysis type.

This section explains the typical report layout using the profile measurement and the areal roughness measurement as examples.

■Report of the profile measurement



a Tab

Displays the name of the measurement analysis you performed. In this case, [Profile] is displayed.

b Title

Displays the field to input the title.

c 2D image

Displays the 2D image. Displays the measurement region or the measurement line you specified.

d 3D image

Displays the 3D image. Dragging the image allows you to change the angle to display the image. Rotating the mouse wheel on the image zooms in or out the image. Dragging the image while holding down the right button of the mouse allows you to move the view position.

e Profile

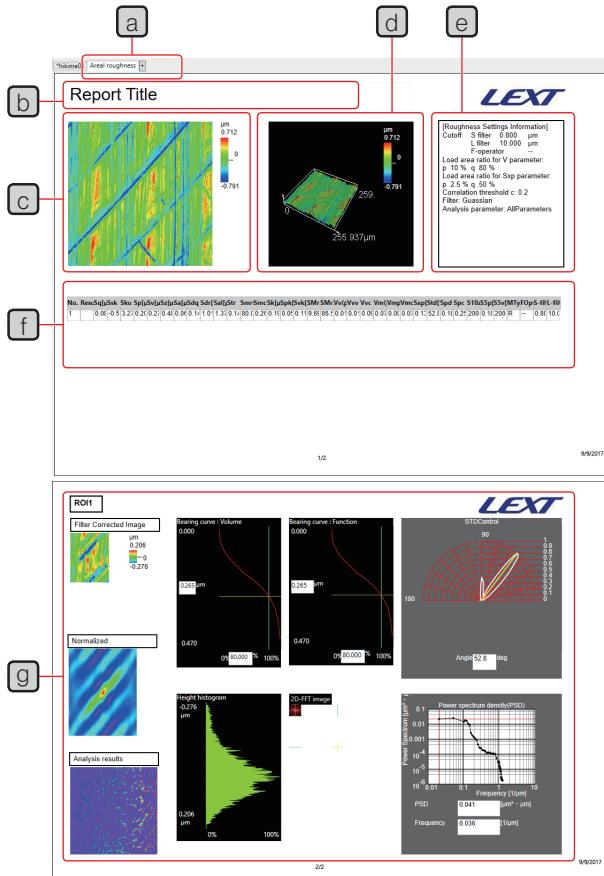
Displays the profile.

The profile may not be displayed depending on the measurement analysis type.

f Measurement analysis results

Displays the measurement analysis results.

■Report of the areal roughness measurement



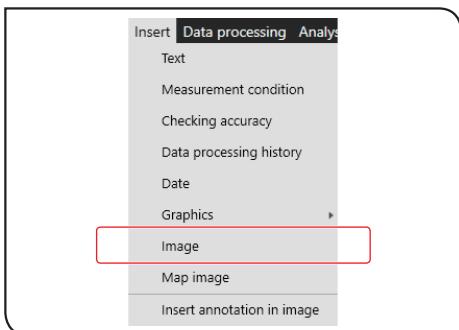
- a Tab**
Displays the name of the measurement analysis you performed. In this case, [Areal roughness] is displayed.
 - b Title**
Displays the field to input the title.
 - c 2D image**
Displays the 2D image. Displays the measurement region or the measurement line you specified.
 - d 3D image**
Displays the 3D image. Dragging the image allows you to change the angle to display the image.
Rotating the mouse wheel on the image zooms in or out the image.
Dragging the image while holding down the right button of the mouse allows you to move the view position.
 - e Setting condition**
Displays the setting conditions of the measurement.
 - f Measurement analysis results**
Displays the measurement analysis results.
 - g Areal roughness measurement information**
Displays the height image, the histogram and the roughness curve parameter.

3-3-2 Inserting the image or the graphics in the report

You can insert the text, image or graphics in the report.

Inserting the image

You can insert an arbitrary image in the report.



1 Select [Image] from the [Insert] menu.

The [Open] screen appears.

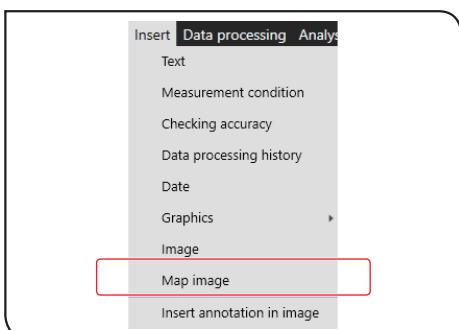
TIP The initial setting of the file format is JPEG. You can also select the BMP, POIR or TIFF file format.

2 Specify the image file and click the [Open] button.

The image is inserted in the report.

Inserting the map image

You can insert the map image in the report.

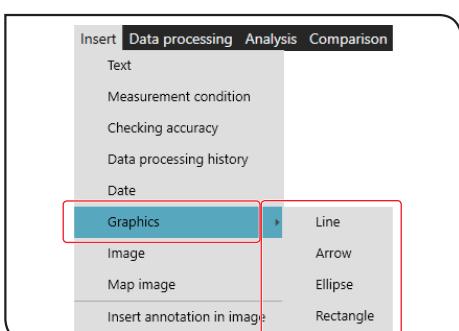


1 Select [Map image] from the [Insert] menu.

The map image is inserted in the report.

Inserting the graphics

You can insert the graphics: line, arrow, ellipse or rectangle.



1 Select [Graphics] from the [Insert] menu, and select the graphics type you want to insert.

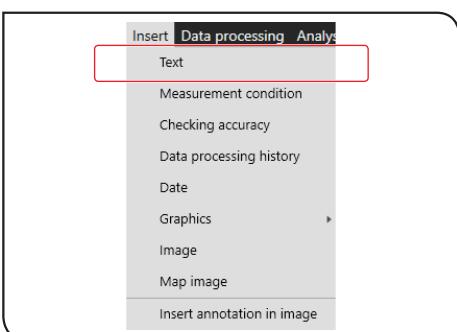
TIP You can select the [Line], [Arrow], [Ellipse] or [Rectangle].

The graphics is inserted in the report.

2 Adjust the position or the size of the graphics.

Inserting the text box

You can insert the text box.



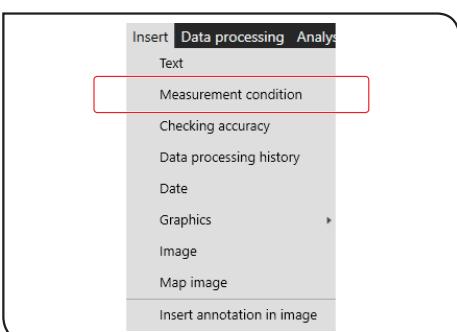
- 1 Select [Text] from the [Insert] menu.

The text box is inserted in the report.

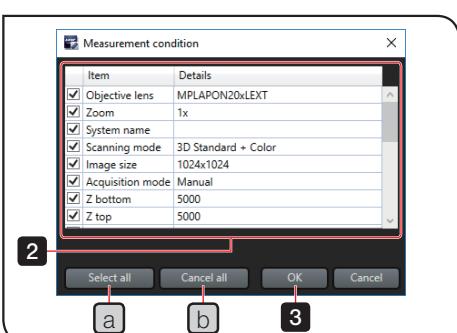
- 2 Input the string.
- 3 After inputting the string, click a position other than the text box.
- 4 Adjust the position or the size of the text box.

Inserting the data acquisition condition

You can insert a list of data acquisition conditions.



- 1 Select [Measurement condition] from the [Insert] menu.



The [Measurement condition] screen appears.

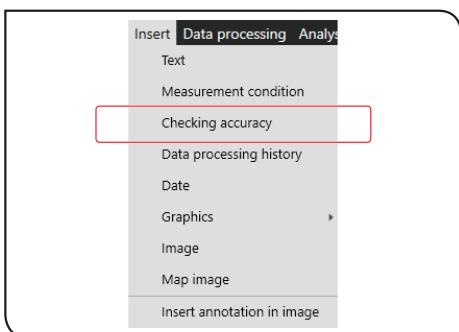
- 2 In the list of data acquisition conditions, check the checkbox of the item you want to display on the report.
- TIP**
- To check the checkboxes of all items, click the [Select all] button **a**.
 - To uncheck the checkboxes of all items, click the [Cancel all] button **b**.
- 3 Click the [OK] button to close the [Measurement condition] screen.

The data acquisition conditions are inserted in the report.

- TIP**
- To re-select the items you want to display on the report, right-click on the data acquisition condition to display the menu, and select [Set column items].

Inserting the results from checking accuracy

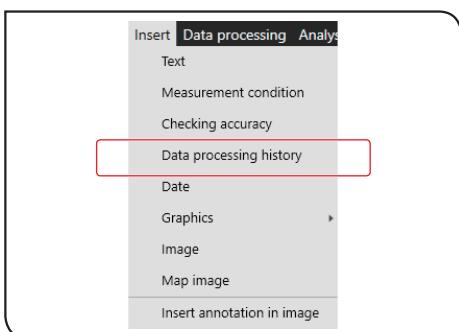
You can insert the results obtained from checking accuracy in the report.



- 1** Select [Checking accuracy] from the [Insert] menu.
The results from checking accuracy are inserted in the report.
- 2** Adjust the position or the size of the results from checking accuracy.

Inserting the data processing history

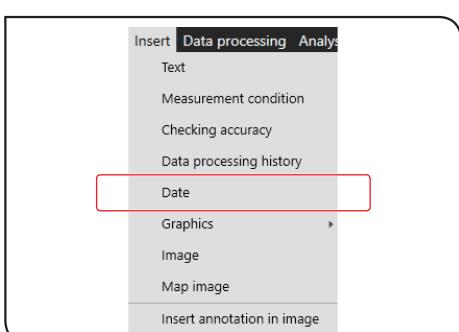
You can insert the text box displaying the data processing history in the report.



- 1** Select [Data processing history] from the [Insert] menu.
The data processing history is inserted in the report.
 - 2** Adjust the position or the size of the data processing history.
- TIP** You can change the data processing history by inputting the string.

Inserting the date

You can insert the text box that shows the date when image data is acquired in the report.

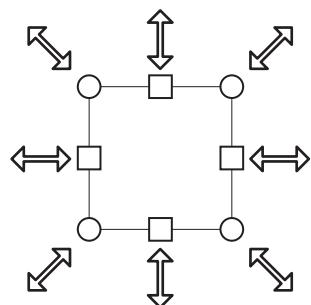


- 1** Select [Date] from the [Insert] menu.
The date is inserted in the report.
 - 2** Adjust the position or the size of the date.
- TIP** You can change the date by inputting the string.

3-3-3 Editing the report

You can edit (change size, move position, copy, and delete) data on the report (image, profile and measurement analysis results) and also the image or the graphics inserted in the report.

Changing the size

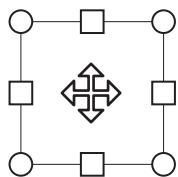


Click on data you want to change the size.

The handles are displayed on the outside frame of data.

When the mouse pointer changes its shape to the double-headed arrow, drag the handle to change the size.

Moving data

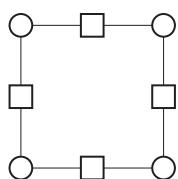


Click on data you want to move.

The handles are displayed on the outside frame of data.

When the mouse pointer changes its shape to the cross arrow, drag the handle to move the position.

Deleting data



Click on data you want to delete.

The handles are displayed on the outside frame of data.

Select [Delete] from the [Edit] menu.

TIP

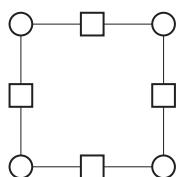
- You can also delete data by right-clicking on data to display the menu and selecting [Delete].
- You can also delete data by pressing the [Delete] key of the keyboard.

When the message asking to delete data appears, click the [OK] button.

Copying and pasting

You can copy data (image, measurement analysis results) on the report.

- TIP**
- If you copy and paste 3D image data in the report file, you can select whether to paste it as 2D image data or as 3D image data. If you paste data as 3D image data, you can change the 3D view setting.
 - If you paste the copied data (image, measurement analysis results) to a report on a different data view window, data will be pasted as the 2D image. Therefore, you cannot redo the measurement analysis.



Click on data you want to copy.

The handles are displayed on the outside frame of data.

Select [Copy] from the [Edit] menu.

- TIP**
- You can also copy data by right-clicking on data to display the menu and selecting [Copy].
 - You can also copy data by pressing the **[Ctrl]** key and the **[C]** key of the keyboard.

Select [Paste] or [Paste as image] from the [Edit] menu.

- TIP**
- If you copy 3D image data and select [Paste], data is pasted as 3D image data. If you select [Paste as image], data is pasted as 2D image data.
 - If you paste data by selecting [Paste], you can redo the measurement analysis. If you paste data by selecting [Paste as image], data will be 2D image data. Therefore, you cannot redo the measurement analysis.
 - You can also paste data by right-clicking on the report without any data to display the menu, and selecting [Paste] or [Paste as image].
 - You can also paste data by pressing the **[Ctrl]** key and the **[V]** key of the keyboard.

Changing items displayed on measurement analysis results

You can change items displayed in rows and columns of the measurement analysis results on the report.

Items displayed on measurement analysis results

No.	Result	Sq[μm]	Ssk	Sku	Sp[μm]	Sv[μm]	Sz[μm]	Sa[μm]	Sdq	Sdr[%]	MType	FOperator	S-filter[μm]	L-filter[μm]
1		0.248	-0.258	3.088	2.104	2.346	4.450	0.199	0.320	4.911	R	--	--	--
Count	1		1	1										
Average	0.248	-0.258	3.088	2.104	2.346	4.450	0.199	0.320	4.911	0	0	0.000	0.000	
Max.	0.248	-0.258	3.088	2.104	2.346	4.450	0.199	0.320	4.911	0	0	0.000	0.000	
Min.	0.248	-0.258	3.088	2.104	2.346	4.450	0.199	0.320	4.911	0	0	0.000	0.000	
Range	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	
σ	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	
3σ	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0	0.000	0.000	
Sum	0.248	-0.258	3.088	2.104	2.346	4.450	0.199	0.320	4.911	0	0	0.000	0.000	
Tolerance	Off													
Upper tolerance	0	0	0	0	0	0	0	0	0	0	0	0	0	
Standard	0	0	0	0	0	0	0	0	0	0	0	0	0	
Lower tolerance	0	0	0	0	0	0	0	0	0	0	0	0	0	

Statistic information
Tolerance

Displaying statistic information

Right-click on the measurement analysis results table to display the menu, and select [Show statistic information].

Displaying the tolerance

Right-click on the measurement analysis results table to display the menu, and select [Show tolerance].

Selecting items to be displayed

- 1 Right-click on the measurement analysis results to display the menu, and select [Set column items].

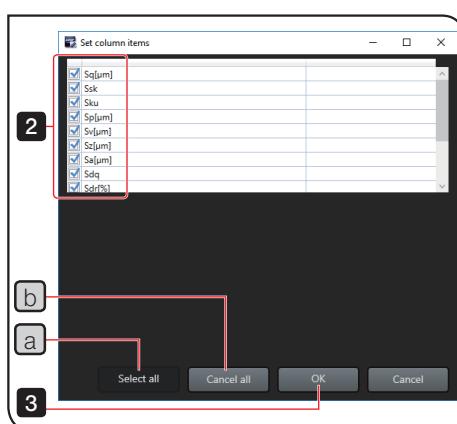
The [Set column items] screen appears.

- 2 In the item list of measurement analysis results, check the checkbox of the item you want to display on the report.

- TIP** • The items to be displayed differ depending on the measurement analysis type.
 • To check the checkboxes of all items, click the [Select all] button a.
 • To uncheck the checkboxes of all items, click the [Cancel all] button b.

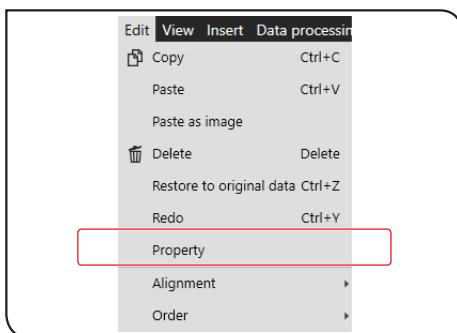
- 3 Click the [OK] button to close the [Set column items] screen.

The items to be displayed on measurement analysis results are changed.



Changing the format

You can change the format of data (image, profile, measurement analysis results) on the report and the image or the graphics inserted in the report.



1 Select data you want to change the format.

2 Select [Property] from the [Edit] menu.

TIP You can also display the [Property] screen by the following procedure.

- Right-click on selected data to display the menu, and select [Property].
- Double-click the graphics.

The [Property] screen appears.

3 Change the format.

TIP Items you can change differ depending on the data type selected in step **1**.

When the 2D image or the 3D image is selected:

Coordinate, [Width], [Height] **c**, [View type] **k**, [Show XYZ scale] **l**
(3D image only)

When the map image is selected:

Coordinate, [Width], [Height] **c**

When the profile or the histogram is selected:

Coordinate, [Width], [Height] **c**, Text format **d** (font, font size, [Bold], [Italic], [Underline], alignment, text color), Filling color **e**, [Show XY scale] **m**, [Show gridline] **n** (histogram only)

When the graphics (line, arrow) is selected:

Coordinate, [Width], [Height] **c**, Line color **f**, Line width **g**, Line type **h**, Line end **i**

When the graphics (ellipse, rectangle) is selected:

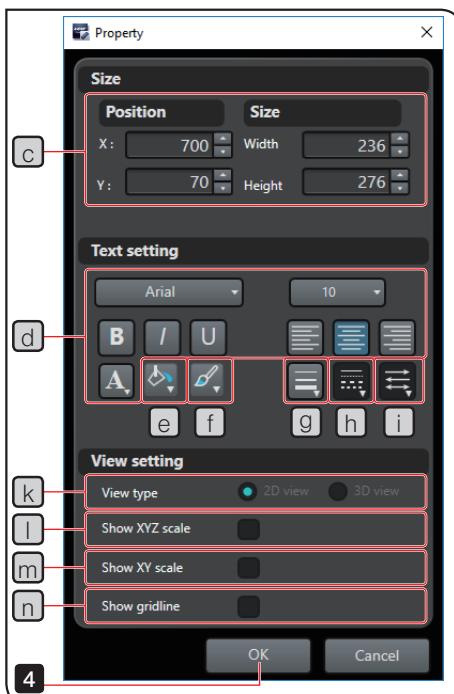
Coordinate, [Width], [Height] **c**, Filling color **e**, Line color **f**, Line width **g**, Line type **h**

When other data is selected:

Coordinate, [Width], [Height] **c**, Text format **d** (font, font size, [Bold], [Italic], [Underline], alignment, text color), Filling color **e**, Line color **f**, Line width **g**

4 Click the [OK] button to close the [Property] screen.

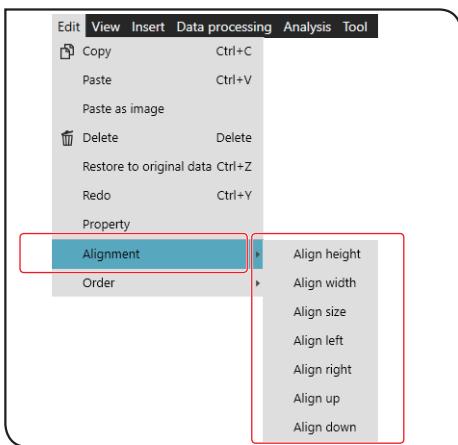
The data format is changed.



Adjusting the layout

3

You can adjust the layout by aligning the position or the size of data (image, profile, measurement analysis results) on the report and of the image or the graphics inserted in the report.



- 1 Select multiple data you want to adjust the layout.

TIP Data you selected first becomes the base for adjusting the layout.

- 2 Select [Alignment] from the [Edit] menu, and select the alignment method.

You can select [Align height], [Align width], [Align size], [Align left], [Align right], [Align up] or [Align down].

[Align height]

Align the data height. The width does not change.

[Align width]

Align the data width. The height does not change.

[Align size]

Align the height and the width.

[Align left]

Align data to the left.

[Align right]

Align data to the right.

[Align up]

Align data to the top.

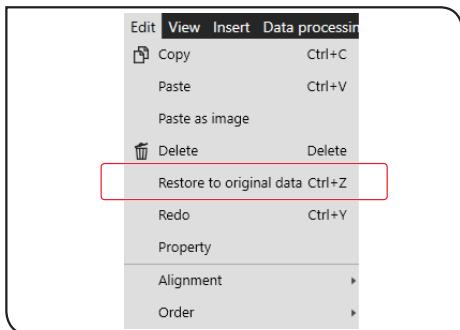
[Align down]

Align data to the bottom.

The report layout is adjusted.

Undoing/redoing the editing

You can undo the editing performed to the report or redo the editing.



To undo the editing performed to the report, select [Restore to original data] from the [Edit] menu.

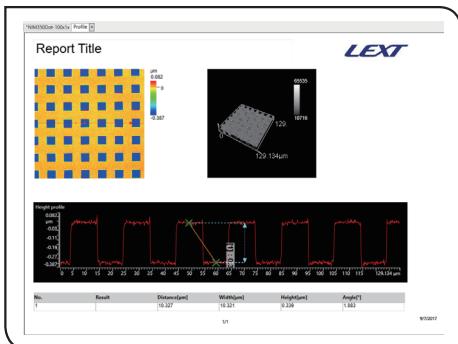
TIP You can also undo the editing by pressing the **[Ctrl]** and the **[Z]** key of the keyboard.

To redo the editing, select [Redo] from the [Edit] menu.

TIP You can also redo the editing by pressing the **[Ctrl]** and the **[Y]** key of the keyboard.

3-3-4 Redoing the measurement analysis

You can redo the measurement analysis based on data on the report.



Double-click on either 2D image data, 3D image data, profile, histogram or measurement analysis results on the report.

TIP You can also display the measurement analysis window by right-clicking on either 2D image data, 3D image data, profile, histogram or measurement analysis results on the report to display the menu and selecting [Edit analysis].

The measurement analysis window used when creating the report appears. Set measurement analysis conditions again and click the [Create report] button.

The measurement analysis results on the report are updated.

TIP You can redo only the measurement analysis that was performed when creating the report. You cannot redo a different measurement analysis.

3-3-5 Setting the report magnification

You can change the report magnification.

This section describes the type and the setting method of the report magnification.

Magnification type

■Auto

Zooms in or out the report according to the size of the data view window.

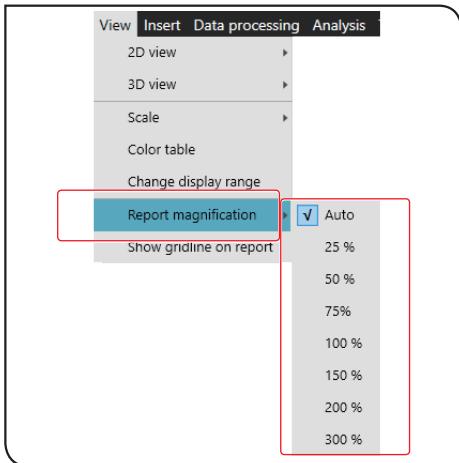
■Same size

Displays the report in a same size (100%).

■Zoom in/out

Displays the report with the specified magnification (25%, 50%, 75%, 200%, 300% or 400%).

Setting method of the magnification



Select [Report magnification] in the [View] menu, and select the magnification you want to display.
The report magnification changes.

3-3-6 Setting the magnification to display the 2D image

You can change the magnification to display the 2D image.

This section describes the type and the setting method of the magnification to display the 2D image.

Magnification type

■Auto

Zooms in or out the 2D image according to the size of the area to display the 2D image on the report.

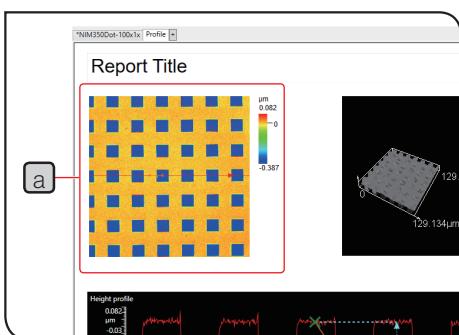
■Same size

Displays the 2D image in a same size (100%).

■Zoom in/out

Displays the 2D image with the specified magnification (25%, 50%, 75%, 200%, 300% or 400%).

Setting method of the magnification



- Right-click on the 2D image **a** on the report to display the menu, select [Zoom] and select the magnification you want to display.
The magnification of the 2D image changes.

3-3-7 Using the template

You can save the data processing and the measurement analysis performed to image data and the layout of data (image, profile, measurement analysis results, etc.) on the report as a template.

By applying the template to the image data file you want to perform the same data processing or the measurement analysis, you can perform the same data processing or the measurement analysis saved in the template and also display the report with the same layout.

Saving the report as a template

You can save the data processing and the measurement analysis performed to image data and the layout of data (image, profile, measurement analysis results, etc.) on the report as a template.

For procedures to save the template, see "Saving the template" (page 22).

Applying the template to the file

By applying the template to open the file, the same data processing or the measurement analysis saved in the template is performed and the report is displayed with the same layout.

For applying the template to the file, see "Opening the file by applying the template" (page 18).

TIP

If data acquisition conditions (data acquisition mode, image size, etc.) of the file you want to apply the template are not suitable for the data processing or the measurement analysis saved in the template, you cannot open the file by applying the template.

3-4 Outputting to the CSV file

You can output profile data of the cross section of the image displayed on the data view window to the comma separated value file (CSV file format).

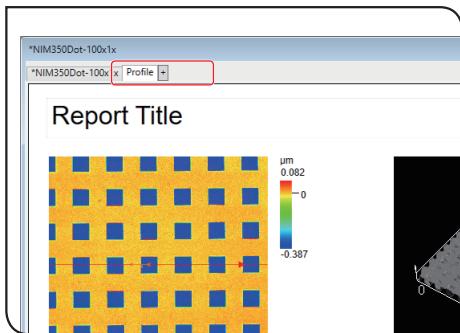
Data in CSV file format can be used for spreadsheet software such as Microsoft Excel, etc.

TIP If you open the CSV file in Microsoft Excel by double-clicking it on Windows Explorer, the texts may be garbled.

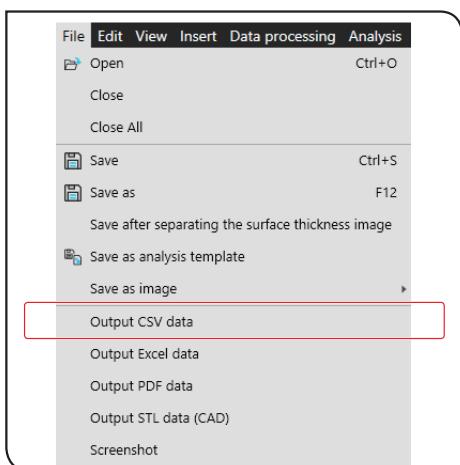
Open the CSV file by selecting [Open] from the [File] menu of Microsoft Excel.

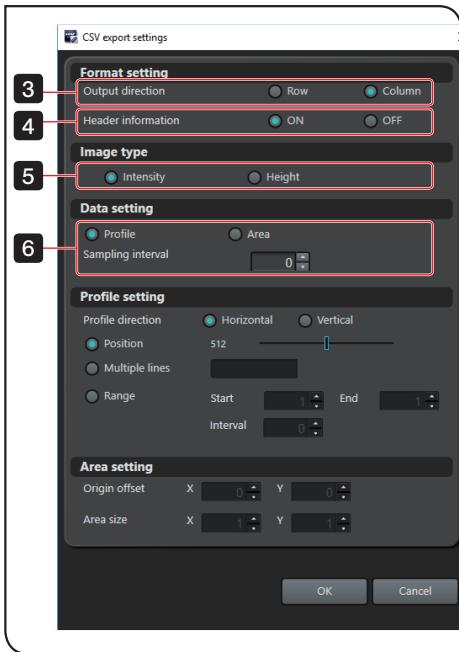
3-4-1 Outputting to the CSV file

- Display the tab of the report that contains data you want to save in CSV file format on the data view window.



- Select [Output CSV data] from the [File] menu.





The [CSV export settings] screen appears.

- 3** Select the direction to output data from the [Output direction] radio button.

- TIP**
- You can select [Row] or [Column].
 - The initial setting is [Column].

1	2	3	4	5	6	7	8	9	10

[Row]

1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

[Column]

- 4** Select whether to output the header information or not from the [Header information] radio button.

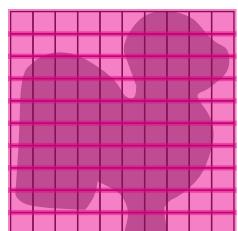
- TIP**
- You can select [ON] or [OFF].
 - The initial setting is [OFF].

- 5** Select the image data type from the [Image type] radio button.

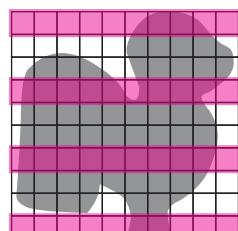
- TIP**
- You can select [Intensity] or [Height].
 - The initial setting is [Intensity].

- 6** Select the data type from the [Data setting] radio button, and set the interval to output pixels in the [Sampling interval] setting field.

- TIP**
- You can select [Profile] or [Area].
 - The initial setting is [Profile].
 - The setting range of the sampling interval is from "0" to the image size.
 - The initial value of the sampling interval is "0".



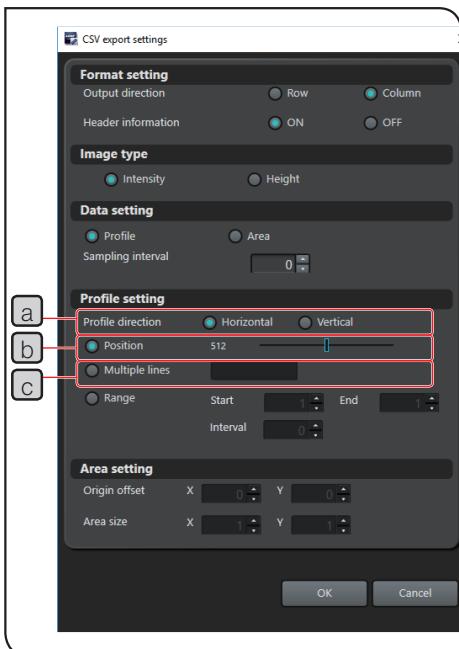
[Sampling interval] = 0



[Sampling interval] = 3

- TIP**
- If you select [Profile], go to step **7**.

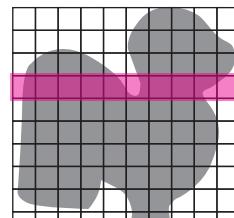
- If you select [Area], go to step **8**.



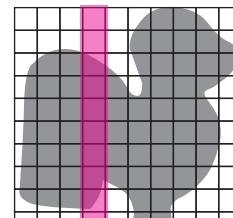
7 If you select [Profile] in step 6, perform following procedures.

1. Select the cross section direction of the profile from the [Profile direction] radio button **a**.

- TIP**
- You can select [Horizontal] or [Vertical].
 - The initial setting is [Horizontal].



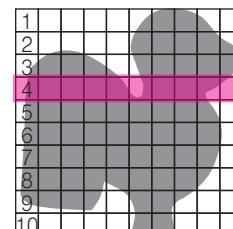
[Horizontal]



[Vertical]

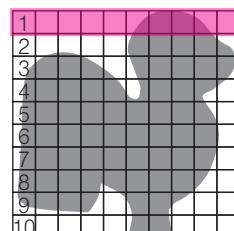
2. To specify a single cross section position of the profile, select the [Position] radio button **b** and specify the cross section position using the slider next to the radio button.

- TIP**
- The setting range of the slider is from "1" to the image size.
 - The initial value is "512".

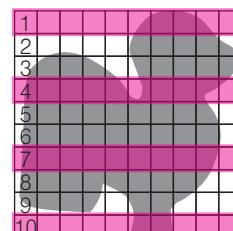


Cross section position = 4

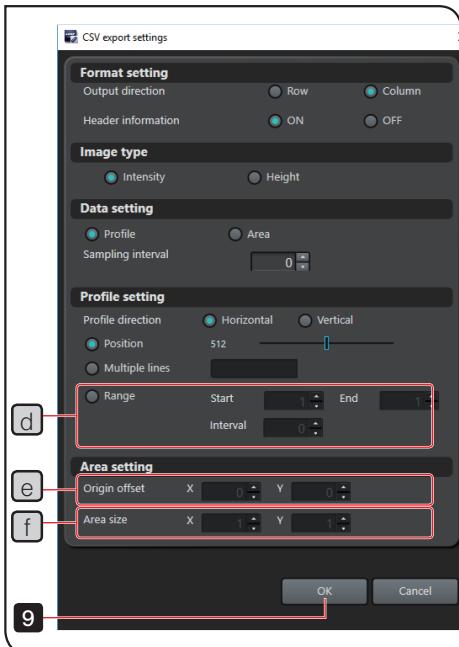
3. To specify the multiple cross section positions of the profile, select the [Multiple lines] radio button **c** and input the number of cross section positions in the next text box by separating with commas.



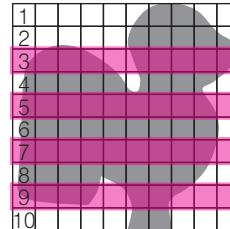
[Multiple lines] = 1



[Multiple lines] = 1, 4, 7, 10



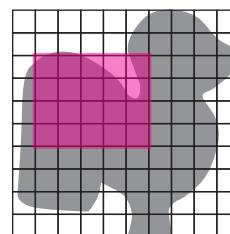
4. To specify the consecutive multiple cross section positions of the profile, select the [Range] radio button **d** and input the range in [Start], [End] and [Interval] setting fields.



[Start] = 3, [End] = 9, [Interval] = 1

- 8** If you select [Area] in step **6**, perform following procedures.

1. Input the XY position of the top left of the area you want to output data in CSV file format in [X] and [Y] fields of [Origin offset] **e**.
2. Input the number of pixels of the area you want to output data in CSV file format in [X] and [Y] fields of [Area size] **f**.



[Origin offset X] = 2, [Origin offset Y] = 3
[Area size X] = 5, [Area size Y] = 4

- 9** Click the [OK] button.

The [Save as] screen appears.

- 11** Input the save location and the file name, and click the [Save] button.

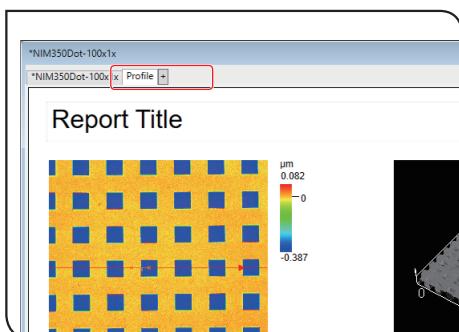
The CSV file is saved.

3-5 Outputting to the Excel file

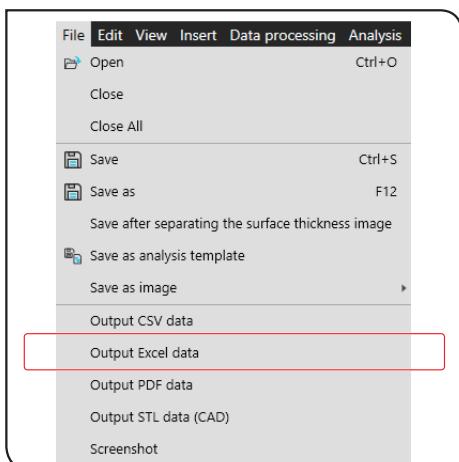
You can output all image data and all reports displayed on the data view window to the Microsoft Excel file (xlsx file format).



Microsoft Excel should have been installed on the controller or the PC in advance.



- Display the tab of image data or the report you want to output on the data view window.



- Select [Output Excel data] from the [File] menu.

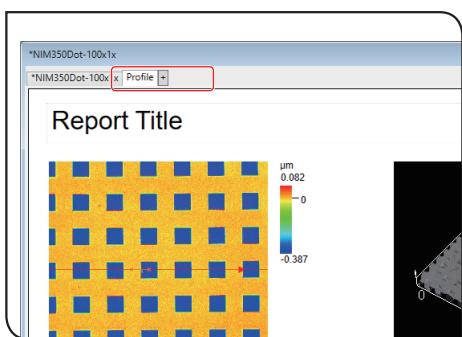
The [Save as] screen appears.

- Input the save location and the file name, and click the [Save] button.

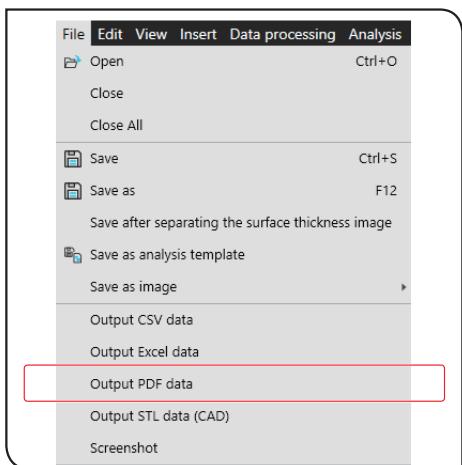
The Microsoft Excel file is saved.

3-6 Outputting to the PDF file

You can output all image data and all reports displayed on the data view window to the Portable Document Format file (PDF file format).



- Display the data view window of data you want to output.



- Select [Output PDF data] from the [File] menu.

The [Save as] screen appears.

- Input the save location and the file name, and click the [Save] button.

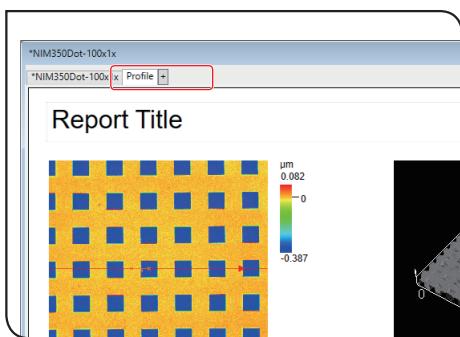
The PDF file is saved.

3-7 Outputting to the 3D-CAD file

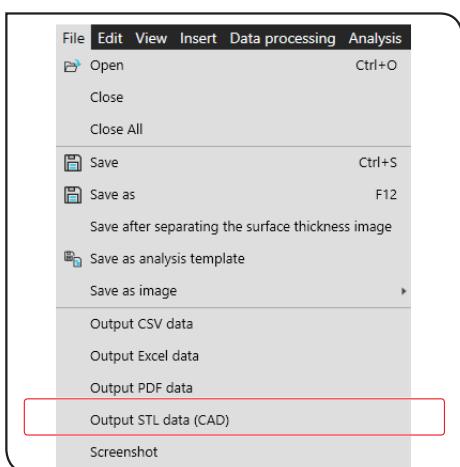
You can output height data of the image displayed on the data view window to the 3D-CAD file (STL file format).

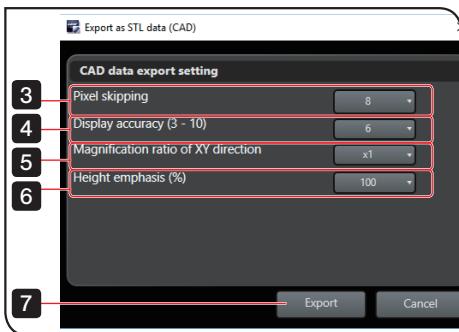
You can use data in STL file format with the 3D-CAD system.

- 1 Display the data view window of data you want to output.



- 2 Select [Output STL data (CAD)] from the [File] menu.





The [Export as STL data (CAD)] screen appears.

- 3** Select the number of pixels you want to skip from data in the [Pixel skipping] dropdown list.

TIP • You can select from the following values.

- 1, 2, 4, 8, 16 or 32

- The initial value is “8”.

- If you select “1”, pixels are not skipped.

- 4** Select the number of decimal places from the [Display accuracy] dropdown list.

TIP • You can select from the following values.

- 3, 4, 5, 6, 7, 8, 9 or 10

- The initial value is “6”.

- 5** Select the magnification ratio of data in XY direction from [Magnification ratio of XY direction].

TIP • Use this function if you want to zoom in small data using the 3D-CAD system.

- You can select from the following magnification ratios.
X1, X10, X100 or X1000

- The initial value is “X1”. Data is not zoomed in.

- 6** Select the magnification ratio of height data from [Height emphasis (%)].

TIP • Use this function if you want to emphasize the height of the sample with less height difference.

- The setting range is from 25 to 50000.

- The initial value is “100”. Data is not zoomed in.

- 7** Click the [Export] button.

The [Save as] screen appears.

- 8** Input the save location and the file name, and click the [Save] button.

The STL file is saved.

4 Displaying image data

You can set the view of image data.

Open the image file according to procedures in “Opening the file” (page 16) first, and then follow procedures in this chapter.

4-1 Selecting image data

4

The following data is saved in the image file.

- Color image
- Laser intensity image
- Height image
- Map image

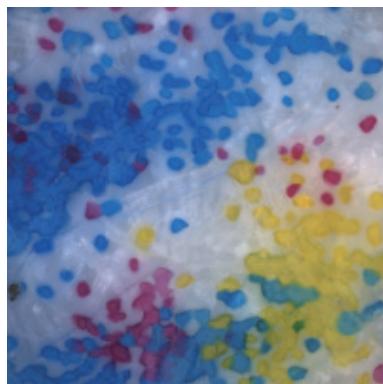
When you open the image file, the aforementioned data is displayed on the data view window.

You can change image data you want to display on the data view window.

4-1-1 Image data type

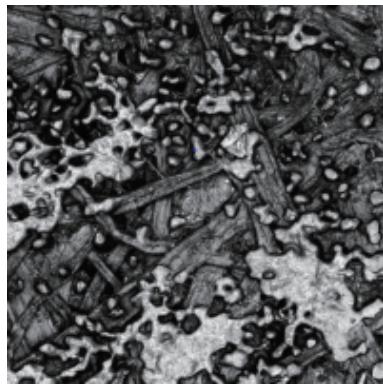
You can change the view of four types of image data on the data view window.

The outline of each image data type is described below.



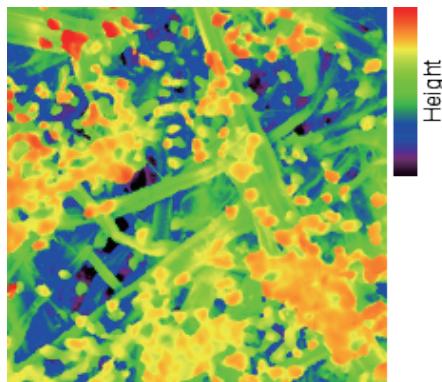
■Color image

This image is acquired by using multiple color images acquired at different focus positions to compose a single image where all positions in the field of view are in focus.



■Laser intensity image

This image is acquired by using multiple laser confocal images acquired at different focus positions to compose a single image where all positions in the field of view are in focus.



■ Height image

This data is acquired by imaging the uneven shape (3D shape) on the sample surface from multiple laser confocal images acquired at different focus positions.

The uneven shape is displayed according to the color or the shading of the color table.

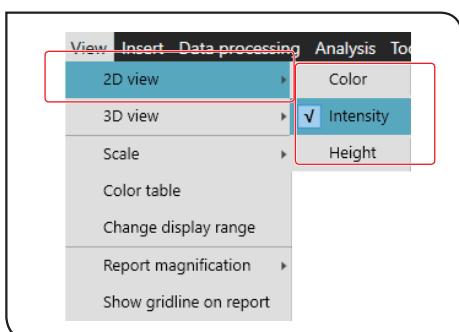
TIP When acquiring single line data, you can display only the height image.



■ Map image

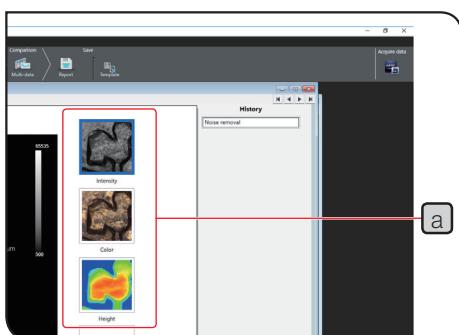
This image is acquired by automatically stitching the color images in conjunction with the stage movement. This image is automatically created during color image observation, and is useful for understanding the whole image of the sample.

4-1-2 Selecting image data



1 Select [2D view] from the [View] menu, and select the image data type you want to display.

The view of the image changes.



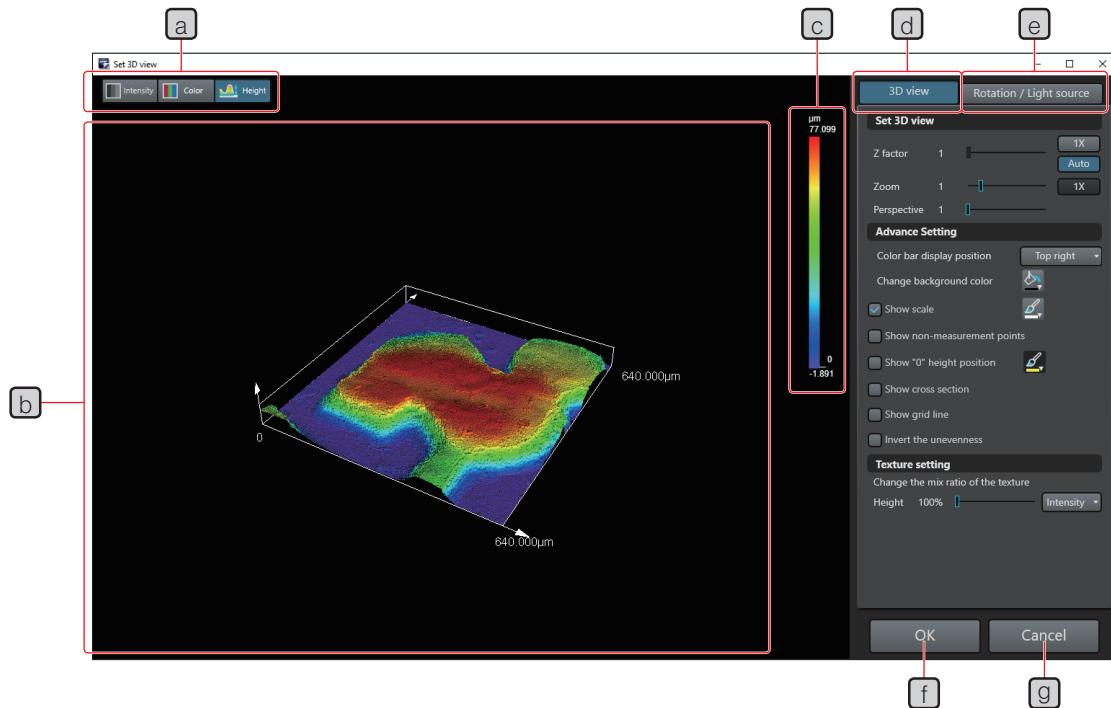
TIP You can also change image data by clicking the thumbnail image **a** on the data view window.

4-2 3D view

With the analysis application, you can display image data in 2D or in 3D.

While displaying image data in 3D, you can set details of the view, such as view position, view angle, light source position, etc.

4-2-1 Screens used with the 3D view



a 3D image data selection button

Selects either the laser intensity image, the color image or the height image on the 3D image view area.

b 3D image view area

Displays the 3D image.

Dragging the image allows you to change the angle to display the image.

Rotating the mouse wheel on the image zooms in or out the image.

Dragging the image while holding down the right button of the mouse allows you to move the view position.

c Scale bar

When the height image is displayed on the 3D image view area, the color tone corresponding to the height of the 3D image is displayed in bar. The scale bar shows the height value corresponding to the color in vertical direction.

When the laser intensity image is displayed on the 3D image view area, the shading corresponding to the laser intensity of the 3D image is displayed in bar. The scale bar shows the laser intensity corresponding to the shading in vertical direction.

d [3D view] tab

Sets the view method of the 3D image.

e [Rotation / Light source] tab

Sets the view point of the 3D image or the light source.

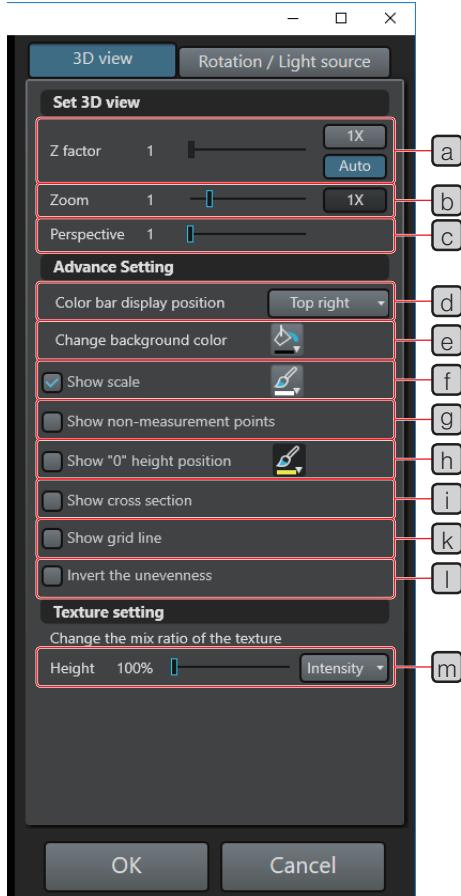
f [OK] button

Displays image data in 3D based on settings.

g [Cancel] button

Closes the [View setting] screen without saving the settings.

[3D view] tab

**[a] [Z factor] slider**

Sets the view of the height of the 3D image with the magnification (1 to 50000%). To return to 1X, click the [1X] button. To adjust the height magnification automatically, click the [Auto] button.

[b] [Zoom] slider

Sets the zoom magnification of the 3D image.

[c] [Perspective] slider

Changes the emphasizing degree of the perspective.

[d] [Color bar display position] dropdown list

Select the position to display the scale bar on the 3D image view area.

[e] [Change background color] button

Changes the background color of the 3D view.

[f] [Show scale] checkbox/color button

Displays the scale bar on the 3D image view area. You can change the color of the scale or the value using the color button.

[g] [Show non-measurement points] checkbox

Displays the area determined as a noise.

[h] [Show "0" height position] checkbox/color button

Highlights the area where height data becomes "0 (zero)" by the data processing, e.g. noise removal, etc. on the 3D image. You can change the color you want to highlight using the color button.

[i] [Show cross section] checkbox

Displays the cross section (XZ) of the 3D image. Dragging the cross section allows you to change the cross section position (X).

[k] [Show grid line] checkbox

Displays the grid-shape auxiliary line on the 3D image. You can use this auxiliary line as a guide to know the approximate shape or the distance of the sample.

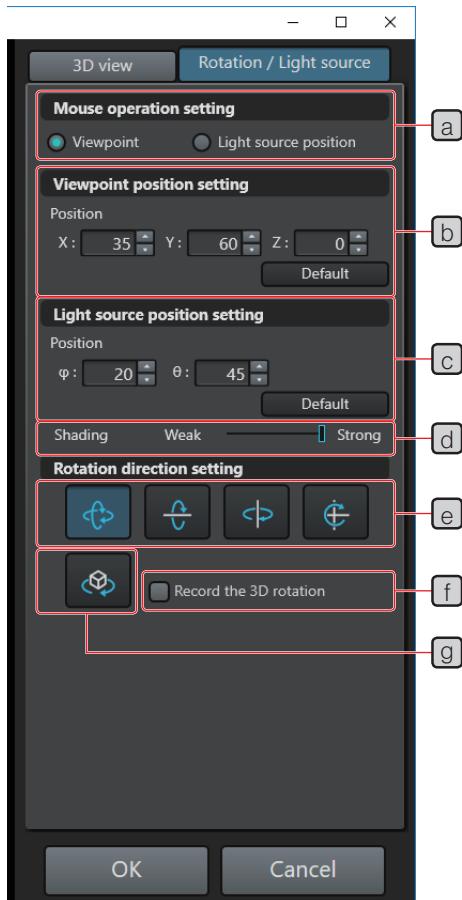
[l] [Invert the unevenness] checkbox

Displays inverted height data of the 3D image.

[m] [Change the mix ratio of the texture] slider

Displays data by composing data currently displayed with different type data. Select the data type from the dropdown list and set the ratio of composition using the slider.

[Rotation / Light source] tab

**[a] [Mouse operation setting]**

Select [Viewpoint] or [Light source position] to operate the mouse on the 3D image.

[b] [Viewpoint position setting]

Sets the viewpoint of the 3D image. Dragging the 3D image view area allows you to reflect coordinates to [X], [Y] and [Z]. To return to the initial settings, click the [Default] button.

[c] [Light source position setting]

Sets the light source position of the 3D image. Dragging the 3D image view area allows you to reflect the elevation angle to [φ] and the azimuth angle to [θ].

To return to the initial settings, click the [Default] button.

[d] [Shade effect slider]

Sets the shade degree of the 3D image.

[e] [Rotation direction setting] button

Select the rotation axis for rotating the image in 3D from [Free], [Horizontal axis], [Vertical axis] or [Perpendicular axis].

[Free]: Rotates freely.

[Horizontal axis]: Rotates the image vertically around the horizontal axis of the screen displayed.

[Vertical axis]: Rotates the image horizontally around the vertical axis of the screen displayed.

[Perpendicular axis]: Rotates the image around the perpendicular axis of the screen displayed.

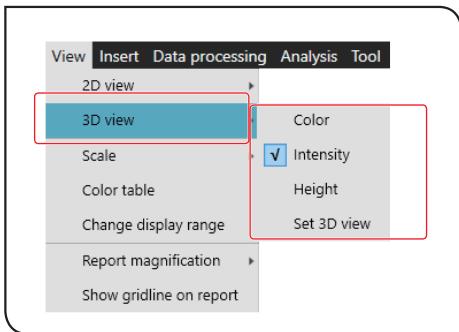
[f] [Record the 3D rotation] checkbox

Saves the image being rotated in 3D in the file (GIF file format or WMV file format).

[g] [3D rotation] button

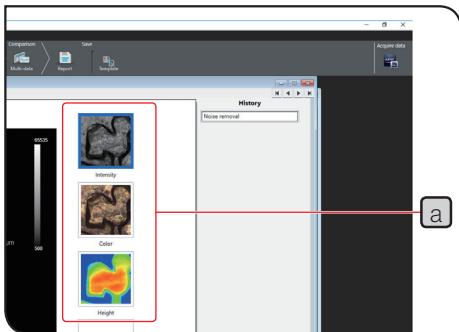
Rotates the 3D image and displays it.

4-2-2 Displaying the image in 3D



1 Select [3D view] from the [View] menu, and select the image data type you want to display.

The view of the image changes.



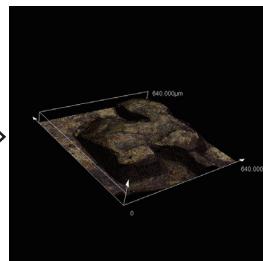
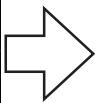
TIP

You can also change image data by clicking the thumbnail image **a** on the data view window.

4-2-3 Operating the 3D image

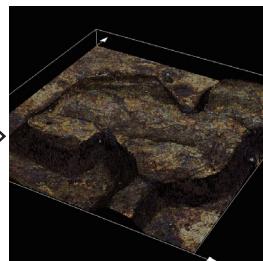
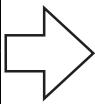
You can rotate, zoom in, zoom out and move the 3D image by operating the mouse on the 3D image view area.

TIP The image is rotated, zoomed in and zoomed out with the center of the sample on the image as a base.



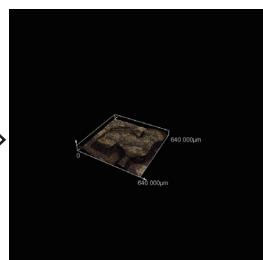
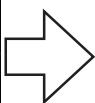
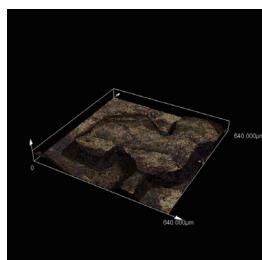
■Rotation

While holding down the left button of the mouse on the 3D image, drag the 3D image to the direction you want to rotate, e.g. up, down, right, left or diagonal.



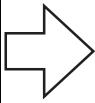
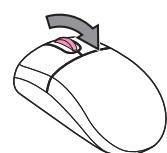
■Zoom in

Rotate the mouse wheel button toward back on the 3D image.



■Zoom out

Rotate the mouse wheel button toward front on the 3D image.



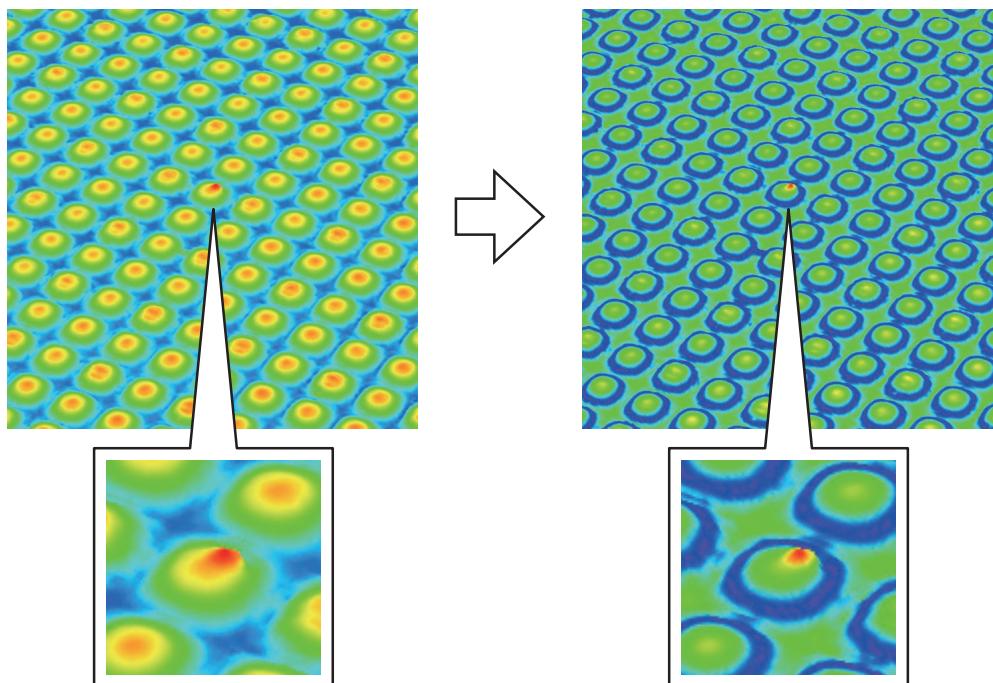
■Movement

While holding down the right button of the mouse on the 3D image, drag the 3D image to the direction you want to move, e.g. up, down, right, left or diagonal.

4-3 Setting the color table

You can set the color table for displaying the laser intensity image and the height image in 2D and 3D. Using the color table, you can change the color tone of the image or display the contour.

4



There are two types of color tables as described below.

- Standard color table

This color table is installed on the analysis application as default. You cannot delete this color table.

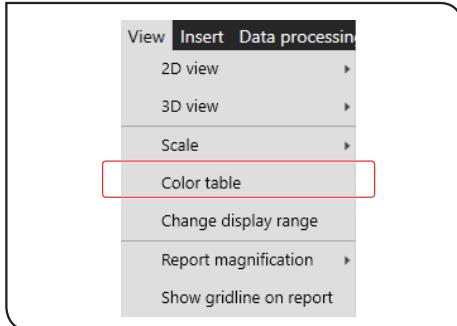
- User-defined color table

This color table can be created freely by the user. You can add or delete the color table to or from the color table list.

4-3-1 Changing the color table

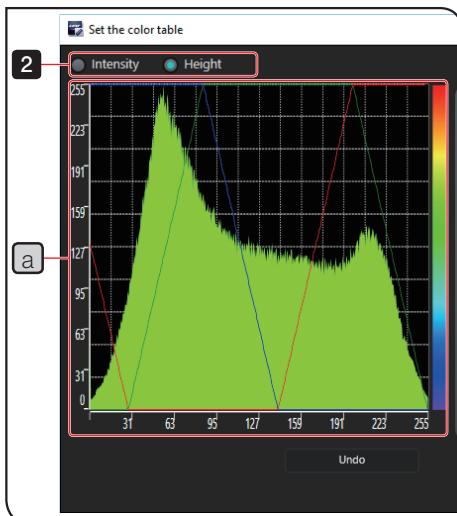
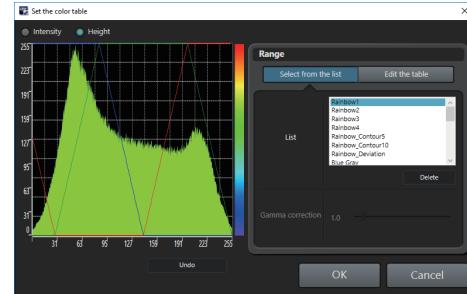
You can change the color tone of the laser intensity image or the height image or display the contour.

4



- 1** Select [Color table] from the [View] menu.

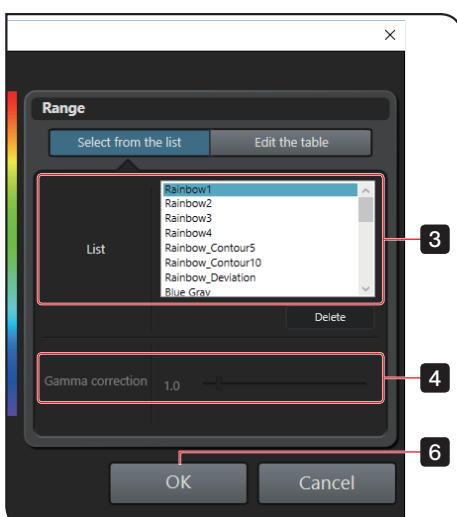
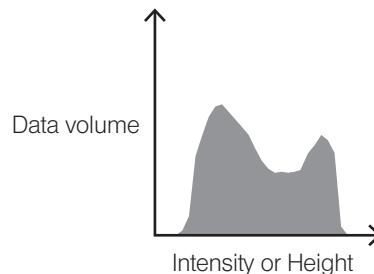
The [Set the color table] screen appears.



- 2** Select the image type you want to set the color table from the radio button.

TIP You can select [Intensity] or [Height].

The histogram and the color table **a** of laser intensity data or height data are displayed.



- 3** Select the color table you want to use from [List].

TIP The initial setting of the laser intensity image is [Gray] and the initial setting of the height image is [Rainbow1].

- 4** Adjust the gamma coefficient using the [Gamma correction] slider, if necessary.

TIP The more the value increases, the brighter the entire image becomes.

- 5** Edit the color table **a**, if necessary.

TIP To return the edited color table to the initial setting, click the [Undo] button.

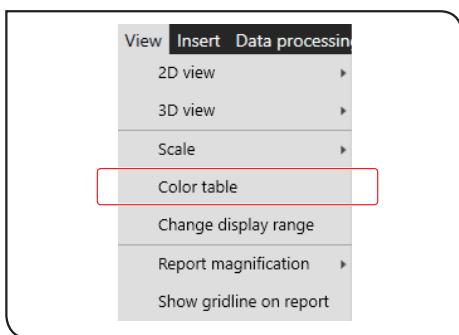
- 6** Click the [OK] button to close the [Set the color table] screen.

The color table of the laser intensity image or the height image is changed.

4-3-2 Creating the color table (user-defined color table)

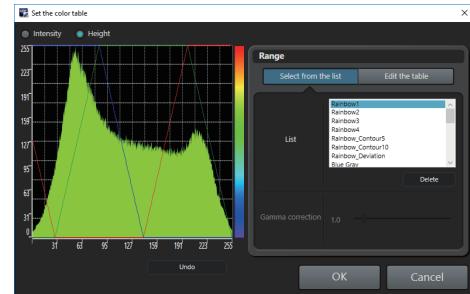
You can create a user-defined color table.

4



- 1 Select [Color table] from the [View] menu.

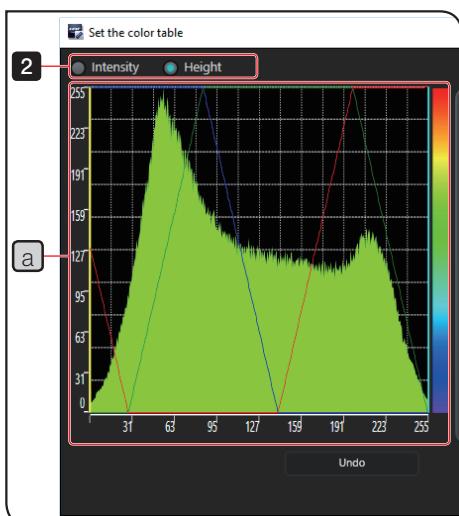
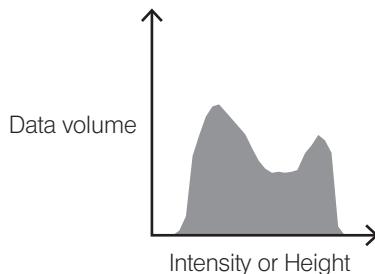
The [Set the color table] screen appears.



- 2 Select the image type you want to create the color table from the radio button.

TIP You can select [Intensity] or [Height].

The histogram and the color table **a** of laser intensity data or height data are displayed.



- 3 Click the [Edit the table] button.

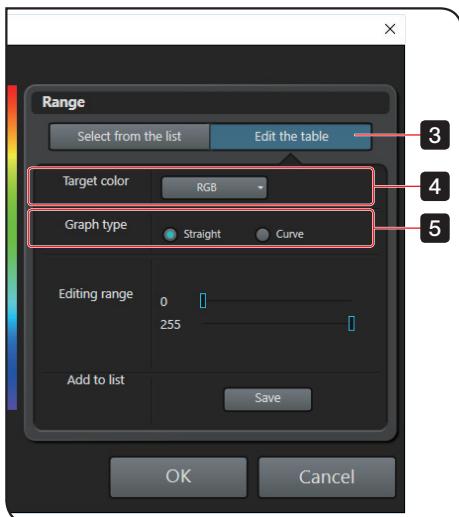
- 4 Select the color you want to adjust from the [Target color table] dropdown list.

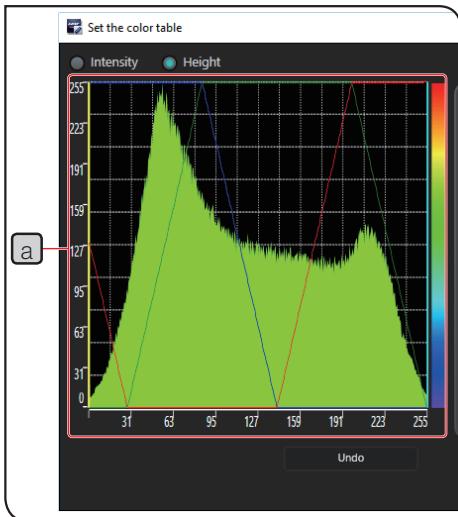
TIP • You can select [Red], [Green], [Blue] or [RGB].

- If you want to adjust the color table by each color, select [Red], [Green] or [Blue].
- If you want to set the same value to red, green or blue, select [RGB].

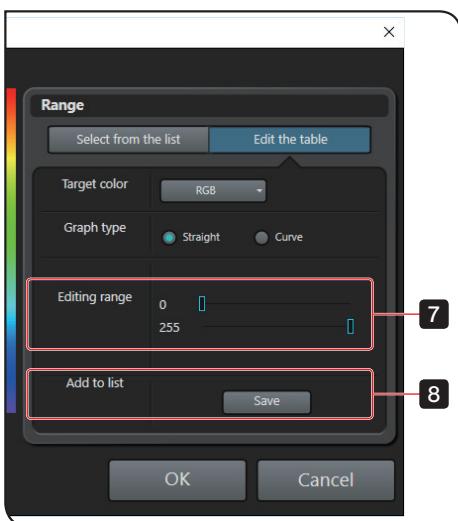
- 5 Select the graph type of the color table from the [Graph type] radio button.

TIP You can select [Straight] or [Curve].





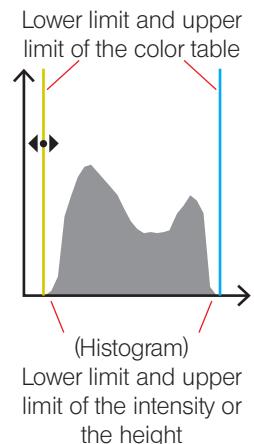
6 While looking at the histogram, adjust the color table [a].



7 To set the range to assign the color table, use the upper slider of [Editing range] to set the lower limit of the range and use the lower slider of [Editing range] to set the upper limit of the range.

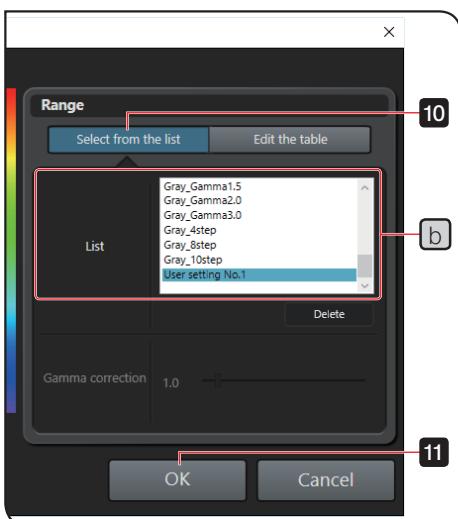
💡 Point

While looking at the distribution of the highest position and the lowest position of the intensity or the height on the histogram, set the upper limit and the lower limit of the range to assign the color table. Since the upper limit and the lower limit of the intensity or the height are assigned to the upper limit and the lower limit of the color table, the image is displayed by emphasizing the brightness difference or the height difference.



TIP

- You can also set the lower limit of the range by dragging the yellow line of the color table.
- You can also set the upper limit of the range by dragging the blue line of the color table.



8 Click the [Save] button.

9 Input the name of the user-defined color table on the screen displayed, and click the [OK] button.

10 Click the [Select from the list] button to display [List] [b], and make sure that the added user-defined color table is selected at the bottom of [List].

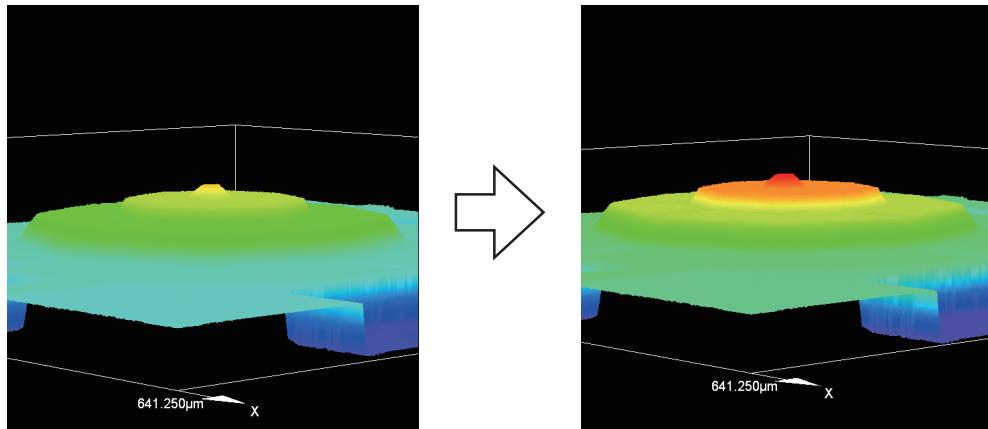
11 Click the [OK] button to close the [Set the color table] screen.

The color table of the laser intensity image or the height image is changed.

4-4 Setting the display range

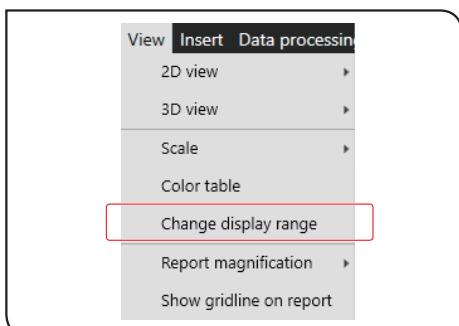
You can set the range to assign (display range) the upper limit and the lower limit of the color table among actual data of the laser intensity image and the height image in 2D and 3D.

Adjusting the display range, you can display the image by emphasizing the brightness difference or the height difference.



4-4-1 Setting the display range of the laser intensity image

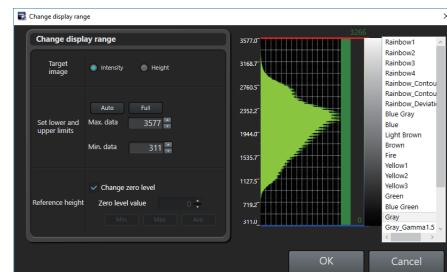
You can display the laser intensity image by emphasizing the brightness difference.

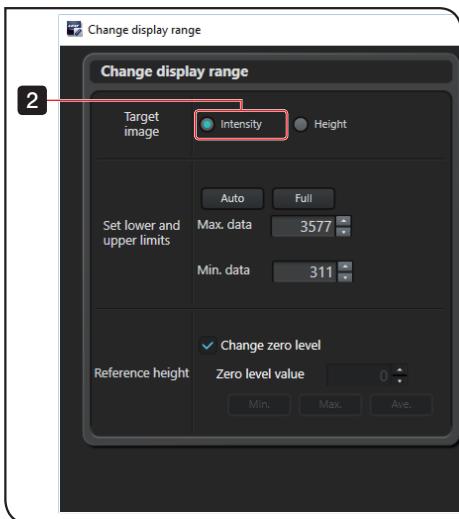


1 Select [Change display range] from the [View] menu.

TIP You can also display the [Change display range] screen by right-clicking on the 2D image or the 3D image to display the menu and selecting [Change display range].

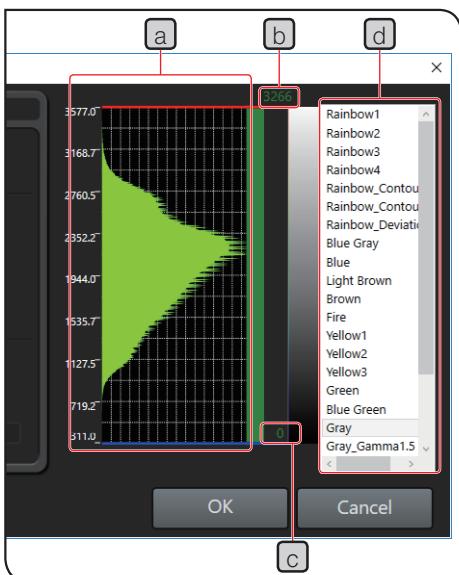
The [Change display range] screen appears.



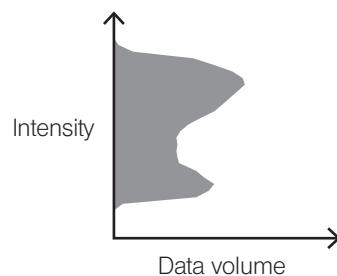


2 Select the [Intensity] radio button.

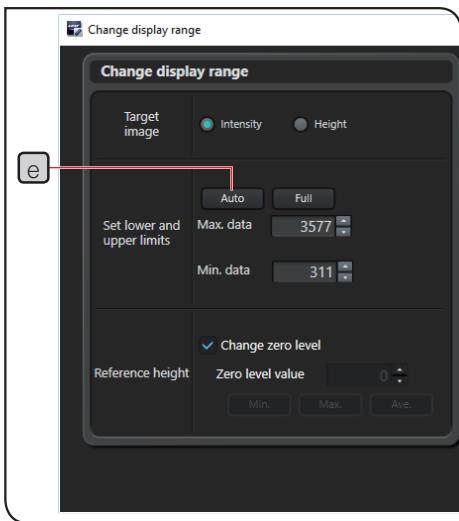
TIP You can select [Intensity] or [Height].



The histogram **a** of laser intensity data and the maximum value **b** and the minimum value **c** of actual intensity data are displayed.



TIP The list of color tables **d** is displayed on the right side of the histogram. You can change the color table by selecting the color table from the list.



3 Set the display range.

There are three methods to set the display range as described below.

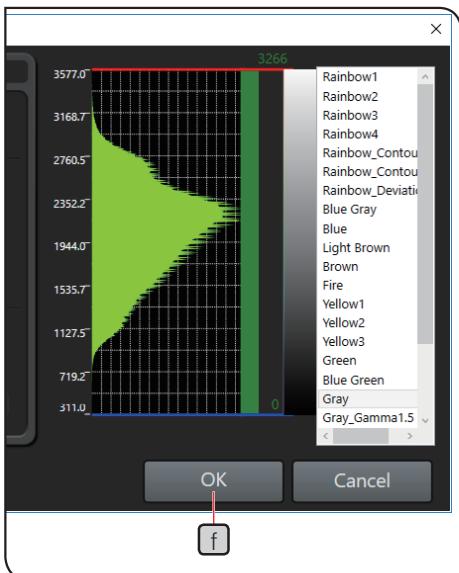
- Set the display range automatically.
- Set the display range manually.
- Set the display range same as the range of actual intensity data.

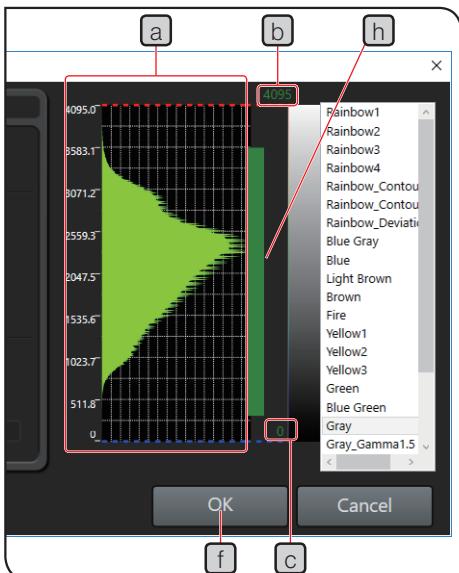
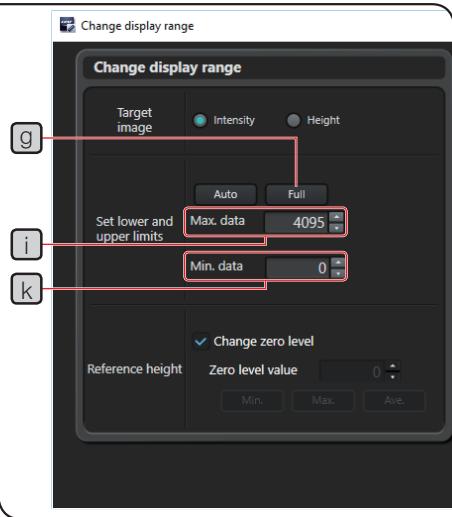
Setting the display range automatically

Set the maximum value and the minimum value of actual intensity data to the maximum value and the minimum value of the display range.

1. Click the [Auto] button **e**.
2. Click the [OK] button **f**.

The display range of the laser intensity image is set.

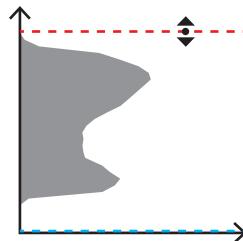




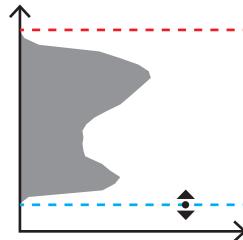
Setting the display range manually

While looking at the histogram of actual intensity data, set the display range.

1. Click the [Full] button **[g]**.
The maximum value **[b]** of the display range becomes "65535" and the minimum value **[c]** becomes "0".
The display range before change is displayed in green bar **[h]** on the right side of the histogram.
2. While looking at the green bar **[h]**, drag the red dotted line on the histogram **[a]** to set the maximum value of the display range.



TIP You can also set the maximum value of the display range by selecting [Maximum data] **[i]**.



3. While looking at the green bar **[h]**, drag the blue dotted line on the histogram **[a]** to set the minimum value of the display range.

TIP You can also set the minimum value of the display range by selecting [Minimum data] **[k]**.

4. Click the [OK] button **[f]**.
The display range of the laser intensity image is set.

Setting the display range same as the range of actual intensity data

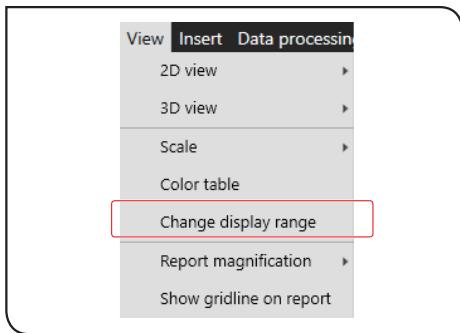
Set the range (0 to 65535) of actual intensity data as the display range.

1. Click the [Full] button **[g]**.
The maximum value **[b]** of the display range becomes "65535" and the minimum value **[c]** becomes "0".
The display range before change is displayed in green bar **[h]** on the right side of the histogram **[a]**.
2. Click the [OK] button **[f]**.
The display range of the laser intensity image is set.

4-4-2 Setting the display range of the height image

You can display the height image by emphasizing its height difference.

4

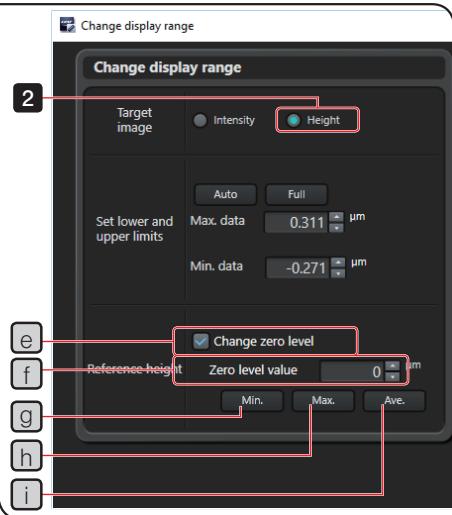


1 Select [Change display range] from the [View] menu.

TIP You can also display the [Change display range] screen by right-clicking on the 2D image or the 3D image to display the menu and selecting [Change display range].

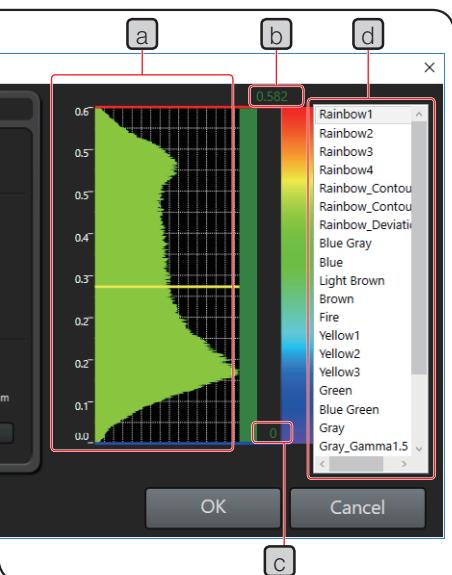
The [Change display range] screen appears.



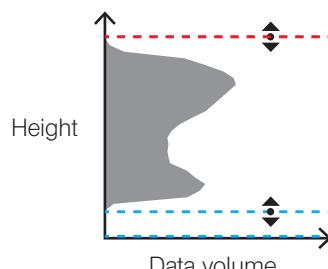


2 Select the [Height] radio button.

TIP You can select [Intensity] or [Height].



The histogram **a** of height data and the maximum value **b** and the minimum value **c** of actual height data are displayed.

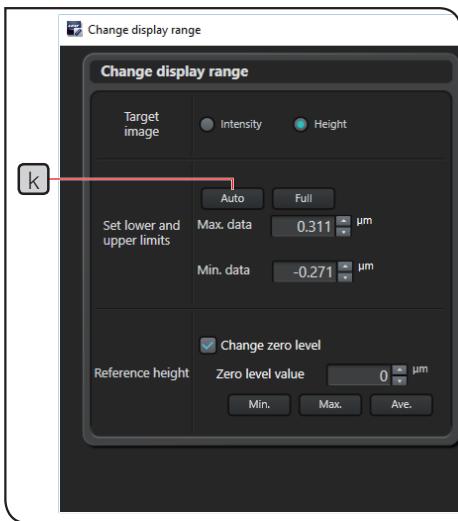


TIP The list of color tables **d** is displayed on the right side of the histogram. You can change the color table by selecting the color table from the list.

3 To set the maximum value and the minimum value of the display range to the relative values from the base surface, perform following procedures.

1. Check the [Change zero level] checkbox **e**.
2. Set the value you want to set as a base surface in [Zero level value] **f**.

TIP If you want to set the minimum value of actual height data as a base surface, click the [Minimum] button **g**, if you want to set the maximum value as a base surface, click the [Maximum] button **h**, and if you want to set the average value as a base surface, click the [Average] button **i**.



4 Set the display range.

There are three methods to set the display range as described below.

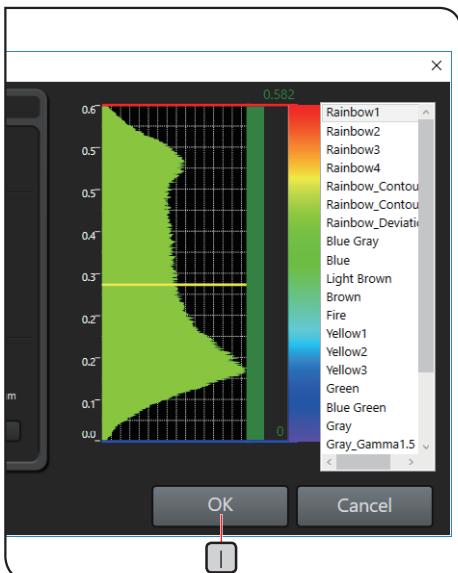
- Set the display range automatically.
- Set the display range manually.
- Set the display range same as the range of actual height data.

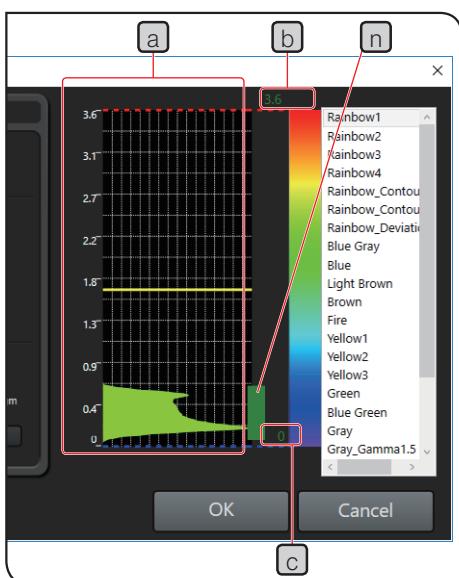
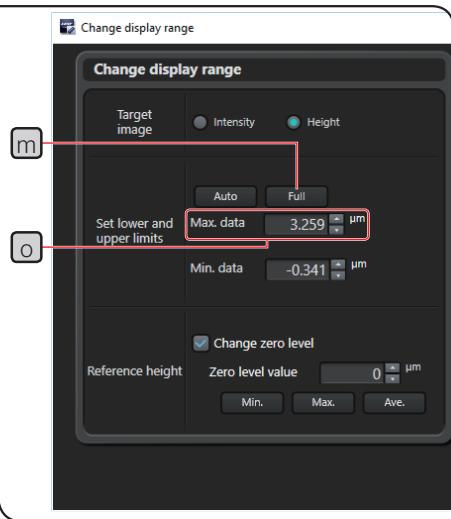
Setting the display range automatically

Set the maximum value and the minimum value of actual height data to the maximum value and the minimum value of the display range.

1. Click the [Auto] button **k**.
2. Click the [OK] button **l**.

The display range of the height image is set.





Setting the display range manually

While looking at the histogram of actual height data, set the display range.

1. Click the [Full] button **m**.

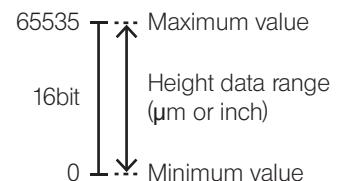
The maximum value **b** of the display range becomes the maximum value of the height data range and the minimum value **c** becomes "0".

The display range before change is displayed in green bar **n** on the right side of the histogram.

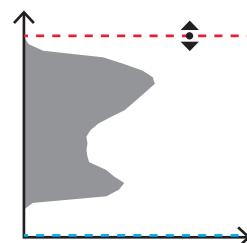
TIP

Maximum value of the height range

Height data is saved with 16bit(0 to 65535) and assigned to μm or inch. The height (μm or inch) where the maximum value is assigned with 16 bit becomes the maximum value of the height range.



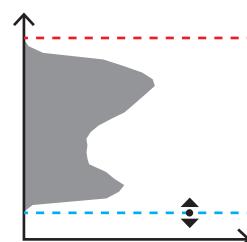
2. While looking at the green bar **n**, drag the red dotted line on the histogram **a** to set the maximum value of the display range.

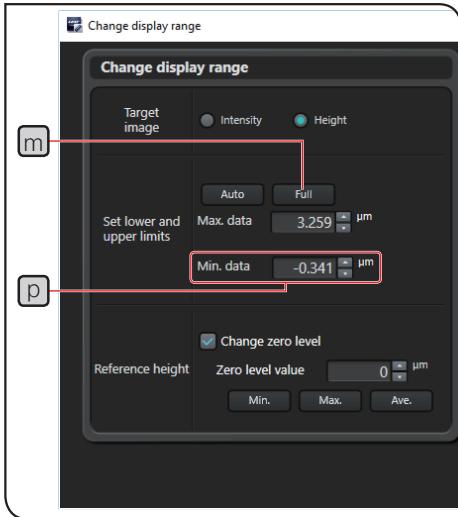


TIP

You can also set the maximum value of the display range by selecting [Maximum data] **o**.

3. While looking at the green bar **n**, drag the blue dotted line on the histogram **c** to set the minimum value of the display range.

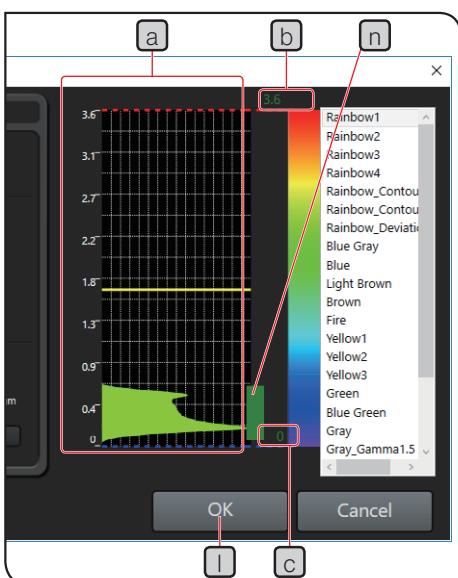


**TIP**

You can also set the minimum value of the display range by selecting [Minimum data] **p**.

- Click the [OK] button **i**.

The display range of the height image is set.



- Click the [Full] button **m**.

The maximum value **b** of the display range becomes the maximum value of the height data range and the minimum value **c** becomes "0".

The display range before change is displayed with the green bar **a** on the right side of the histogram **a**.

- Click the [OK] button **i**.

The display range of the height image is set.

4-5 Displaying data acquisition conditions (image information)

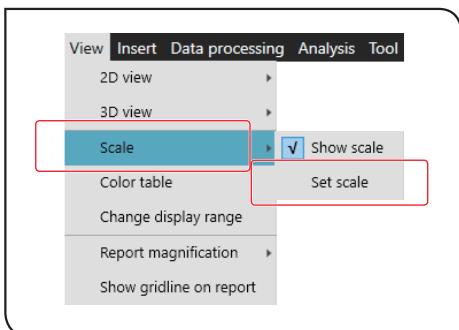
You can display the data acquisition conditions (image information) when data was acquired on the 2D image on the data view window and also on the 2D image on all reports.

4-5-1 List of data acquisition conditions

The data acquisition conditions (image information) include the following information.

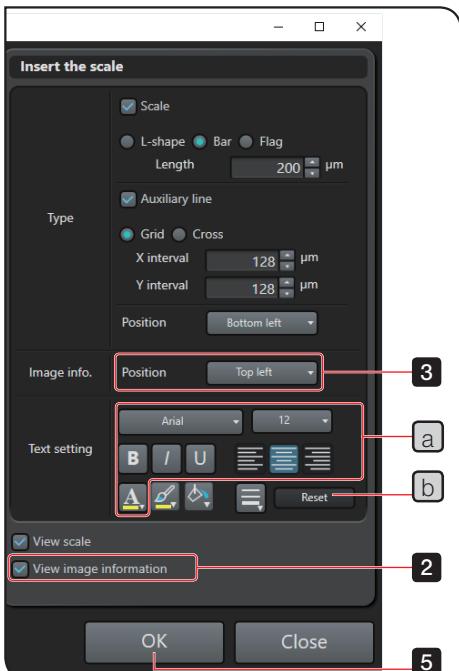
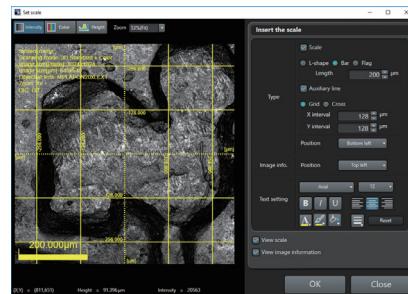
Data acquisition condition	Contents
[Objective]	Objective name
[Zoom]	Zoom magnification
[Microscope name when data is acquired]	System name of the microscope
[Scan mode]	Data acquisition method ([Fine]/[Standard]/[Fast]) or the presence of the color image
[Image size]	Image size (pixel)
[Image acquisition mode]	
[Z position to start acquisition]	Z position when data is acquired first
[Z position to finish acquisition]	Z position when data is acquired last
[Z movement distance]	Movement distance of the Z position when data is acquired
[DIC]	DIC observation ON/OFF
[Brightness]	
[Laser intensity]	
[Offset]	
[Confocal level]	
[Beam diameter diaphragm]	
[Correction of light intensity unevenness]	
[Optical noise filter]	
[Brightness]	
[Auto gain]	
[Gamma correction]	
[Red gain]	
[Blue gain]	

4-5-2 Displaying data acquisition conditions



- 1** Select [Scale] from the [View] menu, and then select [Set scale].

The [Set scale] screen appears.



- 2** Check the [View image information] checkbox.

- 3** Select the position to display the data acquisition condition from the [Position] dropdown list of [Image information].

TIP • You can select either [Top left], [Top right], [Bottom left] or [Bottom right].

- The initial setting is [Top left].
- If you don't want to display the data acquisition condition, uncheck the [View image information] checkbox.

- 4** Change the text format (font, font size, bold, italic, underline, alignment, text color) of the data acquisition condition, if necessary.

1. Click on the data acquisition condition on the 2D image.
2. Change the text format **a** (font, font size, bold, italic, underline, alignment, text color) of the data acquisition condition.

TIP Click the [Reset] button **b** to return the text format of the data acquisition condition to the initial setting.

- 5** Click the [OK] button to close the [Set scale] screen.

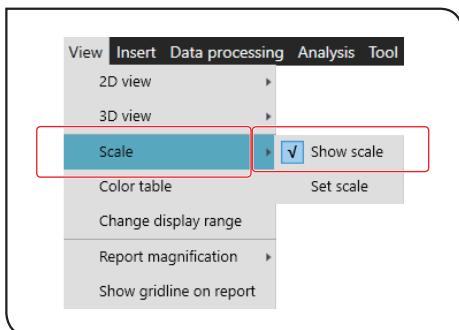
The data acquisition condition is displayed on the 2D image.

TIP For adding the data acquisition condition on the 2D image as annotation, see "4-7 Adding the annotation on the image" (page 75).

4-6 Displaying the scale and the auxiliary line

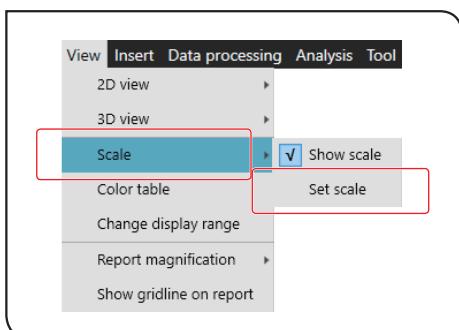
You can display the scale or the auxiliary line on the 2D image on the data view window and also on the 2D image on all reports.

4-6-1 Displaying the scale and the auxiliary line



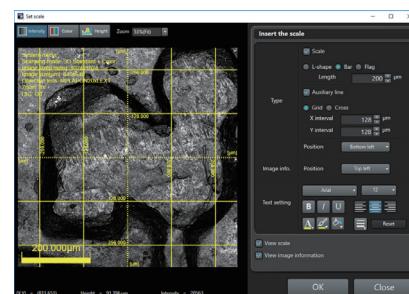
- 1** Select [Scale] from the [View] menu, and then select [Show scale].
[Show scale] is checked. (The scale is displayed on the 2D image.)

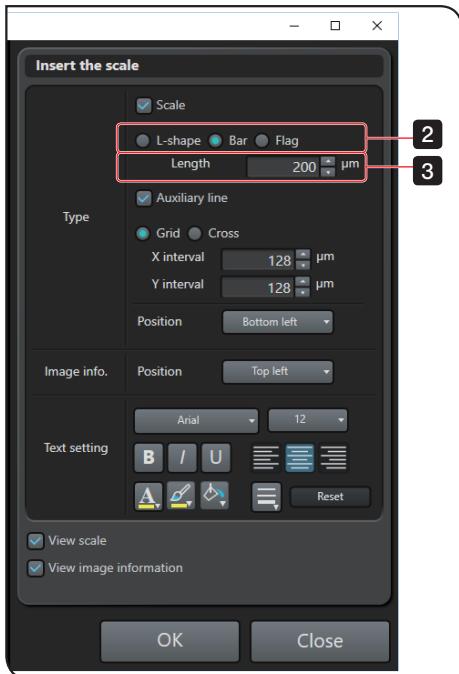
4-6-2 Changing the type or the display position of the scale and the auxiliary line



- 1** Select [Scale] from the [View] menu, and then select [Set scale].

The [Set scale] screen appears.



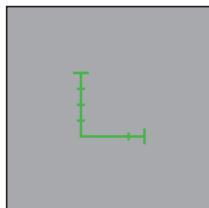


2 Select the scale type from the scale type radio button.

- TIP**
- You can select [L-shape], [Bar] or [Flag].
 - The initial setting is [Bar].

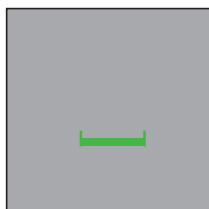
There are three types of scales as described below.

- [L-shape scale]
- [Bar]
- [Flag]



■[L-shape scale]

Displays the scale and its length on the X-axis and Y-axis.



■[Bar]

Displays the scale and its length on the X-axis.

3 Input the scale length in [Length].

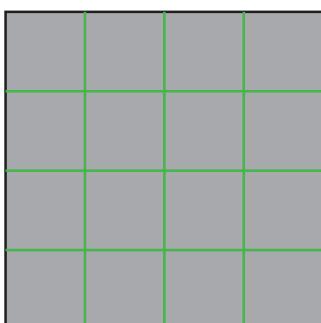
- TIP**
- The setting range is from "1" to 90% of the image size.



4 Select the scale type from the auxiliary line type radio button.

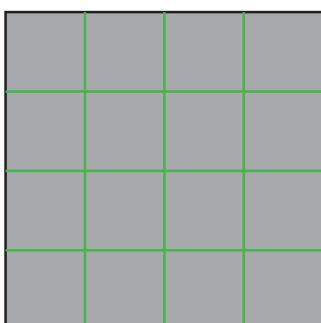
TIP • You can select [Grid] or [Cross].

- The initial setting is [Grid].



■[Grid]

You can display the grid-shape auxiliary line on both X-axis and Y-axis.

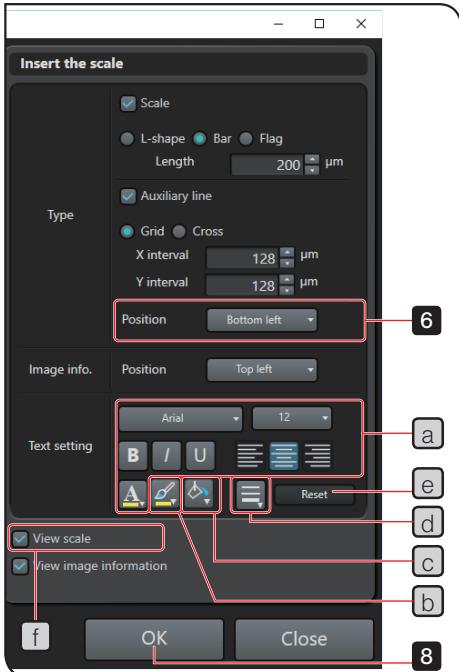


■[Cross (cross line)]

You can display a single auxiliary line on both X-axis and Y-axis.

5 Input the interval of the auxiliary line in [X interval] and [Y interval].

TIP The setting range is from "1" to the image size.



- 6** Select the display position of the scale from the [Position] dropdown list.

- TIP**
- You can select either [Top left], [Top right], [Bottom left], [Bottom right] or [User defined].
 - The initial setting is [Bottom left].
 - If you select [User defined], you can move the scale display position by dragging the scale on the 2D image view area.

- 7** Change the format of the scale or the auxiliary line, if necessary.

1. Click on the scale or the auxiliary line on the 2D image.
2. Change the text format **a** (font, font size, bold, italic, underline, alignment, color) of the scale or the auxiliary line.
3. Change the line color **b** of the scale or the auxiliary line.
4. Change the background color **c** of the text of the scale or the auxiliary line.
5. Change the line width **d** of the scale or the auxiliary line.

- TIP** To return the format of the scale or the auxiliary line to the initial setting, click the [Reset] button **e**.

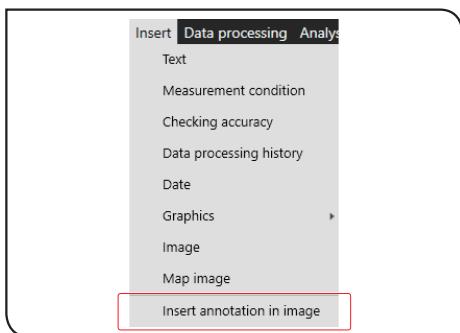
- 8** Click the [OK] button to close the [Set scale] screen.

The scale and the auxiliary line are displayed on the 2D image.

- TIP**
- If you don't want to display the scale and the auxiliary line, uncheck the [View scale] checkbox **f** on the [Set scale] screen.
 - For adding the scale on the 2D image as annotation, see "4-7 Adding the annotation on the image" (page 75).

4-7 Adding the annotation on the image

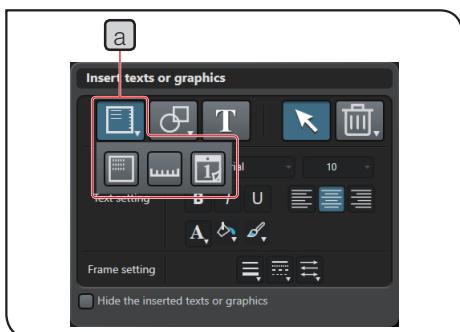
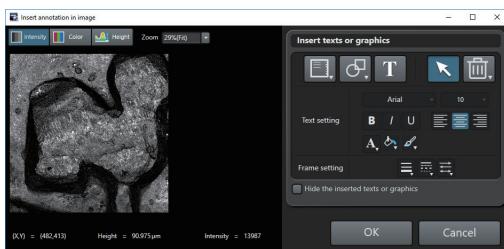
You can insert the data acquisition conditions (image information), graphics and texts on the 2D image on the data view window and also on the 2D image on all reports.



- 1** Select [Insert annotation in image] from the [Insert] menu.

4

The [Insert annotation in image] screen appears.



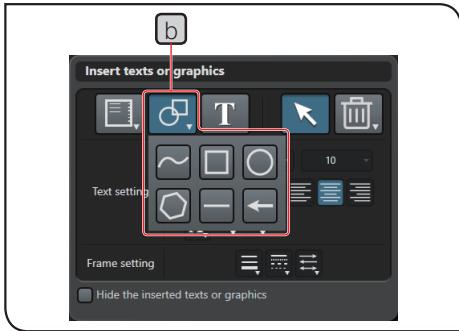
- 2** To insert the objects (image information, scale or date) on the image, perform following procedures.

1. Click the [Object] button **a** to display [Image information], [Scale] and [Date] buttons, and click either button.
2. On the 2D image on the [Insert annotation in image] screen, hold down the mouse button at the start point of the object and drag it to specify the region.

[Image information]: The data acquisition conditions when data is acquired are inserted.

[Scale]: The scale is inserted.

[Date]: The date when data is acquired is inserted.



3 To insert the graphics in the image, perform the following procedures.

1. Click the [Diagram] button **b** to display [Free hand], [Rectangle], [Ellipse], [Polygon], [Line] and [Arrow] buttons, and click either button.
2. Draw graphics on the 2D image on the [Insert annotation in image] screen.

~[Free hand]: Draws graphics freely.

Hold down the mouse button at the position you want to set as a start point on the image, and drag freely.

□[Rectangle]: Draws a rectangle.

Hold down the mouse button at the position you want to set as a vertex of the rectangle on the image, and drag it diagonally.

○[Ellipse]: Draws an circle or an ellipse.

Hold down the mouse button at the position you want to set as a start point on the image, and drag the rectangle circumscribing the circle diagonally.

◇[Polygon]: Draws a polygon.

Click a position you want to set as a start point on the image, click the next vertex one after another and double-click at the end point.

—[Line]: Draws a line.

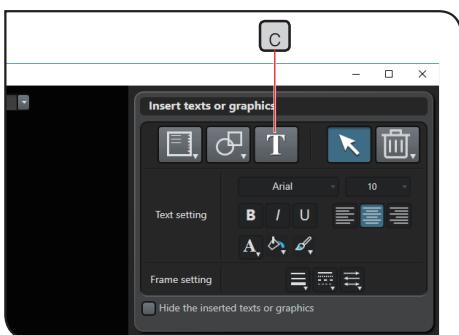
Hold down the mouse button at the position you want to set as a start point on the image, and drag to the position you want to set as an end point.

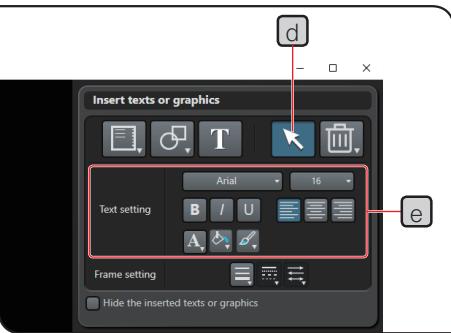
←[Arrow]: Draws an arrow.

Hold down the mouse button at the position you want to set as a start point on the image, and drag to the position you want to set as an end point.

4 To insert the texts in the image, perform the following procedures.

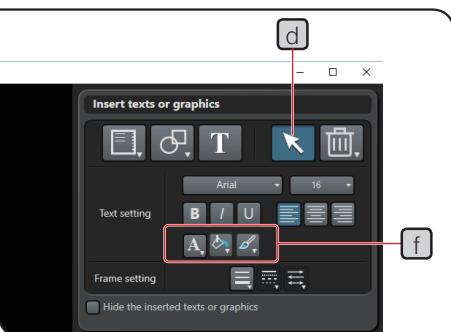
1. Click the [Text] button **c**.
2. On the 2D image on the [Insert annotation in image] screen, hold down the mouse button at the start point of the text box and drag it to specify the area.
3. Input the arbitrary texts in the text box.





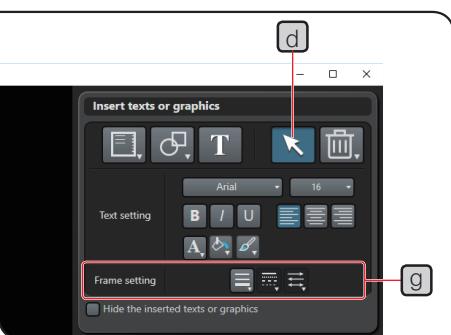
- 5** To change the text format of the object or the text box, perform following procedures.

1. Make sure that the [Select] button **d** is pressed.
2. On the 2D image on the [Insert annotation in image] screen, select the object or the text box you want to change the text format.
3. Change the text format in [Text setting] **e**.



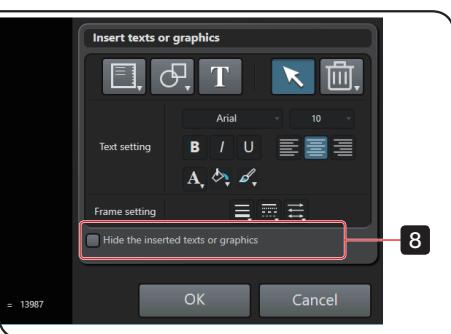
- 6** To change the color of the object, graphics or the text box, perform following procedures.

1. Make sure that the [Select] button **d** is pressed.
2. On the 2D image on the [Insert annotation in image] screen, select the object, graphics or the text box you want to change the color.
3. Change the color of the text, the filling or the frame line in [Text setting] **f**.



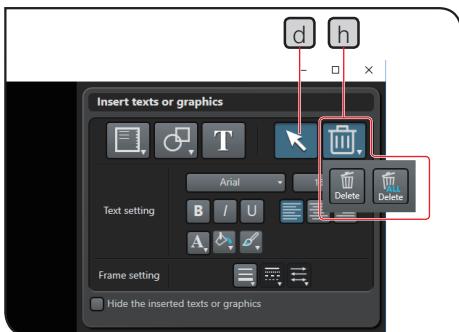
- 7** To change the line width or the line type of the object, graphics or the text box or the arrow style, perform following procedures.

1. Make sure that the [Select] button **d** is pressed.
2. On the 2D image on the [Insert annotation in image] screen, select the object, graphics or the text box you want to change the color or the line type.
3. Change the line width, the line type or the arrow in [Frame setting] **g**.



- 8** To hide the annotation, check the [Hide the inserted texts or graphics] checkbox.

TIP If the annotation is hidden, the annotation is not displayed on the 2D image on the report, but when you display the [Insert annotation in image] screen again, the setting of the annotation remains.

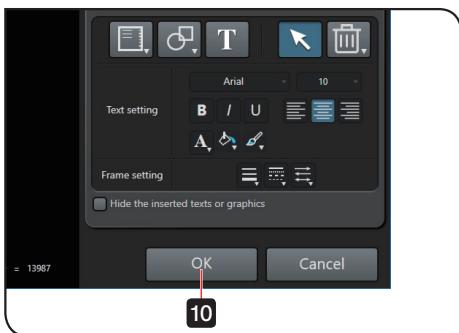


- 9 To delete the object, graphics or the text box, perform following procedures.

1. Make sure that the [Select] button **d** is pressed.
2. On the 2D image on the [Insert annotation in image] screen, select the object, graphics or the text box you want to delete.
3. Click the [Delete] button **h** to display [Delete] and [Delete all] buttons, and click either button.

[Delete]: Deletes the object, graphics or the text box selected on the 2D image.

[Delete all]: Deletes all objects, graphics or text boxes on the 2D image.



- 10 Click the [OK] button.

The annotation is inserted in the 2D image on the report.

5 Data processing

TIP You can display the list of data processing history performed to the image displayed on the data view window. For displaying the data processing history, see "22-3 Data processing history" (page 389).

5-1 Cancelling the data processing

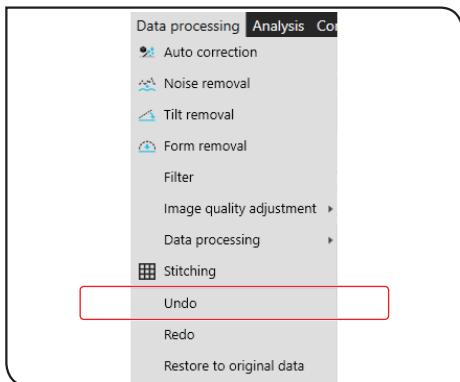
You can cancel the data processing performed to image data. Cancelling all the data processing returns to the original image (image when the file is opened).

- TIP**
- If you save image data, this data becomes the original image and you cannot cancel the data processing. Be sure to cancel the data processing before saving image data.
 - You can cancel the data processing of only image data on the data view window displayed frontmost.

5-1-1 Cancelling the data processing

Cancelling the last data processing

You can cancel the data processing performed to the image displayed on the data view window.

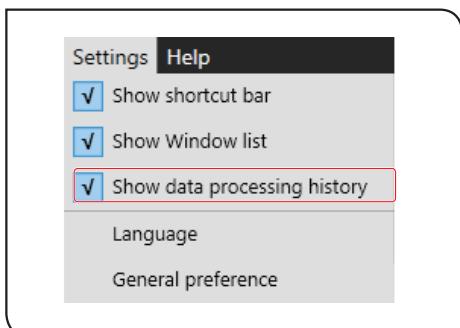


- 1** Select [Undo] from the [Data processing] menu.

TIP If you select [Redo] from the [Data processing] menu, you can redo the data processing you cancelled.

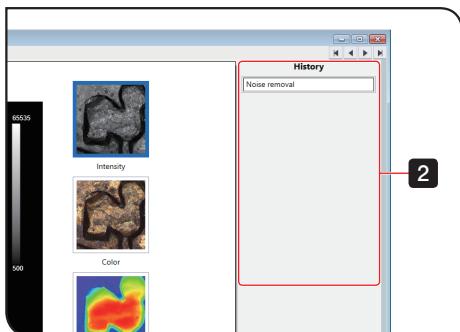
Cancelling the unnecessary data processing

You can cancel the unnecessary data processing among those performed to the image displayed on the data view window.



- 1** If [Data processing history] is not displayed on the data view window, select [Show data processing history] from the [Settings] menu.

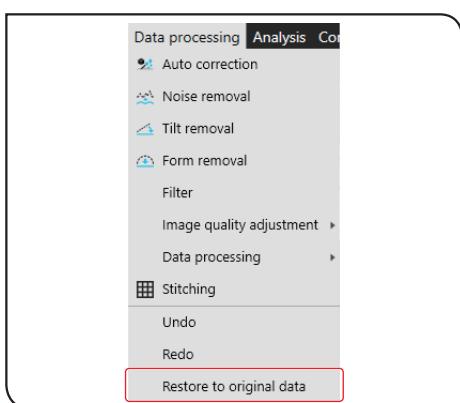
When the [Show data processing history] is checked, the data processing history is displayed.



- 2** Right-click on the data processing you want to cancel in [Data processing history] on the data view window to display the menu, and select [Undo].

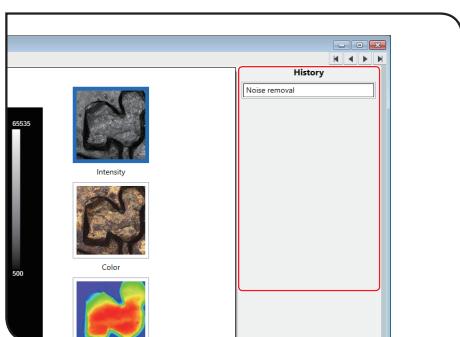
5-1-2 Returning to the original image

You can return to original image data by cancelling all the data processing.



- 1** Select [Restore to original data] from the [Data processing] menu.

All the data processing is cancelled and image data is returned to original image data.

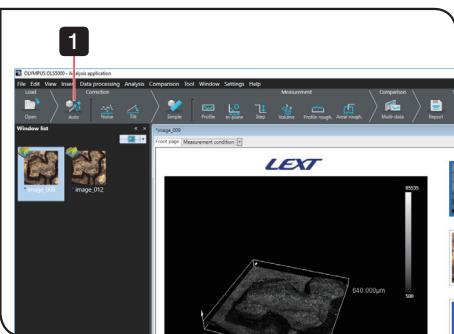


TIP

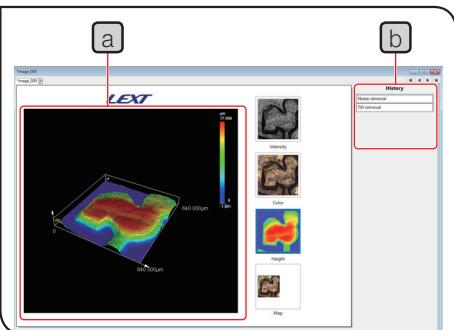
You can also return image data to original image data by right-clicking on the data processing in [Data processing history] on the data view window to display the menu, and selecting [Undo].

5-2 Auto correction

5-2-1 Removing the noise and the tilt automatically



- 1 Click the [Auto] button.

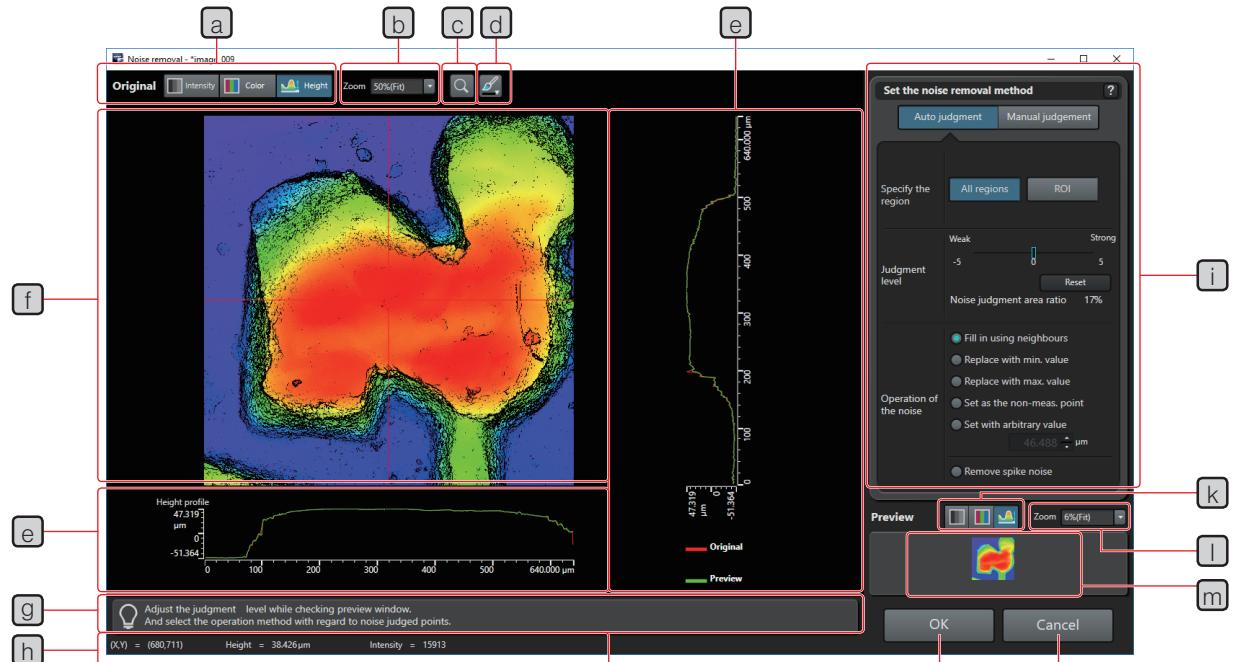


The image where the noise and the tilt are removed is displayed on the image view area **a** on the data view window.

[Noise removal] and [Tilt removal] are added to the [Data processing history] **b** on the data view window.

5-3 Noise removal

5-3-1 Screens used with the noise removal



[a] 2D image data selection button

Selects either the laser intensity image, the color image or the height image on the 2D image view area.

[b] Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

[c] Loupe button

Zooms in the mouse pointer position on the 2D image view area.

[d] Color button

Displays the color pallet for setting the color of the measurement line and the profile displayed on the 2D image view area **[f]**.

[e] Profile view area

Displays the profile of the measurement line position on the 2D image view area. You can change the data type to display using the 2D image data selection button **[a]**.

[f] 2D image view area

Displays the 2D image.

Dragging the measurement line on the image updates the profile **[e]**.

Rotating the mouse wheel on the image zooms in or out the image.

You can change the color of the measurement line. Use the color button **[d]** to display the color pallet.

[g] Information area

Displays the explanation of functions and operating procedures.

[h] Status bar

Displays information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area.

[i] Data processing setting area

Sets the contents of the data processing.

[j] Preview image data selection button

Selects either the laser intensity image, the color image or the height image on the preview image view area.

[k] Magnification dropdown list

Select the magnification to display the image on the preview image view area. Or input the numerical value.

[l] Preview image view area

Displays the preview image based on settings of the data processing.

Rotating the mouse wheel on the image zooms in or out the image.

[n] [OK] button

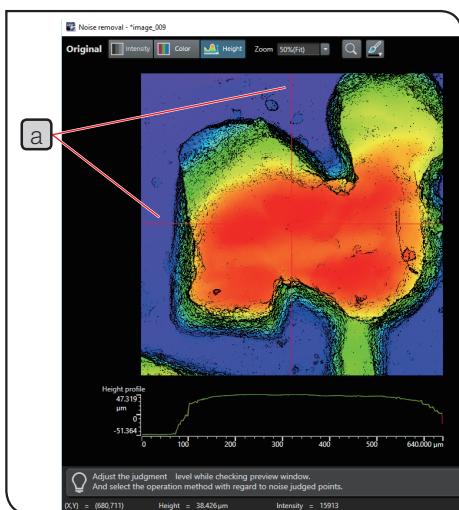
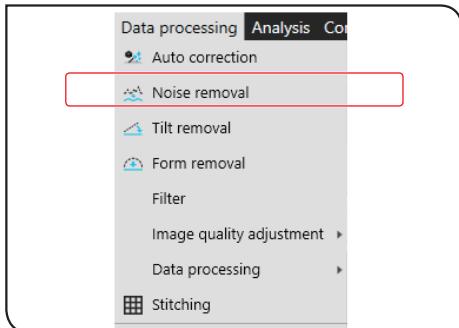
Performs the data processing based on settings.

[o] [Cancel] button

Cancels the data processing.

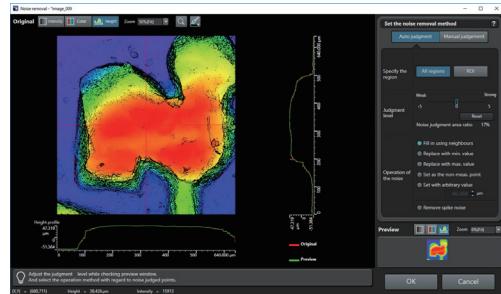
5-3-2 Removing the noise automatically

You can remove the noise from height data or laser intensity data automatically by selecting the noise judgment level or the noise processing method.



- 1** Select [Noise removal] from the [Data processing] menu.

The [Noise removal] screen appears.



- 2** Make sure that the [Auto judgement] button is selected.

- 3** Move the measurement line **a** to the position you want to see the profile of the height or the intensity.

- 4** To specify the region to remove the noise, click the [ROI] button to display the [Set the region] screen, and add the ROI. If no region is specified, the noise is removed from all regions.

TIP For adding the ROI, see “Adding the ROI” (page 399).

- 5** While looking at the profile, specify the noise removal level using the [Judgment level] slider.

The original profile is displayed in the same color as that of the measurement line, and the profile after data processing is displayed in green. If the original profile is same as the profile after data processing, the profile is displayed in green.

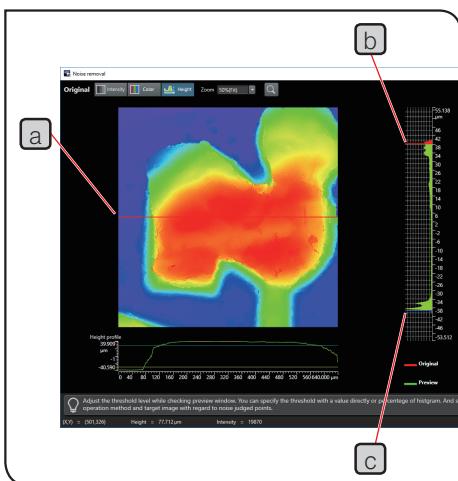
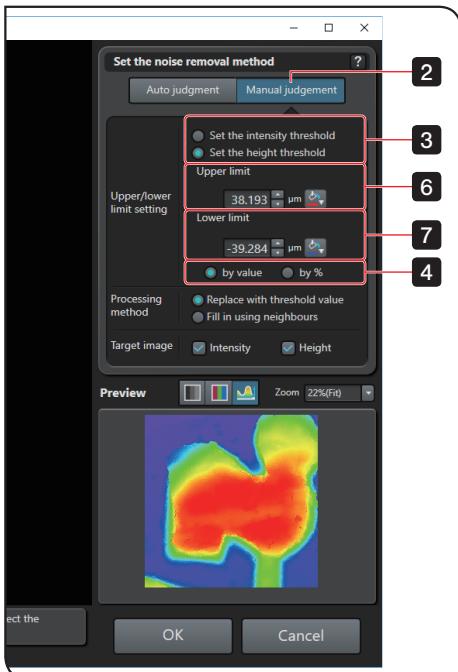
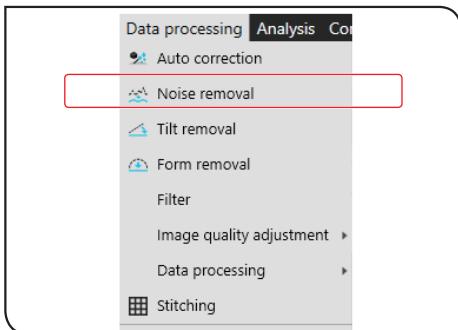
- 6** Select the processing method for the position judged as a noise in [Operation of the noise].

TIP [Remove spike noise] removes the noise by detecting the outliers of uneven surface data and interpolating the unevenness.

- 7** Click the [OK] button to close the [Noise removal] screen.

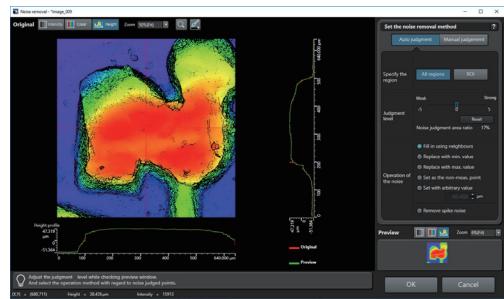
5-3-3 Removing the noise manually

You can remove the noise from height data or laser intensity data by setting the upper threshold (upper limit) and the lower threshold (lower limit).



- Select [Noise removal] from the [Data processing] menu.

The [Noise removal] screen appears.



- Click the [Manual judgement] button.
- Select either laser intensity data or height data you want to perform the data processing from the radio button.
- Select the data value or the ratio you want to use for specifying the upper limit or the lower limit from the radio button.
- Move the measurement line **a** to the position you want to see the profile of the height or the intensity.
- Set the upper threshold in [Upper limit].

If you change the value, the upper limit bar **b** of the histogram moves.

You can also change the upper limit value by dragging the histogram bar **b**.

- TIP**
- To change the color of the upper limit bar, click the color button of the [Upper limit] setting field to display the color pallet, and select the color.
 - The range exceeding the threshold (upper limit) of the histogram is displayed in the same color as that of the upper limit bar.

- Set the lower threshold in [Lower limit].

If you change the value, the lower limit bar **c** of the histogram moves.

You can also change the lower limit value by dragging the bar **c** of the histogram.

- TIP**
- To change the color of the lower limit bar, click the color button of the [Lower limit] setting field to display the color pallet, and select the color.
 - The area lower than the threshold (lower limit) of the histogram is displayed in the same color as that of the lower limit bar.

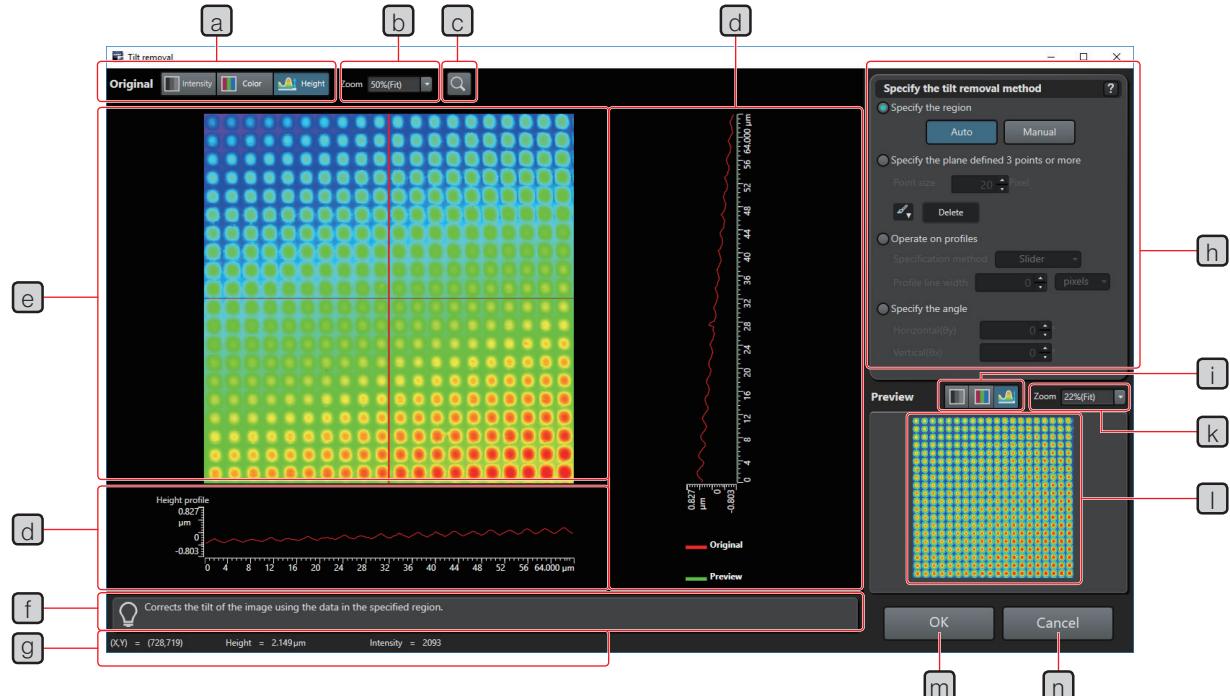
- TIP**
- If you change the upper and the lower thresholds, the data processing is reflected to the profile as well.



- 8 Select the processing method for the position judged as a noise in [Processing method].
- 9 Check the checkbox of data you want to process.
- 10 Click the [OK] button to close the [Noise removal] screen.

5-4 Tilt removal

5-4-1 Screens used with the tilt removal



[a] 2D image data selection button

Selects either the laser intensity image, the color image or the height image on the 2D image view area.

[b] Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

[c] Loupe button

Zooms in the mouse pointer position on the 2D image view area.

[d] Profile view area

Displays the profile of the measurement line position on the 2D image view area. You can change the data type to display on this area using the 2D image data selection button [a].

[e] 2D image view area

Displays the 2D image.
Dragging the measurement line on the image updates the profile [d].
Rotating the mouse wheel on the image zooms in or out the image.

[f] Information area

Displays the explanation of functions and operating procedures.

[g] Status bar

Displays information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area.

[h] Data processing setting area

Sets the contents of the data processing.

[i] Preview image data selection button

Selects either the laser intensity image, the color image or the height image on the preview image view area.

[k] Magnification dropdown list

Select the magnification to display the image on the preview image view area. Or input the numerical value.

[l] Preview image view area

Displays the preview image based on settings of the data processing.
Rotating the mouse wheel on the image zooms in or out the image.

[m] [OK] button

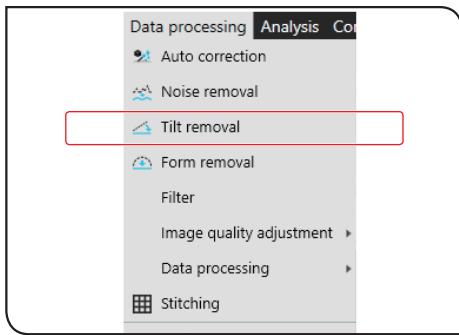
Performs the data processing based on settings.

[n] [Cancel] button

Cancels the data processing.

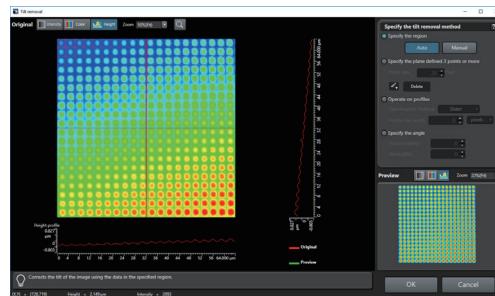
5-4-2 Removing the tilt

You can remove the tilt of height data.



1 Select [Tilt removal] from the [Data processing] menu.

The [Tilt removal] screen appears.



2 Specify the tilt removal method.

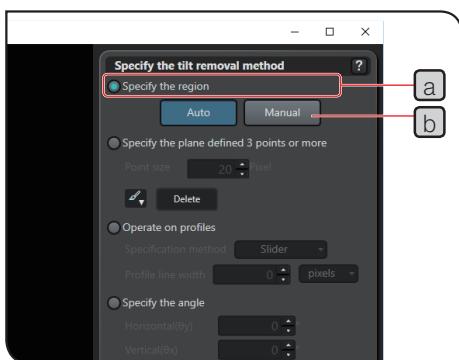
There are four methods to remove the tilt as described below.

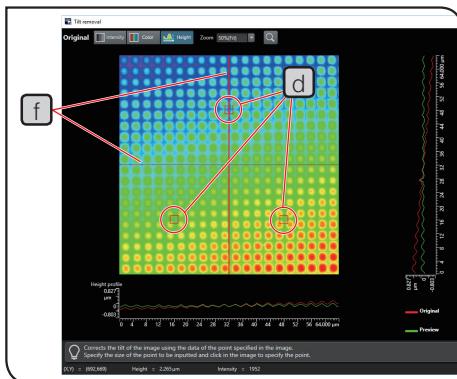
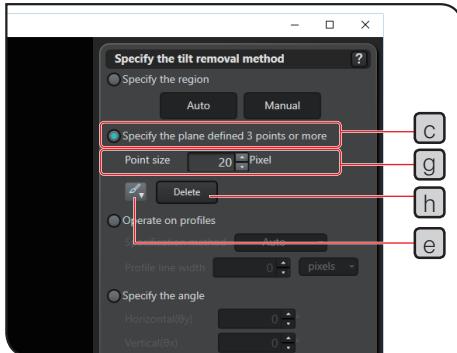
- Remove the tilt automatically.
- Specify the base surface on the 2D image.
- Specify the removal contents on the profile.
- Specify the angle.

Removing the tilt automatically

1. Select the [Specify the region] radio button **a**.
2. To specify the region to remove the tilt, click the [Manual] button **b** to display the [Set the region] screen, and add the ROI.

TIP For adding the ROI, see “Adding the ROI” (page 399).





Specifying the base surface on the 2D image

You can remove the tilt by setting the average of the height of the polygon (base surface) that connects points specified on the 2D image as a height of the base surface and also making the base surface horizontal.

1. Select the [Specify the plane defined 3 points or more] radio button **c**.

Three points **d** for specifying the polygon are displayed on the 2D image view area.

TIP • It may be difficult to identify the point on the 2D image depending on height data. However, it could be easier to identify it by changing the color of the point.

• To change the color of the point, click the color button **e** to display the color pallet, and select the color.

2. Move the measurement line **f** on the 2D image to the position you want to see the profile of the height.

The original profile is displayed in the same color as that of the measurement line, and the profile after data processing is displayed in green. If the original profile is same as the profile after data processing, the profile is displayed in green.

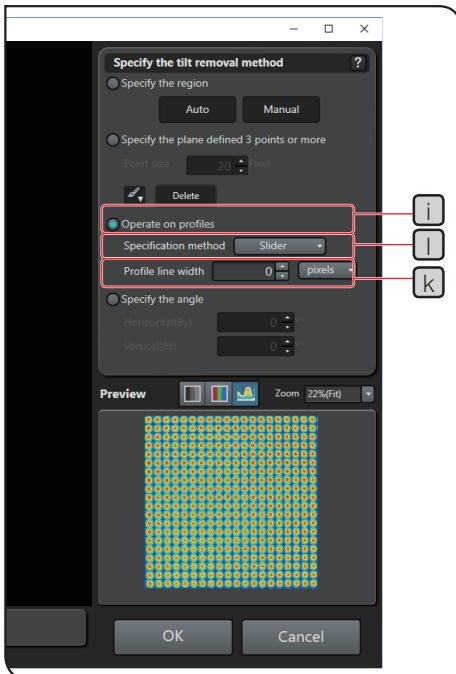
3. To average the height of the periphery of the point, specify the pixels you want to average in the [Point size] setting field **g**.

TIP It could be easier to identify the point position on the 2D image by enlarging pixels. It is recommended to enlarge the pixels temporarily and adjust the point position first and then set the necessary number of pixels.

4. To add points, click the position where you want to add points on the 2D image.

TIP • To delete points, click the point on the 2D image to select it, and click the [Delete] button **h**.

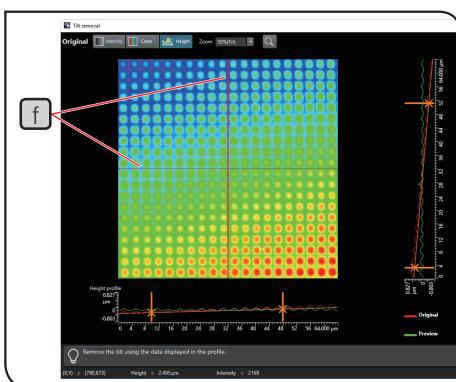
• You can delete points only when there are four points or more on the 2D image.

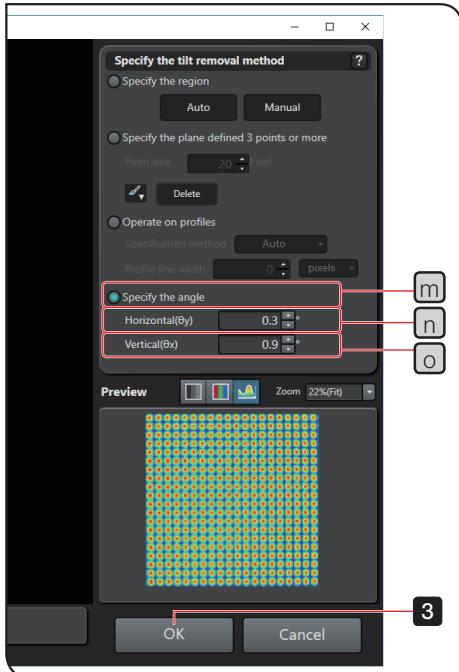


Specifying the correction contents on the profile

You can remove the tilt based on the profile of the height.

1. Select the [Operate on profiles] radio button **i**.
2. Move the measurement line **f** on the 2D image to the position you want to see the profile of the height.
The original profile is displayed in the same color as that of the measurement line, and the profile after data processing is displayed in green. If the original profile is same as the profile after data processing, the profile is displayed in green.
3. If you use the profile of the X-axis, click the measurement line **f** on the X-axis to select it. If you use the profile of the Y-axis, click the measurement line **f** on the Y-axis to select it.
4. Select either the length or the pixel in the [Profile line width] setting field **k** to specify the line width.
As the profile is created using the average width, you can make the profile with less noise by increasing the line width. If you increase the line width, the measurement line width is masked.
5. To remove the tilt automatically, select [Auto] from the [Specification method] dropdown list **l**.
6. To specify a point at an arbitrary position on the profile, select [Point] from the [Specification method] dropdown list **l**, click 2 positions on the profile to create a line, and align the line with the tilt of the profile.
7. To specify two sliders according to the profile line on the profile, select [Slider] from the [Specification method] dropdown list **l** and drag the slider on the profile.



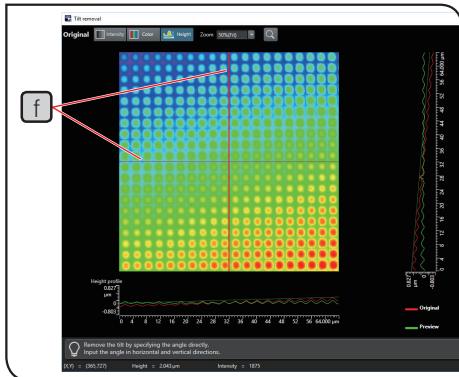


Specifying the angle

You can remove the tilt by specifying the angle.

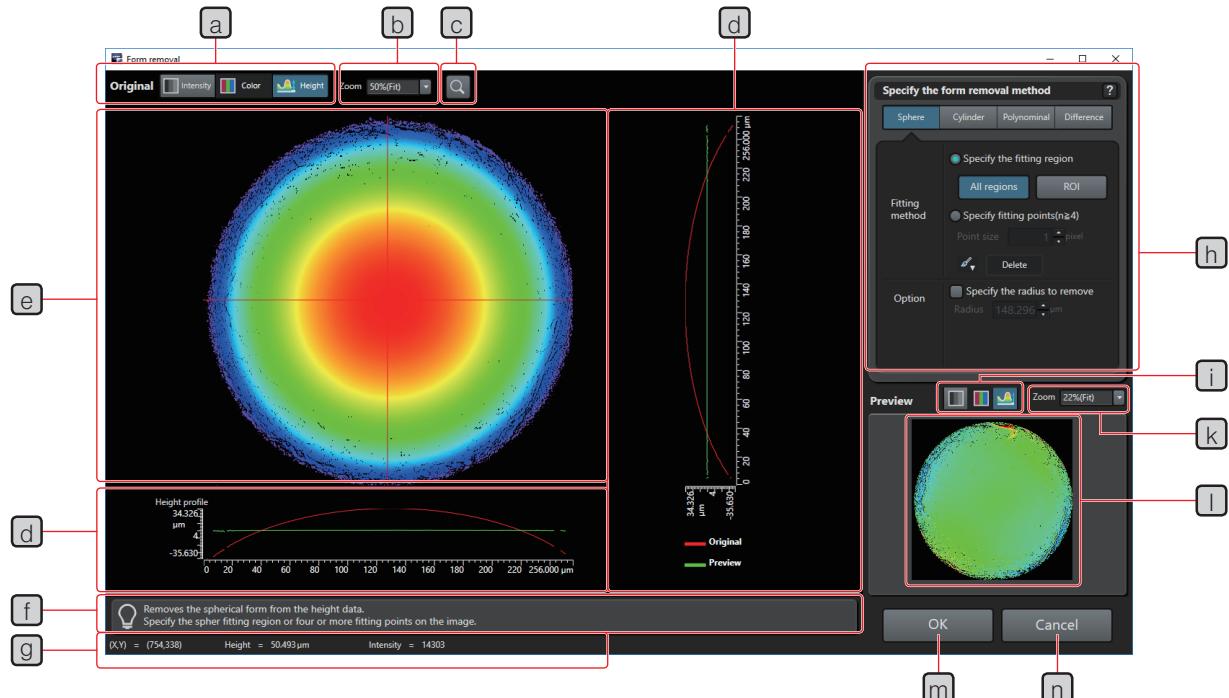
1. Select the [Specify the angle] radio button **m**.
The green line indicating the angle is displayed on the profile of the height.
2. Move the measurement line **f** on the 2D image to the position you want to see the profile of the height.
The original profile is displayed in the same color as that of the measurement line, and the profile after data processing is displayed in green. If the original profile is same as the profile after data processing, it is displayed in green.
3. Set the correction angle in horizontal direction in the [Horizontal] setting field **n**.
4. Set the correction angle in vertical direction in the [Vertical] setting field **o**.

- 3** Click the [OK] button to close the [Tilt removal] screen.



5-5 Form removal

5-5-1 Screens used with the form removal



[a] 2D image data selection button

Selects either the laser intensity image, the color image or the height image on the 2D image view area.

[b] Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

[c] Loupe button

Zooms in the mouse pointer position on the 2D image view area.

[d] Profile view area

Displays the profile of the measurement line position on the 2D image view area. You can change the data type to display on this area using the 2D image data selection button [a].

[e] 2D image view area

Displays the 2D image. Dragging the measurement line on the image updates the profile [d].

Rotating the mouse wheel on the image zooms in or out the image.

[f] Information area

Displays the explanation of functions and operating procedures.

[g] Status bar

Displays information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area.

[h] Data processing setting area

Sets the contents of the data processing.

[i] Preview image data selection button

Selects either the laser intensity image, the color image or the height image on the preview image view area.

[k] Magnification dropdown list

Select the magnification to display the image on the preview image view area. Or input the numerical value.

[l] Preview image view area

Displays the preview image based on settings of the data processing. Rotating the mouse wheel on the image zooms in or out the image.

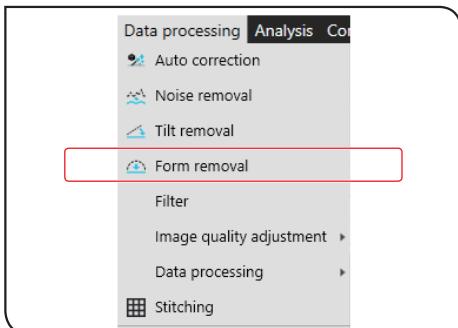
[m] [OK] button

Performs the data processing based on settings.

[n] [Cancel] button

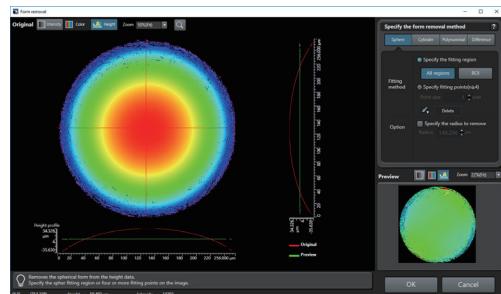
Cancels the data processing.

5-5-2 Removing the spherical form from height data



1 Select [Form removal] from the [Data processing] menu.

The [Form removal] screen appears.

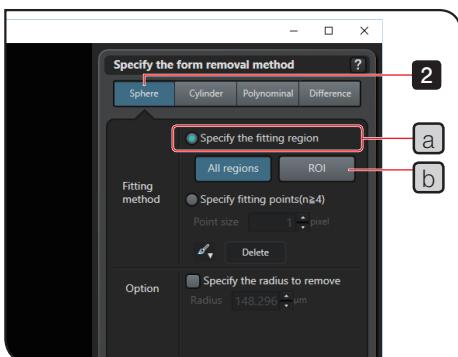


2 Make sure that the [Sphere] button is selected.

3 Select the detection method of the spherical form.

There are two methods to detect the spherical form as described below.

- Specify the correction region.
- Specify the detection point.

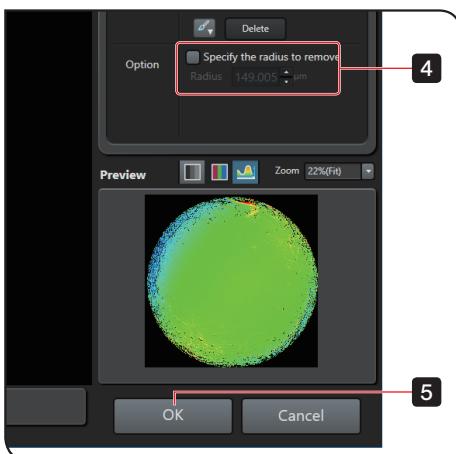
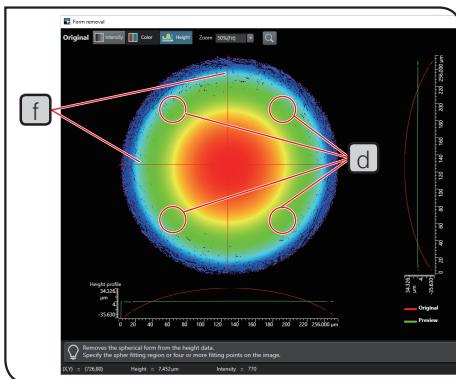
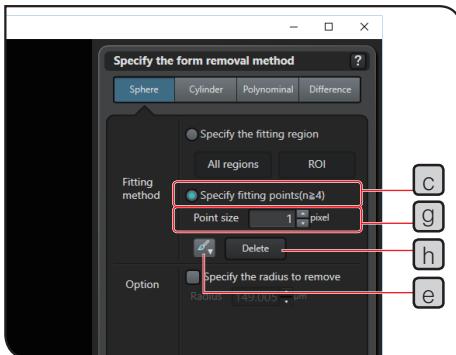


Specifying the correction region

You can detect the spherical form from the specified region on the 2D image and remove it. If no region is specified, the spherical form is detected from all regions.

1. Select the [Specify the fitting region] radio button **a**.
2. To specify the region to detect the shape, click the [ROI] button **b** to display the [Set the region] screen, and add the ROI.

TIP For adding the ROI, see "Adding the ROI" (page 399).



Specifying the detection point on the 2D image

You can detect the spherical form from height data of the point position specified on the 2D image and remove it.

1. Select the [Specify fitting points] radio button **c**.

The four points **d** for detecting the form are displayed on the 2D image view area.

TIP

- It may be difficult to identify the point on the 2D image depending on height data. However, it could be easier to identify it by changing the color of the point.
- To change the color of the point, click the color button **e** to display the color pallet, and select the color.

2. Move the measurement line **f** on the 2D image to the position you want to see the profile of the height.

The original profile is displayed in the same color as that of the measurement line, and the profile after data processing is displayed in green. If the original profile is same as the profile after data processing, the profile is displayed in green.

3. To average the height of the periphery of the point, specify the pixels you want to average in the [Point size] setting field **g**.

TIP

It could be easier to identify the point position on the 2D image by enlarging pixels. It is recommended to enlarge the pixels temporarily and adjust the point position first and then set the necessary number of pixels.

4. To add points, click the position where you want to add points on the 2D image.

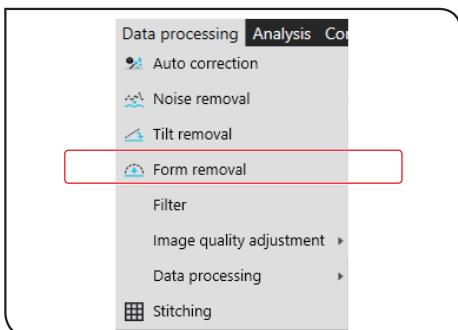
TIP

- To delete points, click the point on the 2D image to select it, and click the [Delete] button **h**.
- You can delete points only when there are five points or more on the 2D image.

- 4 To specify the radius of the sphere, check the [Specify the radius to remove] checkbox and set the radius in the [Radius] setting field.

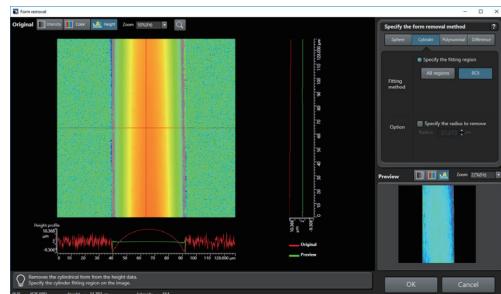
- 5 Click the [OK] button to close the [Form removal] screen.

5-5-3 Removing the cylindrical form from height data



1 Select [Form removal] from the [Data processing] menu.

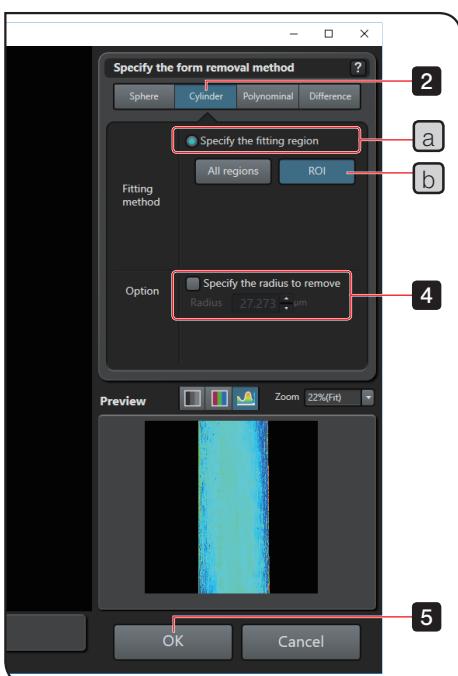
The [Form removal] screen appears.



2 Click the [Cylinder] button.

3 To specify the region you want to detect the cylindrical form, click the [ROI] button **a** to display the [Set the region] screen, and add the ROI. If no region is specified, the cylindrical form is detected from all regions.

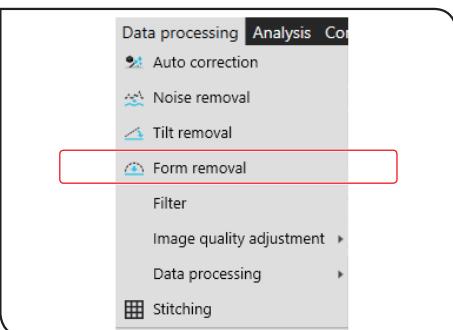
TIP For adding the ROI, see “Adding the ROI” (page 399).



4 To specify the radius of the cylinder, check the [Specify the radius to remove] checkbox and set the radius in the [Radius] setting field.

5 Click the [OK] button to close the [Form removal] screen.

5-5-4 Removing the wave from height data

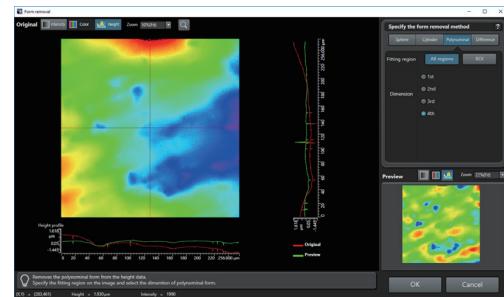


Point

- This function is useful for removing the gentle form from data.
- The higher the degree becomes, the higher the effect of the form removal becomes.

1 Select [Form removal] from the [Data processing] menu.

The [Form removal] screen appears.



2 Click the [Polynomial] button.

3 To specify the region to detect the curved surface, click the [ROI] button **b** to display the [Set the region] screen, and add the ROI. If no region is specified, the curved surface is detected from all regions.

TIP For adding the ROI, see "Adding the ROI" (page 399).

4 Select the curved surface you want to delete from the [Dimension] radio button.

[1st]: Detects the primary curved surface shape and removes it.

[2nd]: Detects the quadratic curved surface shape and removes it.

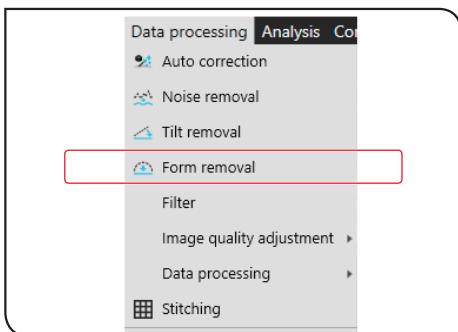
[3rd]: Detects the third-degree curved surface shape and removes it.

[4th]: Detects the fourth-degree curved surface shape and removes it.

5 Click the [OK] button to close the [Form removal] screen.



5-5-5 Removing the form of the reference image from height data



5

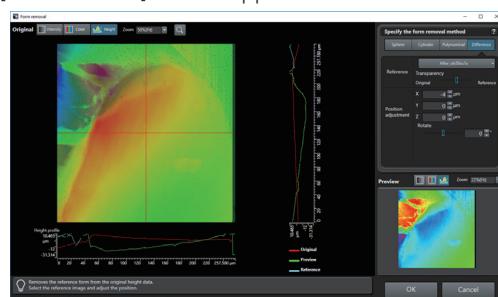
- Open the image file to perform the data processing. Also, open the image (reference image) file that will be a reference for difference.

TIP For opening the file, see "Opening the file" (page 16).

- Display the data view window of the image file to perform the data processing on the front.

- Select [Form removal] from the [Data processing] menu.

The [Form removal] screen appears.



- Click the [Difference] button .

- Select the reference image from the [Reference image] dropdown list.

TIP The dropdown list shows the list of image files currently opened.

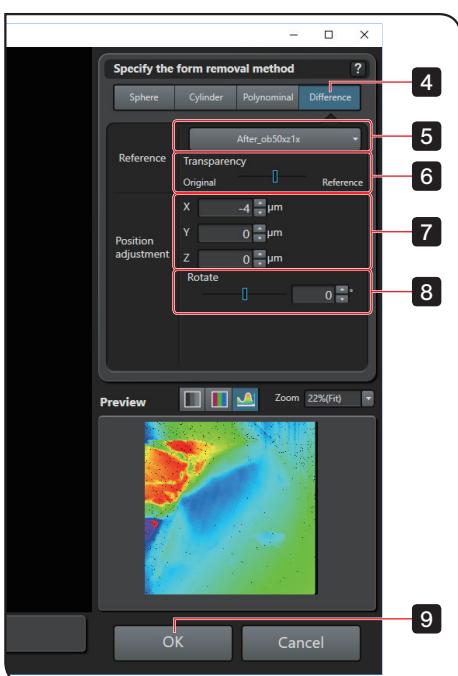
- To change the transparency ratio of the reference image displayed on the 2D image view area to the image to perform the data processing, adjust the ratio using the [Transparency] slider.

TIP The more you move the slider to the left, the thicker the view of the image to perform the data processing becomes.

- Comparing the reference image displayed on the 2D image view area with the image to perform the data processing, adjust the position of the image to perform the data processing in each setting field of [Position adjustment].

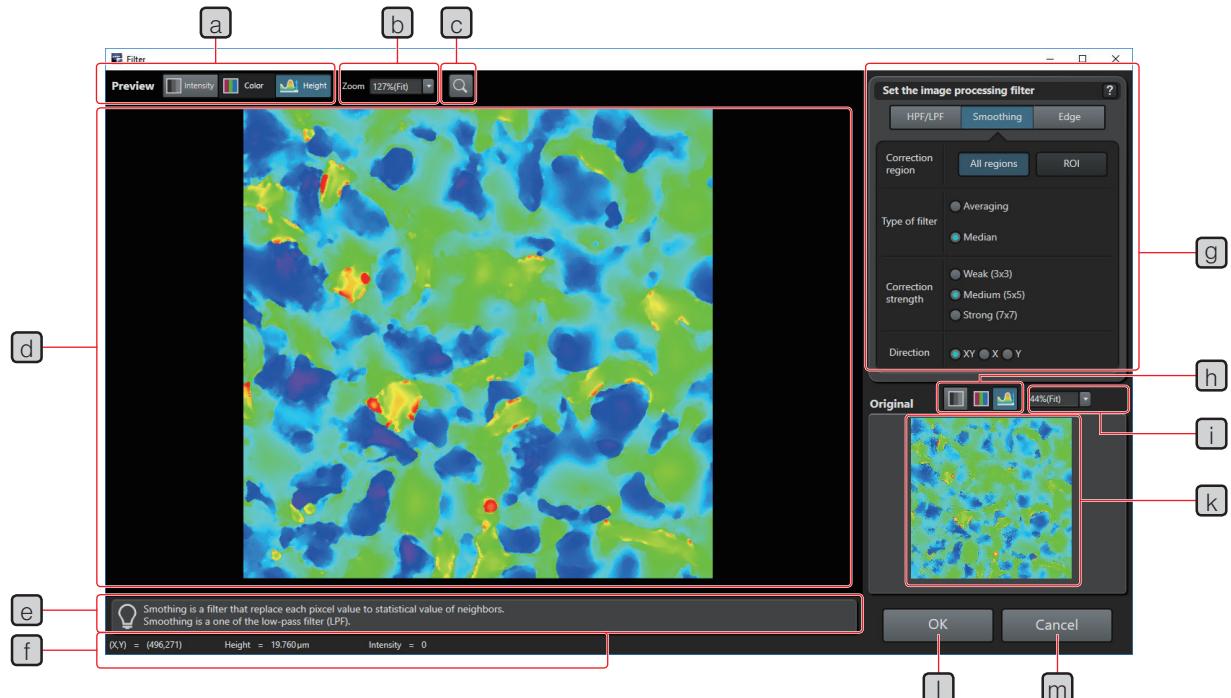
- Use the [Rotate] slider to set the rotation angle of the image to perform the data processing.

- Click the [OK] button to close the [Form removal] screen.



5-6 Filter processing

5-6-1 Screens used with the filter processing



[a] 2D image data selection button

Selects either the laser intensity image, the color image or the height image on the 2D image view area.

[b] Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

[c] Loupe button

Zooms in the mouse pointer position on the 2D image view area.

[d] 2D image view area

Displays the 2D image.
Rotating the mouse wheel on the image zooms in or out the image.

[e] Information area

Displays the explanation of functions and operating procedures.

[f] Status bar

Displays information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area.

[g] Data processing setting area

Sets the contents of the data processing.

[h] Original image data selection button

Selects either the laser intensity image, the color image or the height image on the original image view area.

[i] Magnification dropdown list

Select the magnification to display the image on the original image view area. Or input the numerical value.

[k] Original image view area

Displays the original image before data processing.
Rotating the mouse wheel on the image zooms in or out the image.

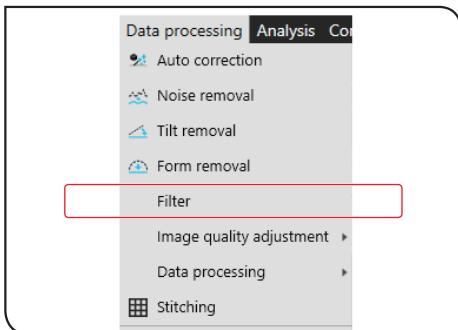
[l] [OK] button

Performs the data processing based on settings.

[m] [Cancel] button

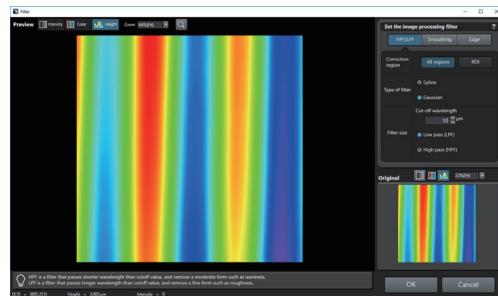
Cancels the data processing.

5-6-2 Applying the high pass filter or the low pass filter



1 Select [Filter] from the [Data processing] menu.

The [Filter] screen appears.



2 Click the [HPF/LPF] button.

3 To specify the region to perform the filter processing, click the [ROI] button to display the [Set the region] screen, and add the ROI. If no region is specified, the filter processing is performed for all regions.

TIP For adding the ROI, see “Adding the ROI” (page 399).

4 Select the filter type radio button.

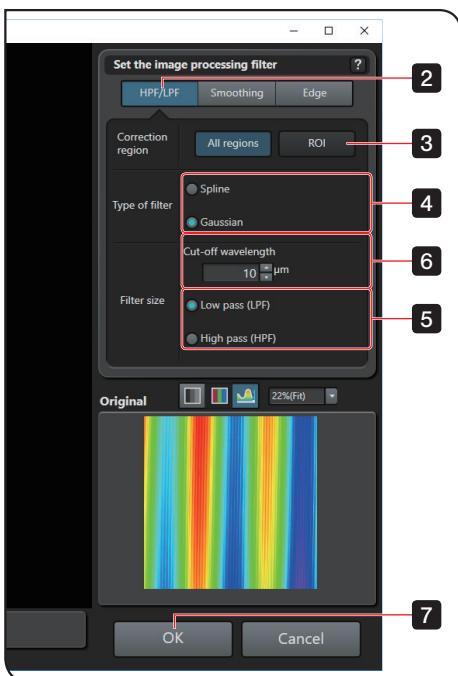
5 Select the radio button of the wavelength to set the cut off.

6 Select the frequency band for cutting the wavelength.

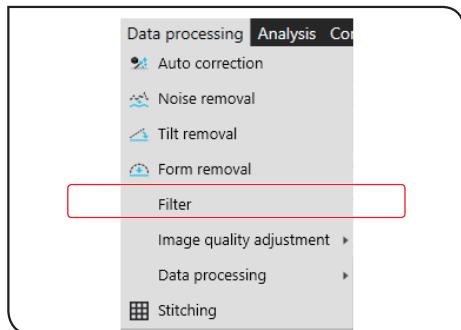
[Low pass (LPF)]: Removes the small variation from height data.

[High pass (HPF)]: Removes the large variation from height data.

7 Click the [OK] button to close the [Filter] screen.

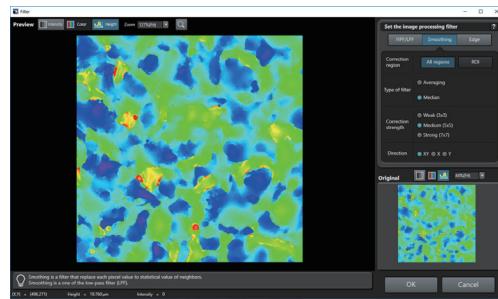


5-6-3 Applying the smoothing filter



- 1 Select [Filter] from the [Data processing] menu.

The [Filter] screen appears.



- 2 Make sure that the [Smoothing] button is selected.

- 3 To specify the region to perform the filter processing, click the [ROI] button to display the [Set the region] screen, and add the ROI. If no region is specified, the filter processing is performed for all regions.

TIP For adding the ROI, see "Adding the ROI" (page 399).

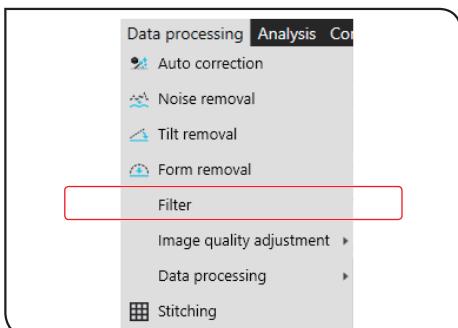
- 4 Select the filter type radio button.

- 5 Select the radio button of the strength of the filter processing.

- 6 Select the radio button of the direction of the filter processing.

- 7 Click the [OK] button to close the [Filter] screen.

5-6-4 Applying the edge enhancement filter

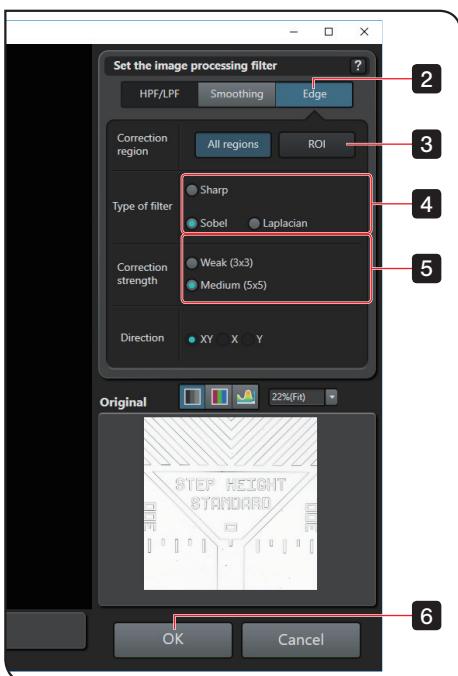
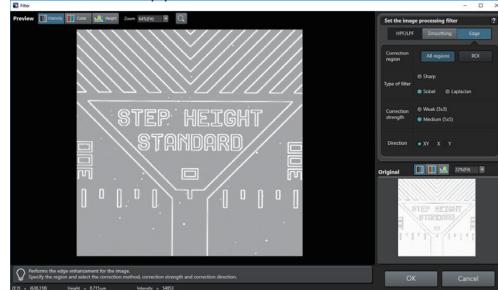


Point

Be sure to apply the edge enhancement filter mainly to the laser intensity image or the color image. Be careful, if you apply it to the height image, the height data changes significantly.

- Select [Filter] from the [Data processing] menu.

The [Filter] screen appears.



- Click the [Edge] button.

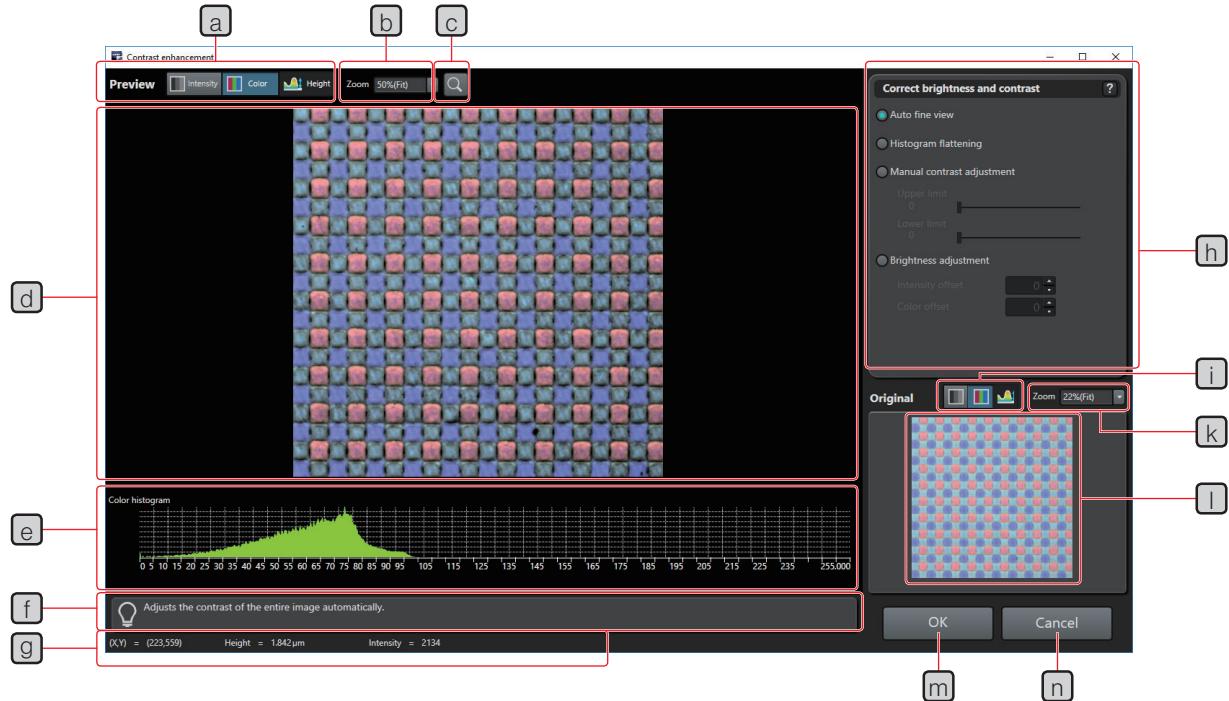
- To specify the region to perform the filter processing, click the [ROI] button to display the [Set the region] screen, and add the ROI. If no region is specified, the filter processing is performed for all regions.

TIP For adding the ROI, see “Adding the ROI” (page 399).

- Select the filter type radio button.
- Select the radio button of the strength of the filter processing.
- Click the [OK] button to close the [Filter] screen.

5-7 Image quality improvement

5-7-1 Screens used with image quality improvement



[a] 2D image data selection button

Selects either the laser intensity image or the color image on the 2D image view area.

[b] Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

[c] Loupe button

Zooms in the mouse pointer position on the 2D image view area.

[d] 2D image view area

Displays the 2D image.

Rotating the mouse wheel on the image zooms in or out the image.

[e] Histogram view area

Displays the histogram of the laser intensity data or color data.

[f] Information area

Displays the explanation of functions and operating procedures.

[g] Status bar

Displays information of the mouse pointer position (X

coordinate, Y coordinate, height and laser intensity) on the 2D image view area.

[h] Data processing setting area

Sets the contents of the data processing.

[i] Original image data selection button

Selects either the laser intensity image or the color image on the original image view area.

[k] Magnification dropdown list

Select the magnification to display the image on the original image view area. Or input the numerical value.

[l] Original image view area

Displays the original image before data processing. Rotating the mouse wheel on the image zooms in or out the image.

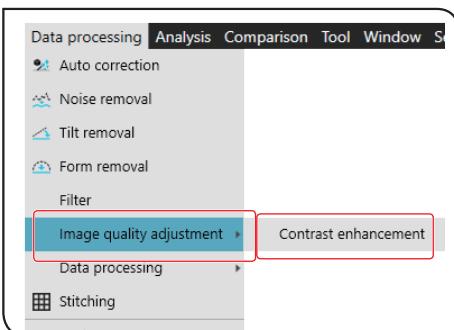
[m] [OK] button

Performs the data processing based on settings.

[n] [Cancel] button

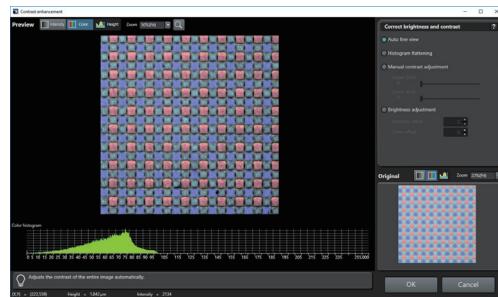
Cancels the data processing.

5-7-2 Adjusting the brightness and the contrast



- 1** Select [Image quality adjustment] from the [Data processing] menu and select [Contrast enhancement].

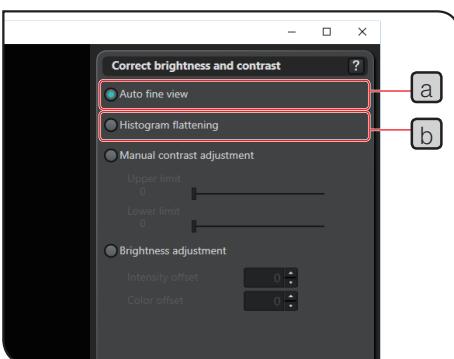
The [Contrast enhancement] screen appears.



- 2** Adjust the brightness and the contrast.

There are four methods to adjust the brightness and the contrast as described below.

- Use the auto fine view.
- Flatten the histogram.
- Adjust the contrast manually.
- Adjust the brightness.



Using the auto fine view

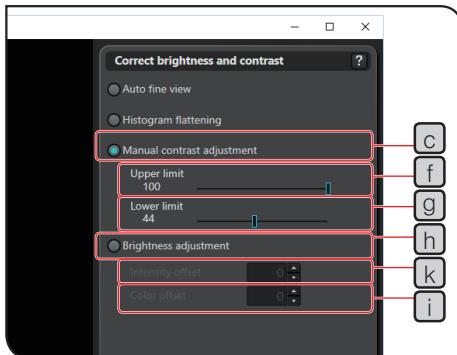
You can adjust the contrast of the entire image automatically.

1. Make sure that the [Auto fine view] radio button **a** is selected.

Flattening the histogram

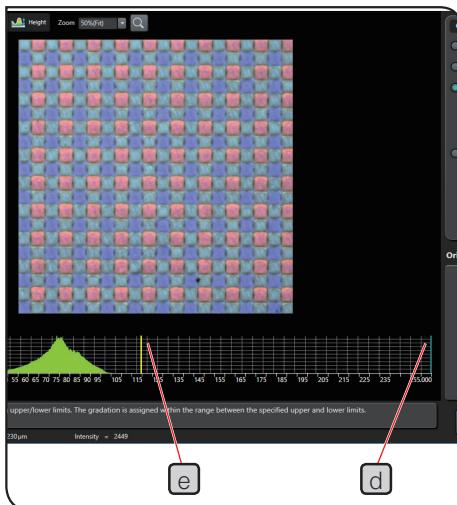
You can flatten the area where the intensity or the color is concentrated on the histogram.

1. Select the [Histogram flattening] radio button **b**.



Adjusting the contrast manually

1. Select the [Manual contrast adjustment] radio button **c**. The upper limit bar **d** and the lower limit bar **e** of the contrast are displayed on the histogram.
2. Looking at the histogram, use the [Upper limit] slider **f** to set the upper limit of the contrast.
You can also change the upper limit value by dragging the upper limit bar **d**.
3. Looking at the histogram, use the [Lower limit] slider **g** to set the lower limit of the contrast.
You can also change the lower limit value by dragging the lower limit bar **e**.



Adjusting the brightness

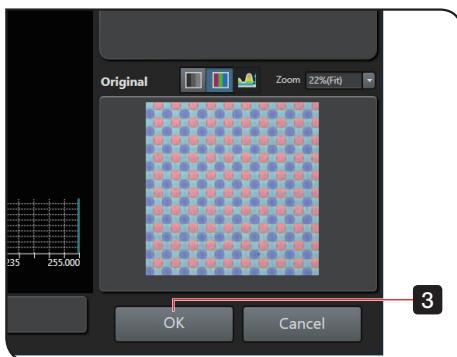
You can adjust the brightness by adding the offset value to color data or laser intensity data.

1. Select the [Brightness adjustment] radio button **h**.
2. To offset color data, set the offset value in the [Color offset] setting field **i**.

TIP You can set [Color offset] only when the color image is displayed on the 2D image view area.
3. To offset laser intensity data, set the offset value in the [Intensity offset] setting field **k**.

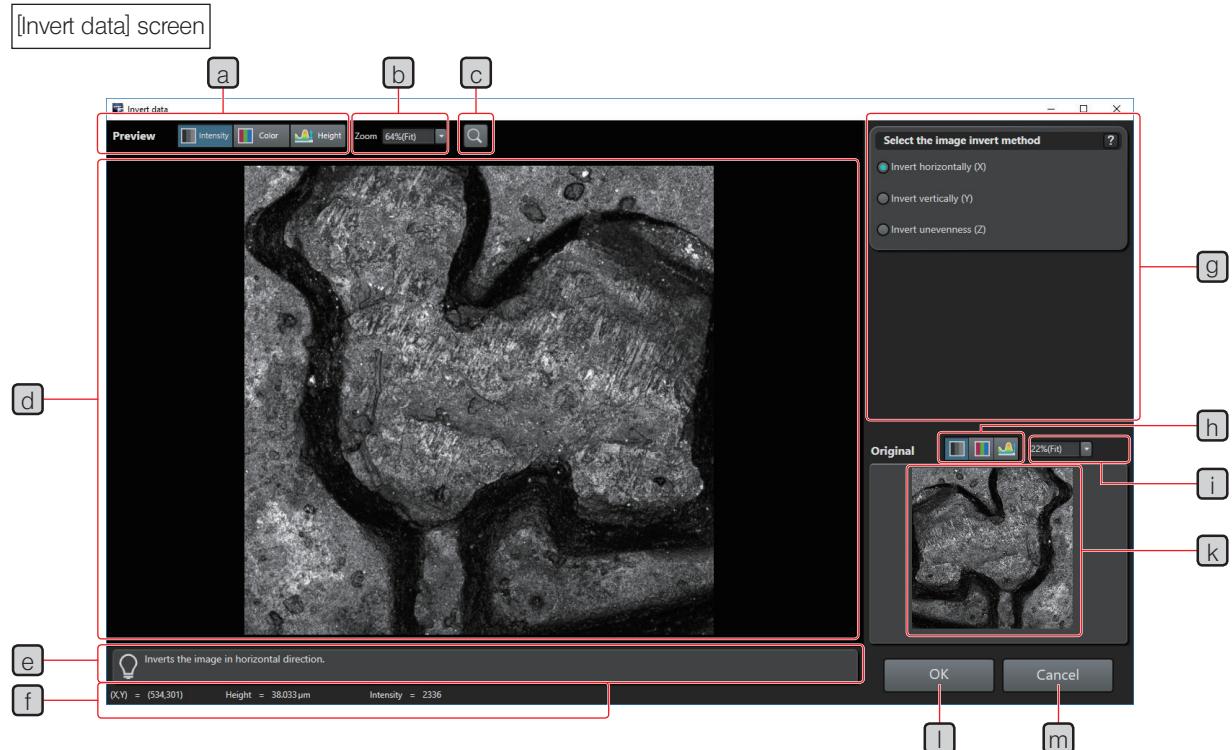
TIP You can set [Intensity offset] only when the laser intensity image is displayed on the 2D image view area.

- 3** Click the [OK] button to close the [Contrast enhancement] screen.



5-8 Data processing

5-8-1 Screens used with the data processing



[a] 2D image data selection button

Selects either the laser intensity image, the color image or the height image on the 2D image view area.

[b] Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

[c] Loupe button

Zooms in the mouse pointer position on the 2D image view area.

[d] 2D image view area

Displays the 2D image.
Rotating the mouse wheel on the image zooms in or out the image.

[e] Information area

Displays the explanation of functions and operating procedures.

[f] Status bar

Displays information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area.

[g] Data processing setting area

Sets the contents of the data processing.

[h] Original image data selection button

Selects either the laser intensity image, the color image or the height image on the original image view area.

[i] Magnification dropdown list

Select the magnification to display the image on the original image view area. Or input the numerical value.

[k] Original image view area

Displays the original image before data processing.
Rotating the mouse wheel on the image zooms in or out the image.

[l] [OK] button

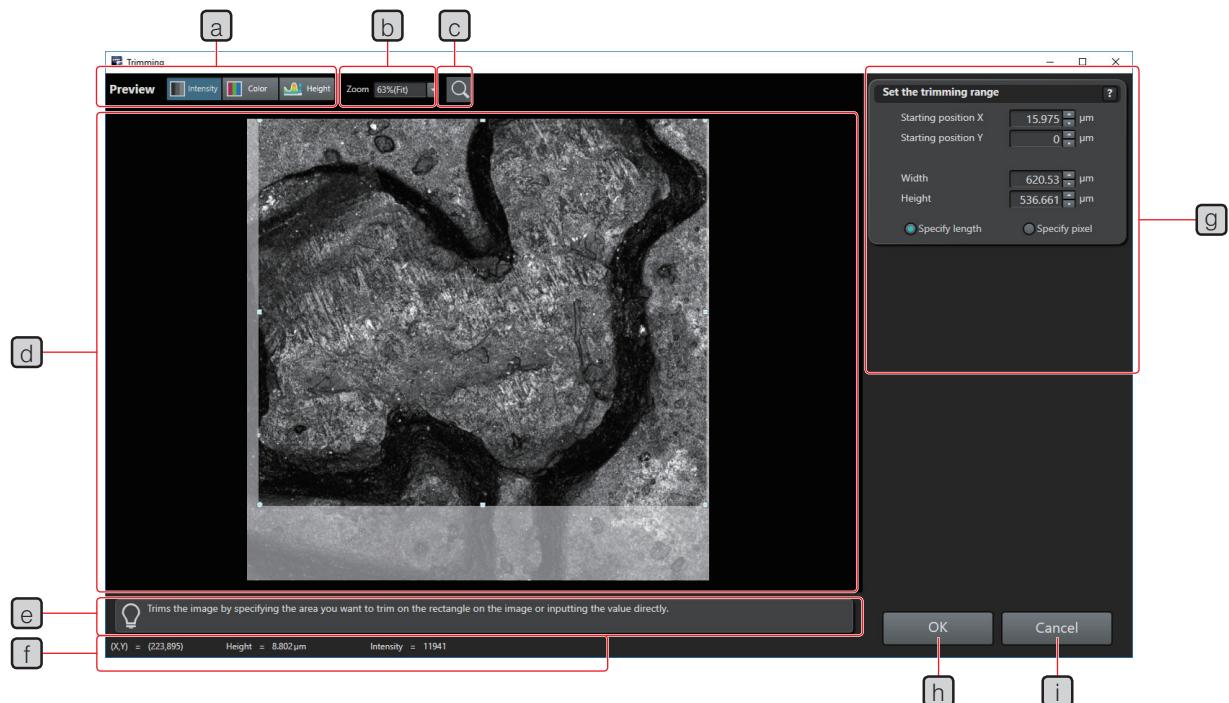
Performs the data processing based on settings.

[m] [Cancel] button

Cancels the data processing.



[Trimming] screen

**[a] 2D image data selection button**

Selects either the laser intensity image, the color image or the height image on the 2D image view area.

[b] Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

[c] Loupe button

Zooms in the mouse pointer position on the 2D image view area.

[d] 2D image view area

Displays the 2D image.
Rotating the mouse wheel on the image zooms in or out the image.

[e] Information area

Displays the explanation of functions and operating procedures.

[f] Status bar

Displays information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area.

[g] Data processing setting area

Sets the contents of the data processing.

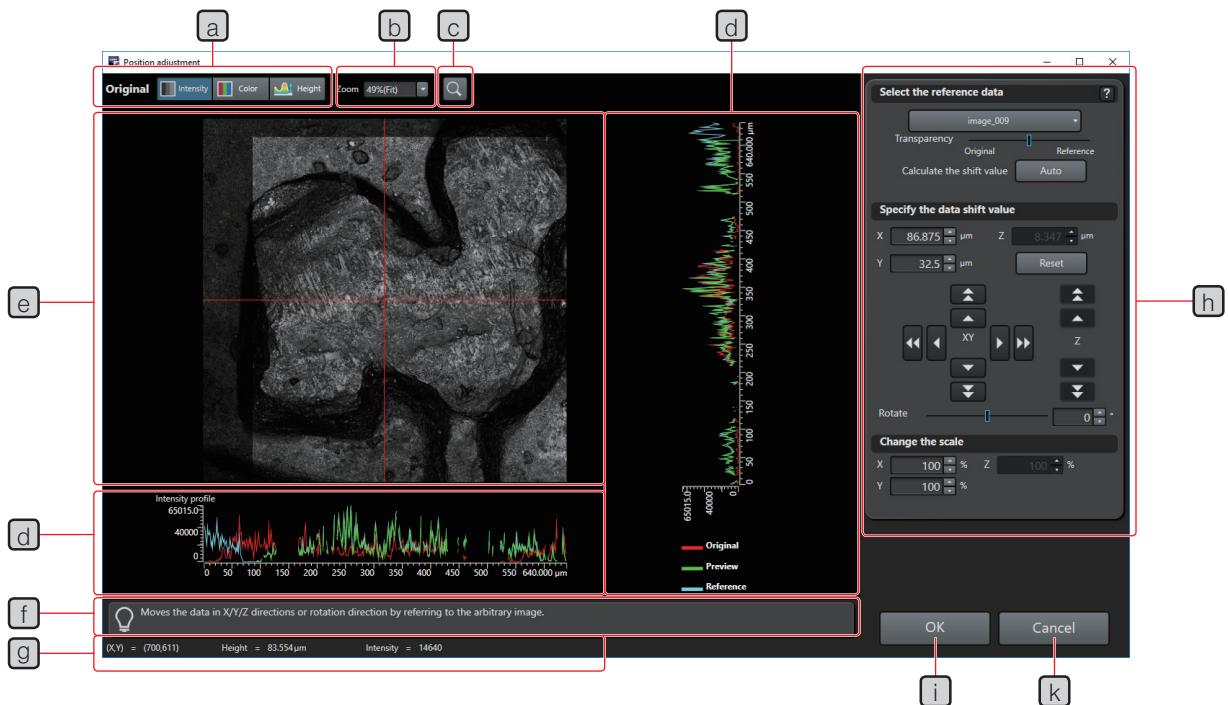
[h] [OK] button

Performs the data processing based on settings.

[i] [Cancel] button

Cancels the data processing.

[Data shifting] screen

**[a] 2D image data selection button**

Selects either the laser intensity image, the color image or the height image on the 2D image view area.

[b] Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

[c] Loupe button

Zooms in the mouse pointer position on the 2D image view area.

[d] Profile view area

Displays the profile of the measurement line position on the 2D image view area. You can change the data type to display using the 2D image data selection button **[a]**.

[e] 2D image view area

Displays the 2D image.

Dragging the measurement line on the image updates the profile **[d]**.

Rotating the mouse wheel on the image zooms in or out the image.

[f] Information area

Displays the explanation of functions and operating procedures.

[g] Status bar

Displays information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area.

[h] Data processing setting area

Sets the contents of the data processing.

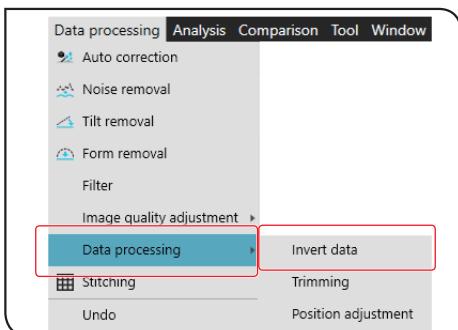
[i] [OK] button

Performs the data processing based on settings.

[k] [Cancel] button

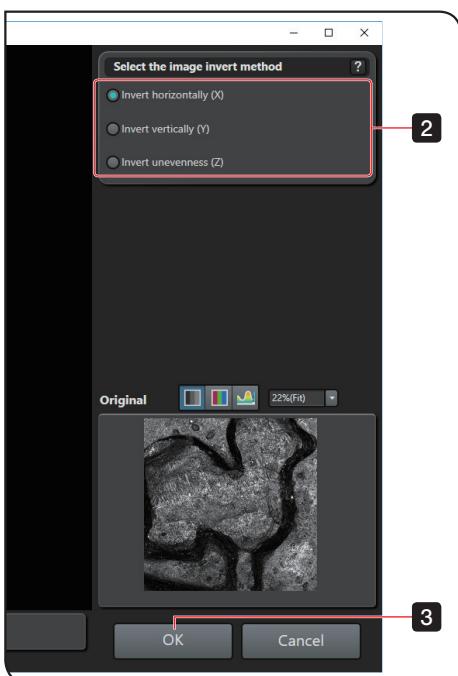
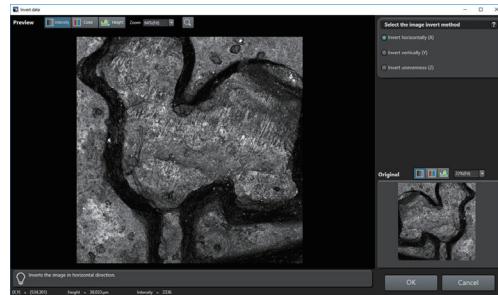
Cancels the data processing.

5-8-2 Inverting the image



- 1** Select [Data processing] from the [Data processing] menu, and select [Invert data].

The [Invert data] screen appears.



- 2** Select the method to invert the image from the radio button.

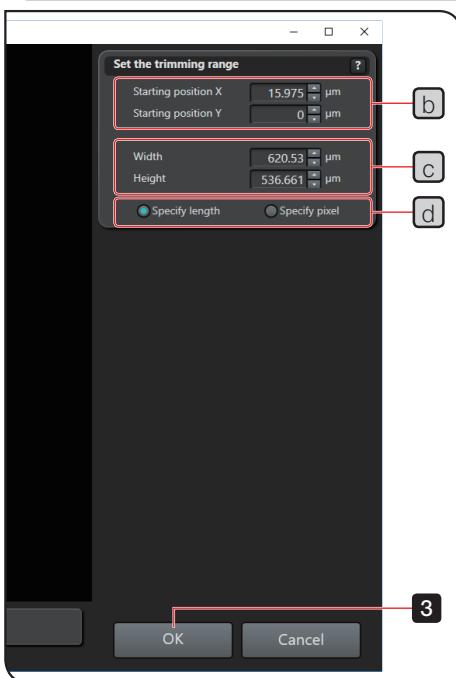
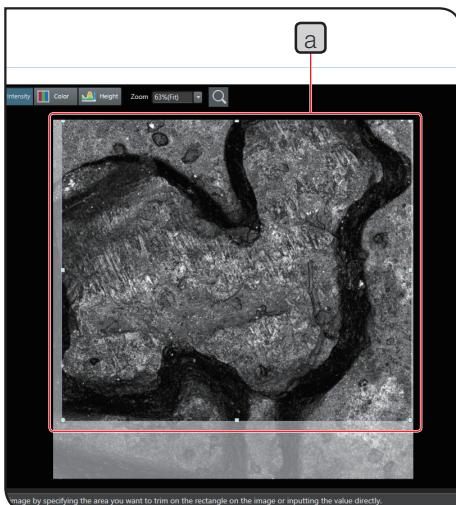
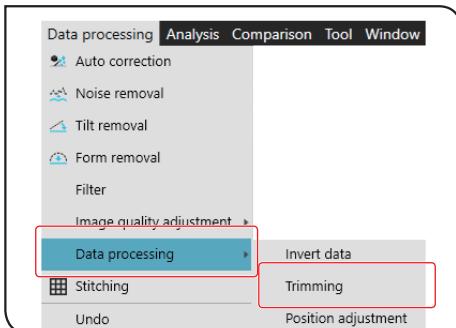
[Invert horizontally]: Inverts image data in horizontal direction.

[Invert vertically]: Inverts image data in vertical direction.

[Invert unevenness]: Inverts the unevenness of image data. When the laser intensity image is displayed on the 2D image view area, the unevenness of laser intensity data inverts. When the color image is displayed, the unevenness of color data inverts. When the height image is displayed, the unevenness of height data inverts.

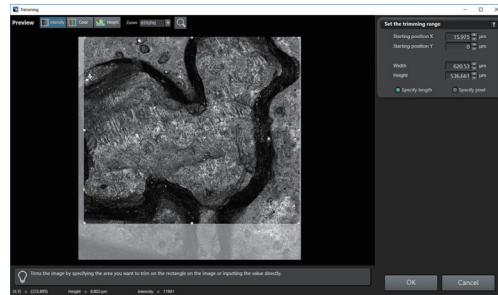
- 3** Click the [OK] button to close the [Invert data] screen.

5-8-3 Trimming the image



- 1** Select [Data processing] from the [Data processing] menu, and select [Trimming].

The [Trimming] screen appears.



- 2** Move the ROI **a** on the 2D image and adjust the trimming range.

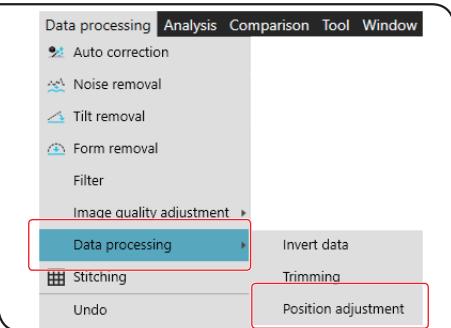
The X and Y coordinate values of the top left position of the ROI are displayed in [Starting position X] and [Starting position Y] **b**.

The width and the height of the ROI are displayed in [Width] and [Height] **c**.

- TIP**
- You can also specify the ROI by inputting the numerical values directly in [Starting position X], [Starting position Y], [Width] and [Height].
 - To change the unit to display [Starting position X], [Starting position Y], [Width] and [Height], select the [Specify length] or [Specify pixel] radio button **d**.

- 3** Click the [OK] button to close the [Trimming] screen.

5-8-4 Correcting the image position

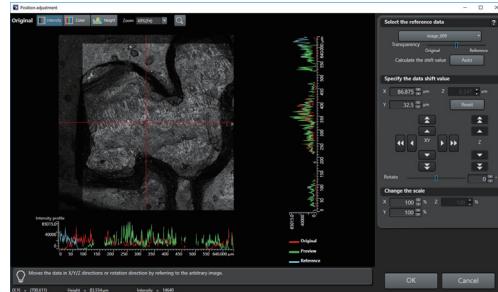


- 1** Open the image file to perform the data processing. If you correct the image position by comparing with other files, also open the image (reference image) file for comparison.

TIP For opening the file, see "Opening the file" (page 16).

- 2** Display the data view window of the image file to perform the data processing on the front.
- 3** Select [Data processing] from the [Data processing] menu, and select [Position adjustment].

The [Position adjustment] screen appears.



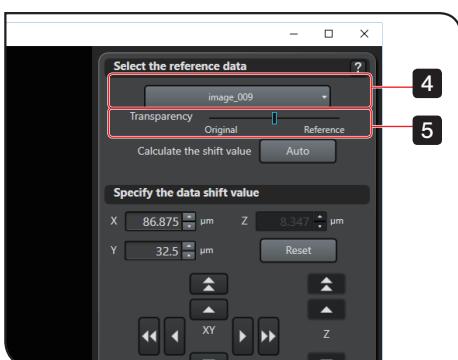
- 4** If you use the reference image, select the reference image from the [Reference data] dropdown list.

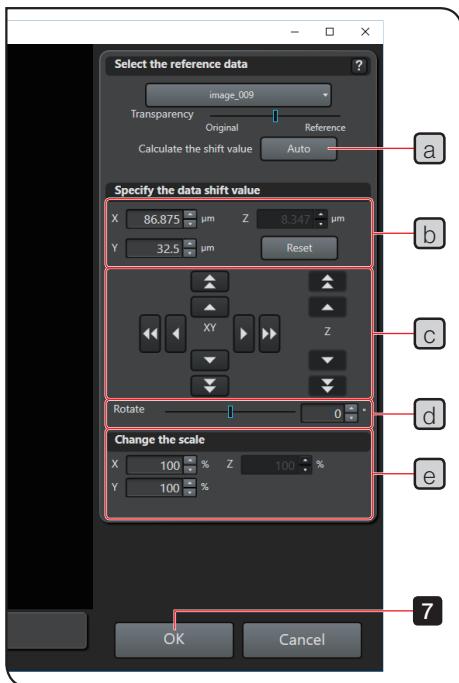
TIP The dropdown list shows the list of image files currently opened.

The profile before correction is displayed in red and the profile after correction is displayed in green.

- 5** To change the transparency ratio of the reference image displayed on the 2D image view area to the image to perform the data processing, adjust the ratio using the [Transparency] slider.

TIP The more you move the slider to the left, the thicker the view of the image to perform the data processing becomes.





6 Correct the image position.

There are four methods to correct the image position.

- Correct the image position automatically.
- Correct the image position by specifying the movement distance.
- Correct the image position by rotating the image.
- Correct the image position by changing the scale ratio of the image.

Correcting the image position automatically

Adjust the image position by comparing with the reference image.

- Click the [Auto] button **a**.

Correcting the image position by specifying the movement distance

Correct the image position by specifying the movement distance in X, Y or Z direction.

- Set the movement distance in X, Y or Z direction in [X], [Y], or [Z] setting field **b** or by using the arrow button **c**.

Correcting the image position by rotating the image

- Set the rotation angle of the image in the [Rotate] setting field **d** or by using the [Rotate] slider.

Correcting the image position by changing the scale ratio of the image

Correct the image position by specifying the scale ratio in X, Y or Z direction.

- Set the scale ratio in X, Y or Z direction in [X], [Y], or [Z] setting field **e**.

7 Click the [OK] button to close the [Position adjustment] screen.

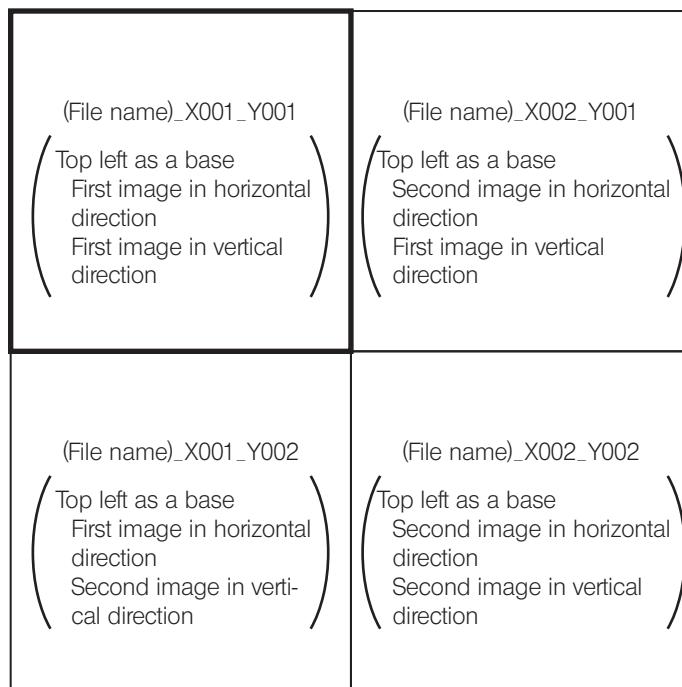
5-9 Manual stitching

5-9-1 What is manual stitching?

A manual stitching is a function to align and stitch multiple image data and connect them into a single image.



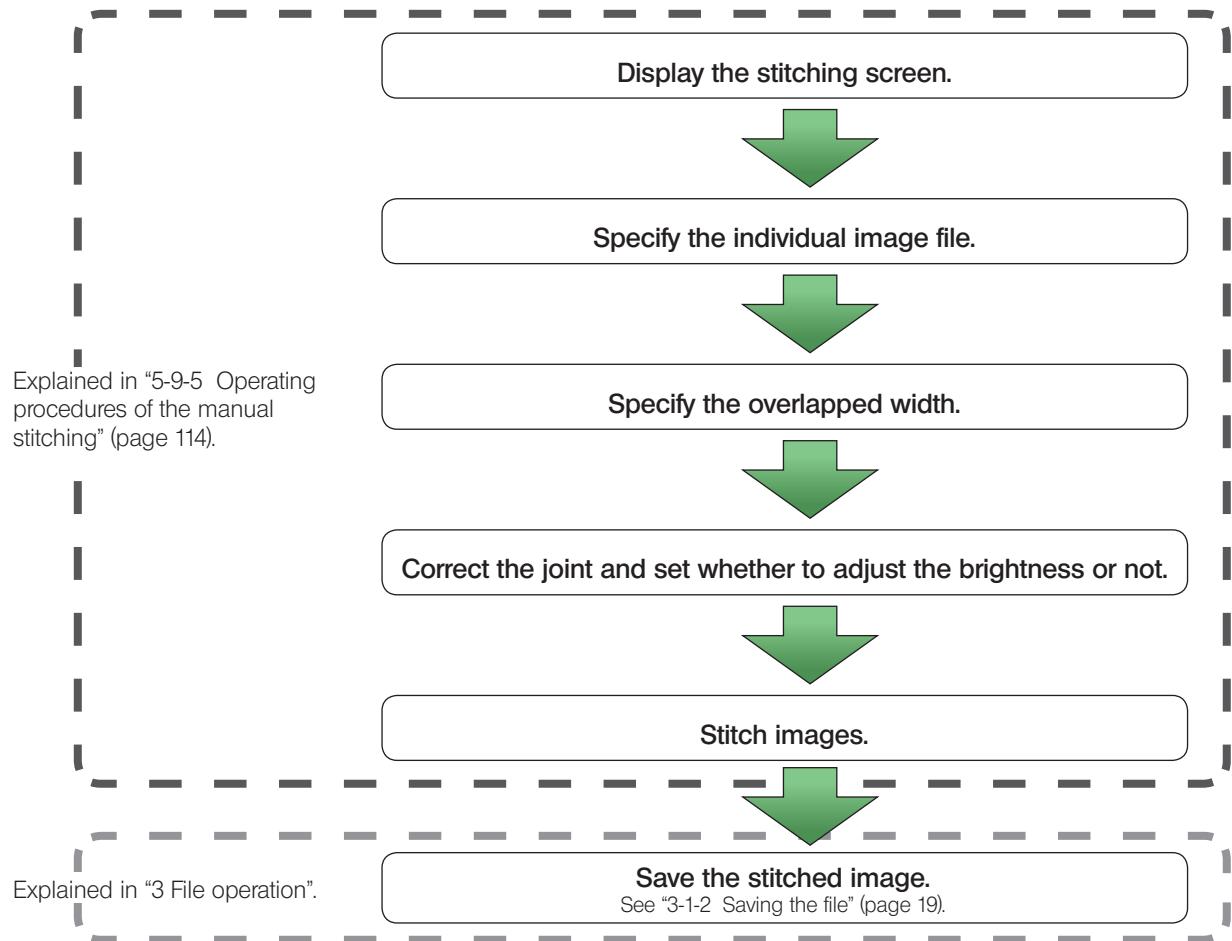
- Be sure to add information of the stitching position at the end of the data file name according to the following rules in advance.
- The analysis application recognizes the end of the file name to identify what number image in horizontal direction and in vertical direction using the top left image as a first image (base) in X direction (horizontal) and Y direction (vertical).



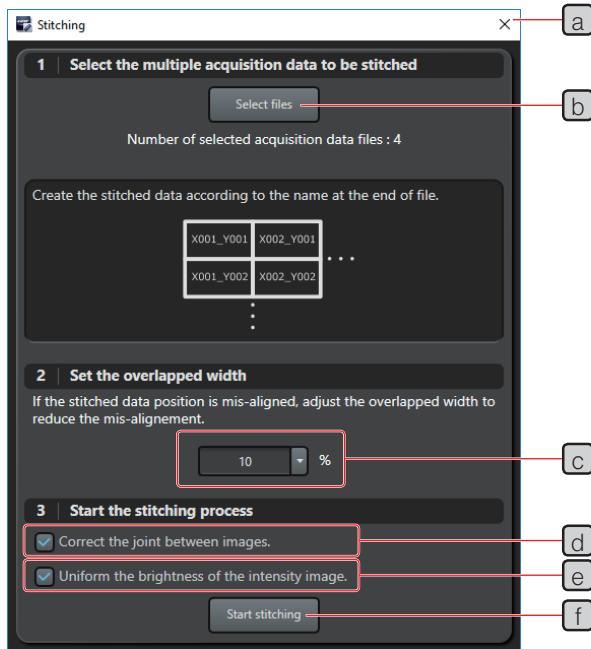
5-9-2 Restrictions for the manual stitching

- You cannot stitch data acquired by enabling the super high resolution acquisition function.
- The maximum stitching size of the image is 36,000,000 pixels ("number of vertical pixels" multiplied by "number of horizontal pixels").

5-9-3 Flow of the manual stitching

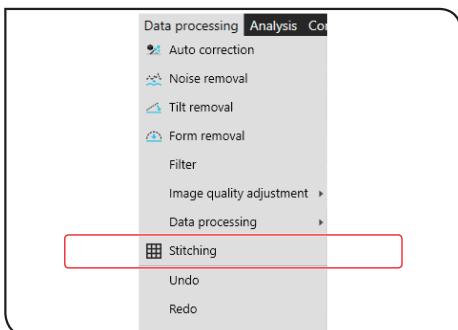


5-9-4 Screens used with the manual stitching

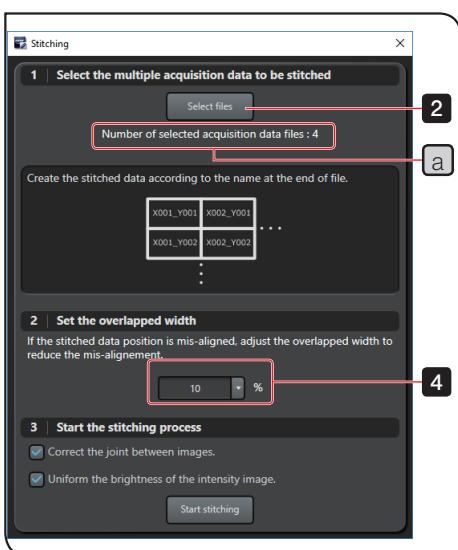


- [a] [Close] button
Cancels the manual stitching.
- [b] [Select file] button
Selects the individual image file to be stitched.
- [c] Overlapped width dropdown list
Set the overlapped width when stitching the individual image files. Select from alternatives in the dropdown list or input the numeral value directly.
- [d] [Correct the joint between images] checkbox
Corrects the joint between adjacent individual images.
- [e] [Uniform the brightness of the intensity image] checkbox
Corrects the brightness so that the laser intensity (brightness) of adjacent individual images is uniform.
- [f] [Start stitching] button
Stitches the individual images.

5-9-5 Operating procedures of the manual stitching



- 1 Select [Stitching] from the [Data processing] menu.



The [Stitching] screen appears.

- 2 Click the [Select file] button.

The [Open] screen appears.

- 3 Select the individual image file you want to stitch and click the [Open] button.

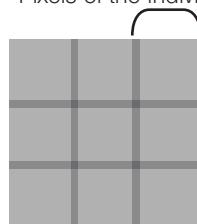
- TIP**
- If you select the files while pressing the **Shift** key of the keyboard, you can select consecutive multiple files.
 - If you select the files while pressing the **Ctrl** key of the keyboard, you can select multiple files that are apart.

When individual image files are selected, the number of individual image files is displayed in [Number of selected acquisition data files] **a**.

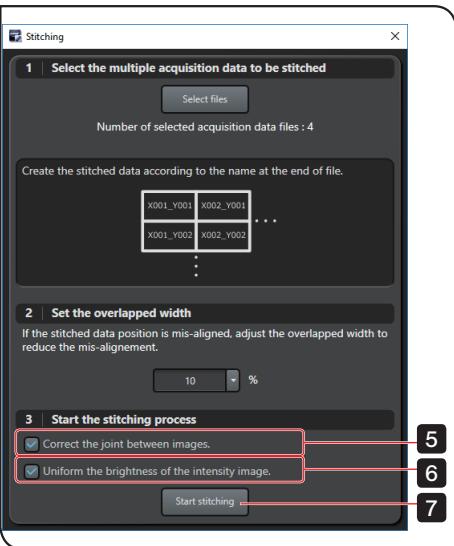
- 4 Set the overlapped width for stitching individual image files in the [Set the overlapped width] dropdown list.

- TIP**
- You can select either "10%", "20%", "30%", "40%" or "50%".
 - The initial setting is "10%".
 - You can also input the numerical value directly to the dropdown list.
 - The overlapped width is a ratio with respect to the number of pixels of the individual image.
 - If the joint between stitched images is overlapped, increase the ratio of the overlapped width.

Pixels of the individual image



Overlapped width (a ratio for the number of pixels of the image)



5 To correct the joint between adjacent individual images, check the [Correct the joint between images] checkbox.

6 To uniform the laser intensity (brightness) of adjacent individual images, check the [Uniform the brightness of the intensity image] checkbox.

7 Click the [Start stitching] button.

The images are stitched and the stitched image is displayed.

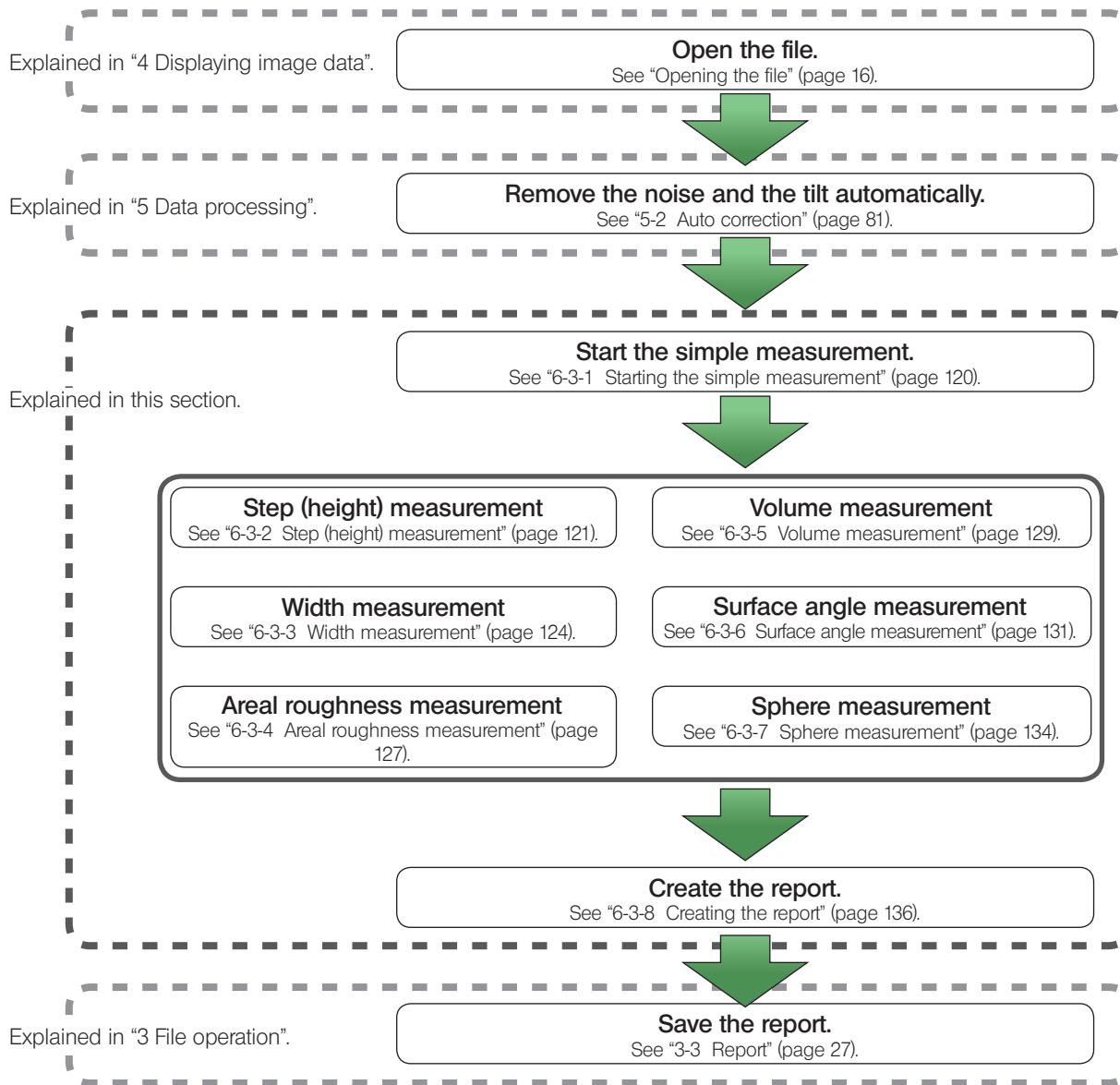
6 Simple measurement

You can perform the following measurements in simple procedures.

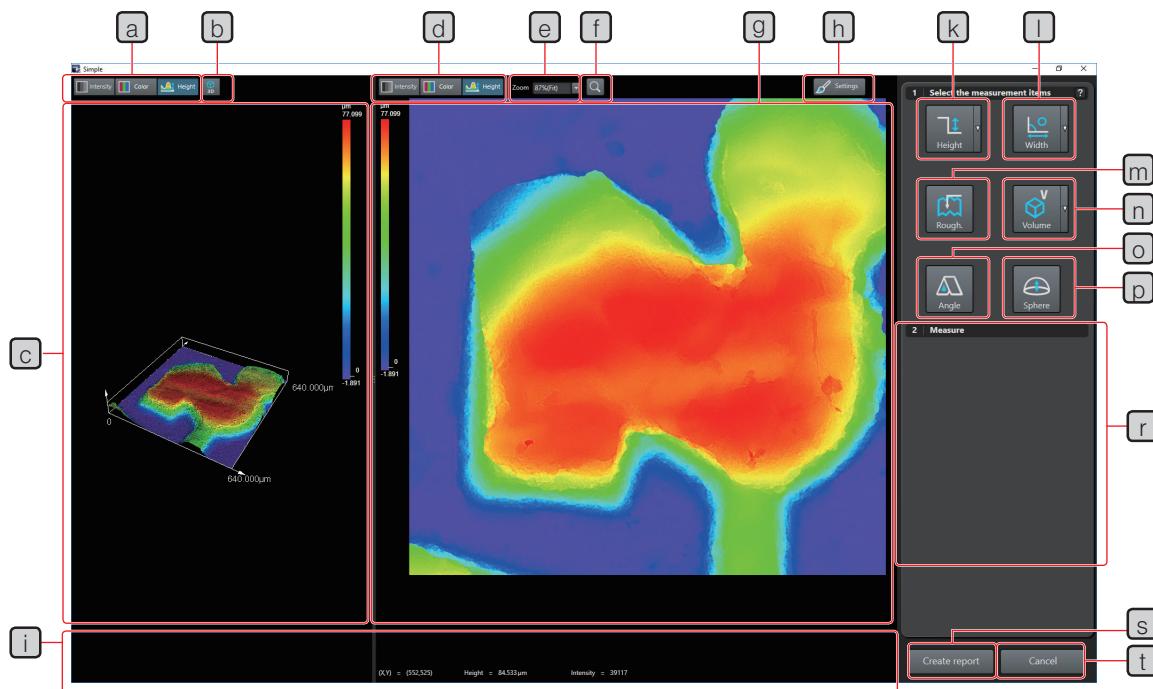
- Step (height) measurement
- Width measurement
- Areal roughness measurement
- Volume measurement
- Surface angle measurement
- Sphere measurement

Any measurement can be performed once for one file at the same time.

6-1 Flow of the simple measurement



6-2 Screens used in the simple measurement



[a] 3D image data selection button

Selects either the laser intensity image, the color image or the height image on the 3D image view area.

[b] Advanced setting button for 3D image

Displays the screen to define advanced settings for displaying the 3D image. For details on the screen, see "4-2-1 Screens used with the 3D view" (page 51).

[c] 3D image view area

Displays the 3D image.

Dragging the image allows you to change the angle to display the image.

Rotating the mouse wheel on the image zooms in or out the image.

Dragging the image while holding down the right button of the mouse allows you to move the view position.

[d] 2D image data selection button

Selects either the laser intensity image, the color image or the height image on the 2D image view area.

[e] Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

[f] Loupe button

Zooms in the mouse pointer position on the 2D image view area.

[g] 2D image view area

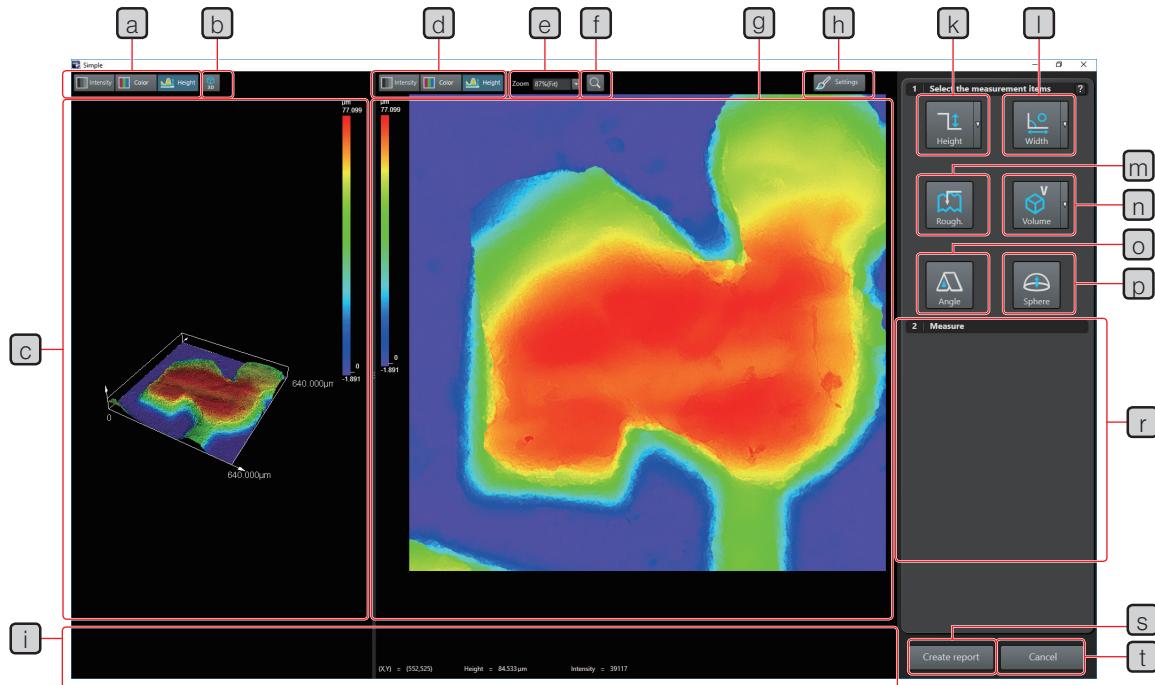
Displays the 2D image and measurement results.

Dragging a measurement region on the image displays measurement results.

Rotating the mouse wheel on the image zooms in or out the image.

You can change the font and the color of measurement results. Use the simple measurement view setting button [i] to display the setting screen.

([h] to [t] are described on the next page.)



(a) to (g) are described on the previous page.)

(h) View setting button

Displays the screen to define advanced settings for the measurement region and measurement results displayed on the 2D image view area (g). For details on the screen, see "View setting" screen" (page 119).

(i) Status bar

Displays information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area.

(k) Step (height) measurement button

Measures the difference between average heights of two planes.

(l) Width measurement button

Detects the edge on the line automatically and measures the width between edges.

(m) Areal roughness measurement button

Measures the roughness of the rectangle region.

(n) Volume measurement button

Measures the volume of the rectangle region.

(o) Surface angle measurement button

Measures the angle between two planes.

(p) Sphere measurement button

Detects the sphere from the measurement region automatically and measures the radius, the diameter and the curvature.

(r) Information area

Displays the explanation of functions and operating procedures.

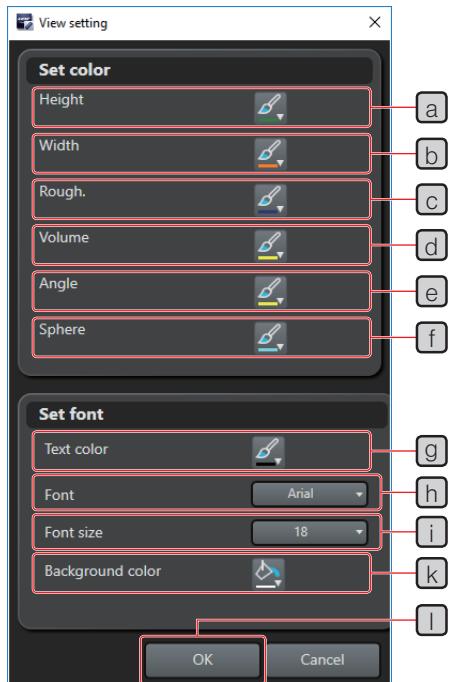
(s) [Create report] button

Creates the report based on measurement results displayed on the 2D image view area.

(t) [Cancel] button

Cancels the simple measurement.

[View setting] screen

**[a] Step (height) measurement button**

Changes the color of the measurement region and the profile in the step (height) measurement.

[b] Width measurement button

Changes the color of the measurement line and the profile in the width measurement.

[c] Areal roughness measurement button

Changes the color of the measurement region in the areal roughness measurement.

[d] Volume measurement button

Changes the color of the measurement region in the volume measurement.

[e] Surface angle measurement button

Changes the color of the measurement region and the profile in the surface angle measurement.

[f] Sphere measurement button

Changes the color of the measurement region and the profile in the sphere measurement.

[g] [Text color] button

Changes the color of strings of measurement results.

[h] [Font] dropdown list

Changes the font of strings of measurement results.

[i] [Font size] dropdown list

Changes the font size of strings of measurement results.

[k] [Background color] button

Changes the background color of strings of measurement results.

[l] [OK] button

Changes the settings and closes the [View setting] screen.

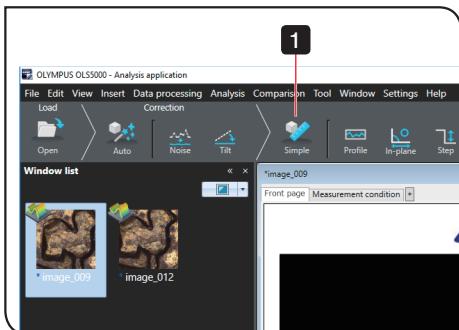
TIP

- Using from [a] to [f] buttons, you can set the color of the measurement region, the profile and the line that connects measurement regions by each measurement type.

- Using from [g] to [k] buttons, you can set the font and the background color of measurement results. The fonts and background colors of measurement results are same in all measurements of the simple measurement.

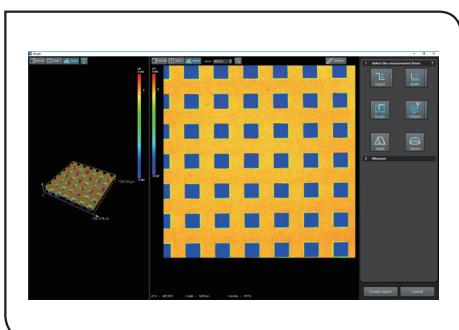
6-3 Operating procedures of the simple measurement

6-3-1 Starting the simple measurement



1 Click the [Simple] button.

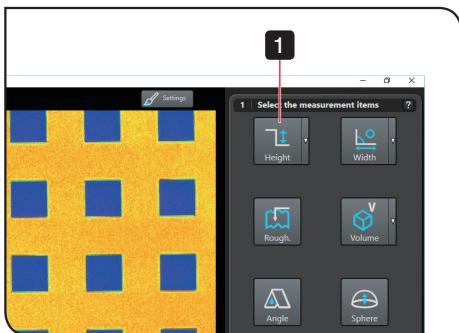
TIP You can also display the [Simple] screen by selecting [Simple] in the [Analysis] menu.



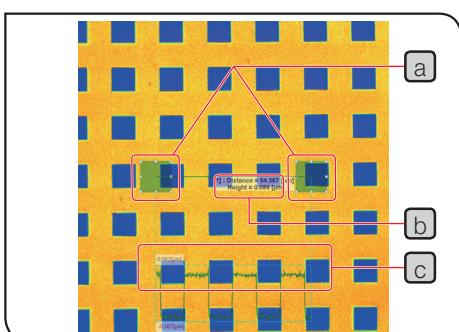
The [Simple] screen appears.

6-3-2 Step (height) measurement

You can obtain the difference (step) between average heights of two regions in simple procedures.



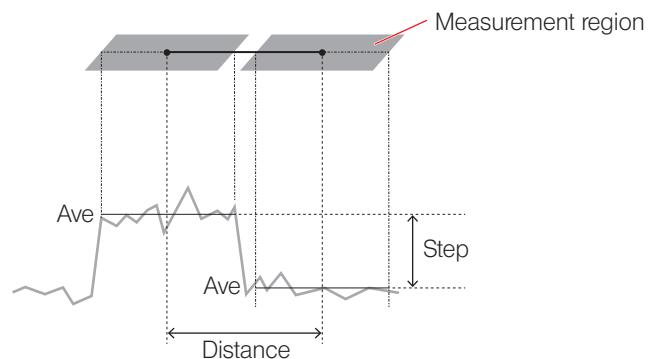
- Click the [Height] button.



The measurement regions **a**, measurement results **b** and the profiles **c** of measurement regions are displayed on the 2D image view area.

Measurement results (Step measurement)

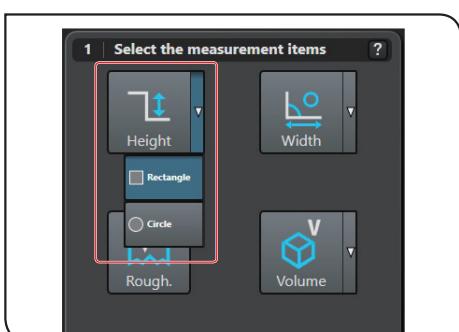
You can obtain the difference (step) between the average height of the first measurement region and the average height of the second measurement region and also the distance between the centers of two measurement regions.



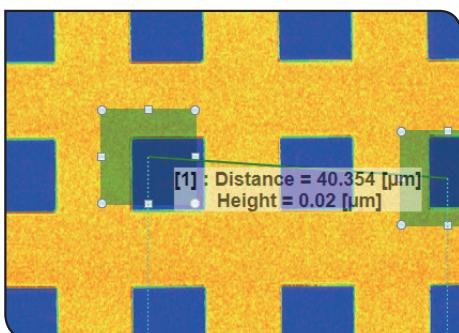
TIP

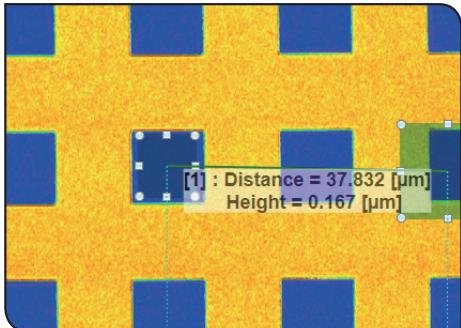
The shape of the measurement region is a rectangle or an ellipse.

To change the shape of the measurement region to an ellipse, click the arrow button on the right side of the [Height] button to display the menu, and select [Circle].

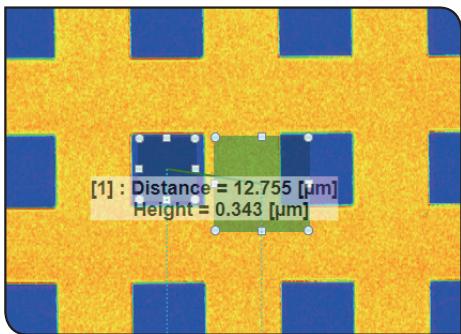


- Drag the first measurement region to the position you want to measure.

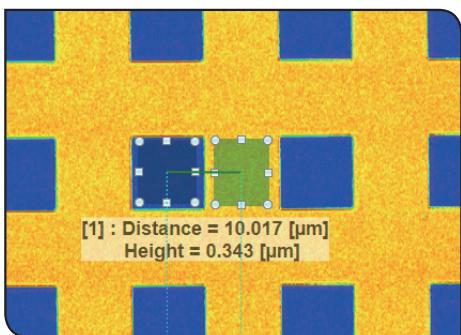




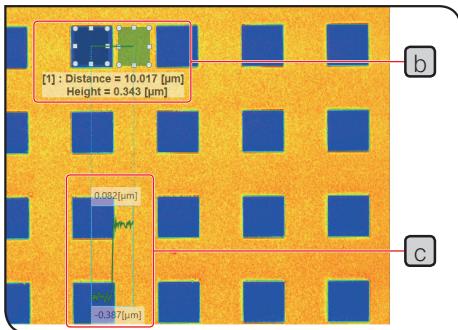
- 3 Drag the handle of the first measurement region to adjust the size of the measurement region.



- 4 Drag the second measurement region to the position you want to measure.



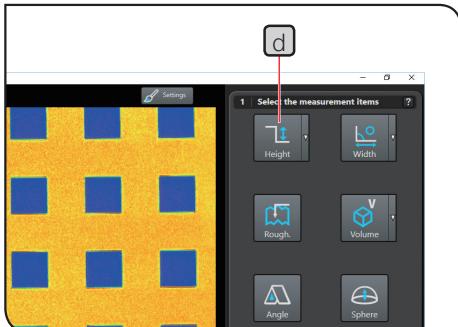
- 5 Drag the handle of the second measurement region to adjust the size of the measurement region.



The measurement results **b** (difference between the average height of the first measurement region and the average height of the second measurement region and distance between centers of two measurement regions) are displayed on the 2D image view area.

TIP

- You can change the view position of measurement results by dragging measurement results.
- If you move or resize the measurement region, measurement results are updated. (The view position of measurement results is adjusted automatically)
- You can change the color of the measurement region or the font and the color of measurement results.
For procedures to change the color or the font, see “[View setting] screen” (page 119).
- You cannot change the view position or the color of the profile **c** of the measurement region.

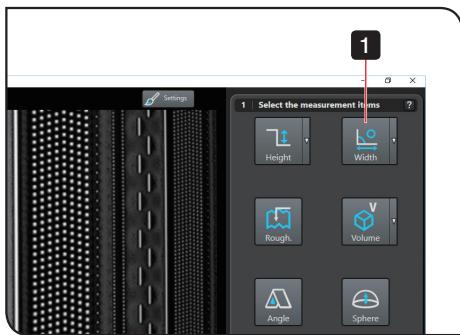


TIP

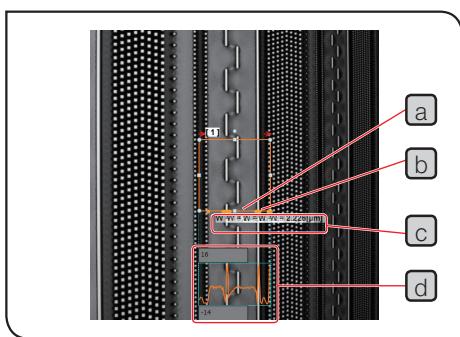
- Clicking the [Height] button **d** during step (height) measurement hides measurement regions and measurement results of the step (height) measurement.
- Clicking the [Height] button again shows measurement regions of the step (height) measurement.
- The profile is hidden during other measurements.

6-3-3 Width measurement

You can obtain the distance between edges in simple procedures by detecting edges on the single line.



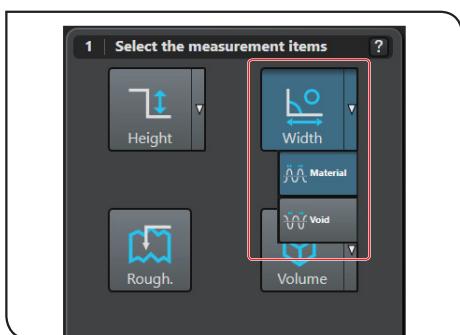
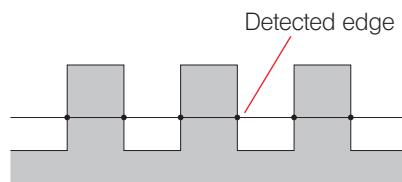
1 Click the [Width] button.



The measurement line **a**, detected edges **b**, measurement results **c** and the profile **d** of the measurement region are displayed on the 2D image view area.

Measurement results (Width measurement)

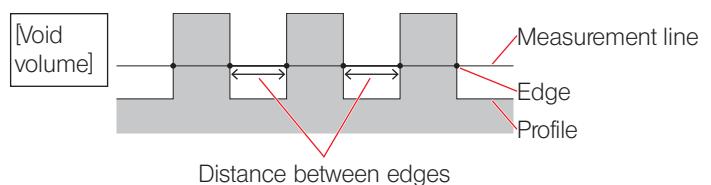
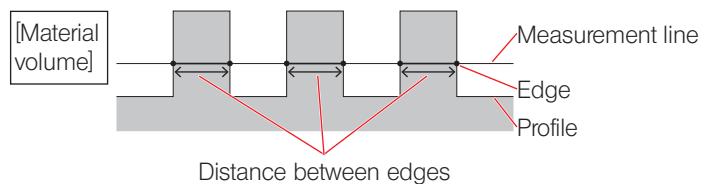
You can obtain the distance between edges by detecting edges of the height on the line.

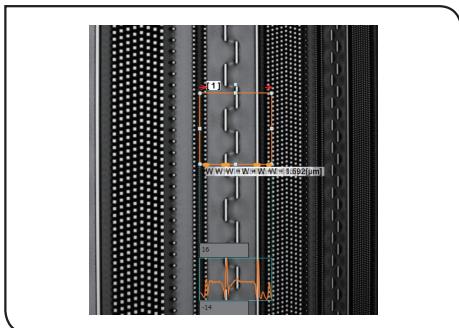


TIP

The distance between edges in the material volume or the void volume of the profile are measured.

To measure the distance between edges in the void volume of the profile, click the arrow button on the right side of the [Width] button to display the menu, and select [Void volume].

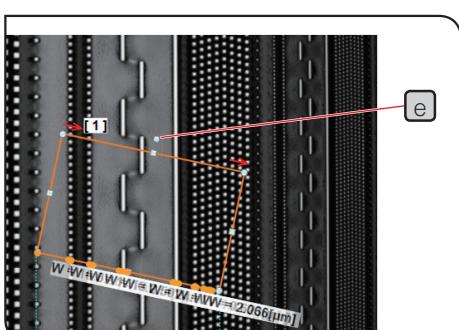




- 2** Drag the one end of the measurement line to the position you want to measure.

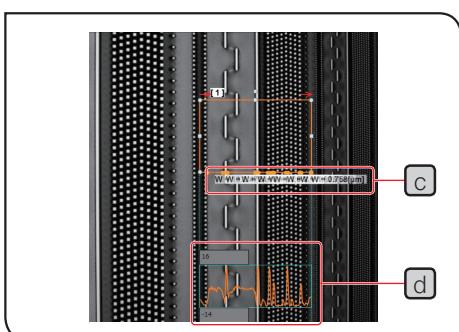


- 3** Drag the other end of the measurement line to the position you want to measure.

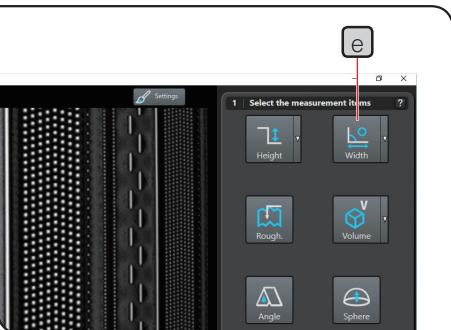


- 4** Rotate the measurement line, if necessary. Click the rotation handle **e** above the measurement line and drag it in arbitrary direction.

The measurement results **c** (distance between edges of the height on the line) are displayed on the 2D image view area.



- TIP**
- You can change the view position of measurement results by dragging measurement results.
 - If you move the measurement line or change its length or angle, measurement results are updated. (The view position of measurement results is adjusted automatically.)
 - You can change the color of the measurement region and the font and the color of measurement results. For procedures to change the color or the font, see “[View setting] screen” (page 119).
 - You cannot change the view position or the color of the profile **d** of the measurement region.

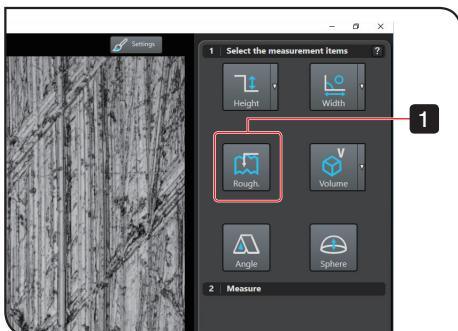


TIP

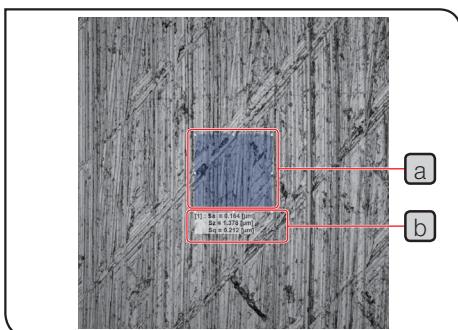
- Clicking the [Width] button  during width measurement hides the measurement line and measurement results of the width measurement.
- Clicking the [Width] button again shows the measurement line of the width measurement.
- The profile is hidden during other measurements.

6-3-4 Areal roughness measurement

You can obtain the roughness or the wave in the measurement region in simple procedures.



- 1 Click the [Roughness] button.



The measurement region (rectangle) **a** and measurement results **b** are displayed on the 2D image view area.

Measurement results (Areal roughness measurement)

Sa, Sz, Sq

TIP

- Measurement results
 - Sa: Arithmetical mean height
 - Sz: Maximum height
 - Sq: Root mean square height
- For details on measurement results, see “13-6 Roughness parameter” (page 279).



- 2 Drag the measurement region to the position you want to measure.

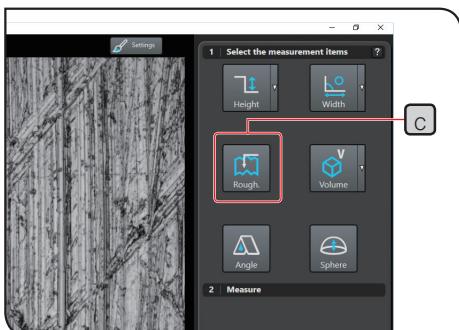


- 3** Drag the handle of the measurement region to adjust the size of the measurement region.



The measurement results **b** (S_a , S_z , S_q) are displayed on the 2D image view area.

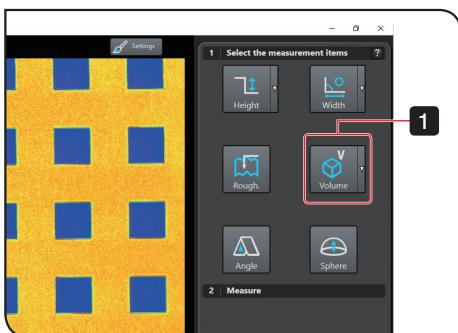
- TIP**
- You can change the view position of measurement results by dragging measurement results.
 - If you move or resize the measurement region, measurement results are updated. (The view position of measurement results is adjusted automatically)
 - You can change the color of the measurement region and the font and the color of measurement results.
For procedures to change the color or the font, see “[View setting] screen” (page 119).



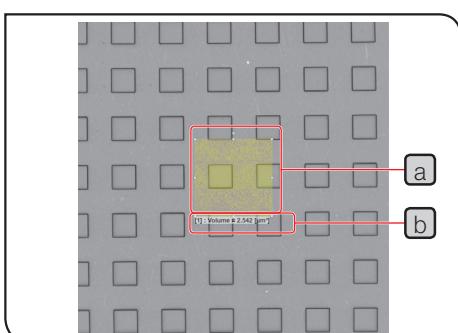
- TIP**
- Clicking the [Roughness] button **c** during areal roughness measurement hides the measurement line and measurement results of the areal roughness measurement.
 - Clicking the [Roughness] button again shows the measurement line of the areal roughness measurement.

6-3-5 Volume measurement

You can obtain the volume of the region in simple procedures.



- 1 Click the [Volume] button.



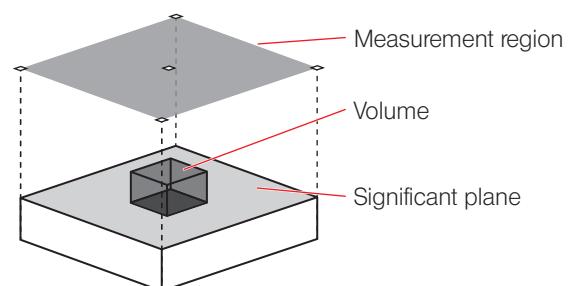
The measurement region (rectangle) **a** and measurement results **b** are displayed on the 2D image view area.

Measurement results (Volume measurement)

You can obtain the volume using the significant plane as a base.

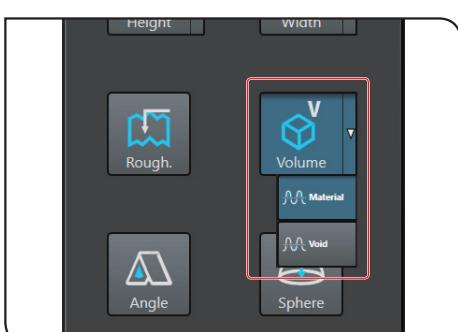
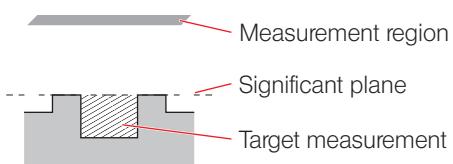
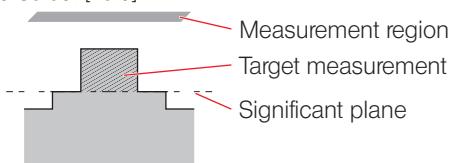


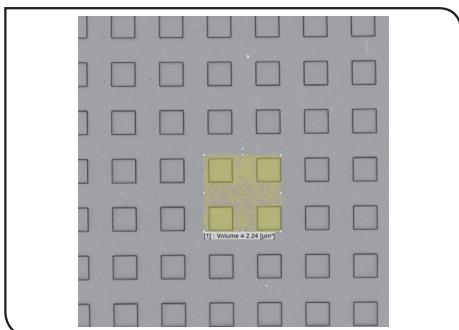
Perform the automatic correction or the tilt removal on image data before measurement. The significant plane is obtained by performing the automatic correction or the tilt removal.



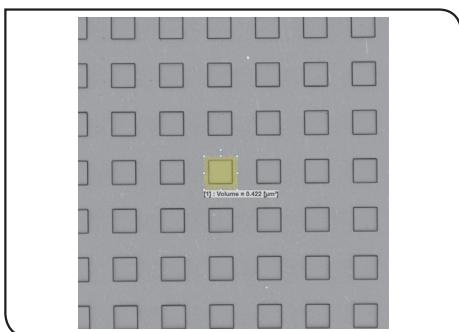
TIP The volume in the material volume or in the void volume is measured.

To measure the volume in the void volume, click the arrow button on the right side of the [Volume] button to display the menu, and select [Void].

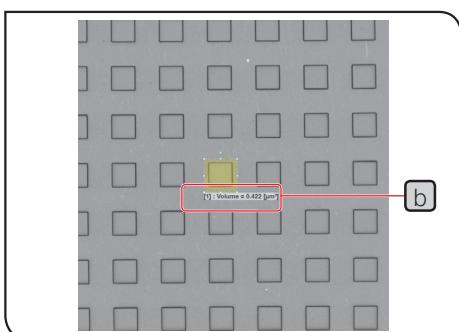




- 2** Drag the measurement region to the position you want to measure.

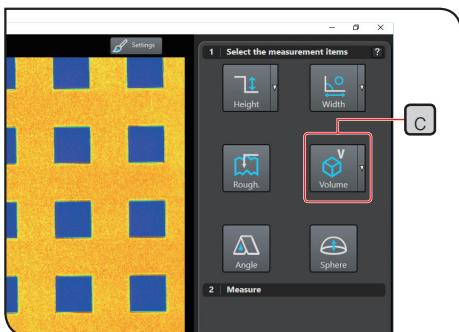


- 3** Drag the handle of the measurement region to adjust the size of the measurement region.



The measurement results **b** (volume) are displayed on the 2D image view area.

- TIP**
- You can change the view position of measurement results by dragging measurement results.
 - If you move or resize the measurement region, measurement results are updated. (The view position of measurement results is adjusted automatically)
 - You can change the color of the measurement region and the font and the color of measurement results. For procedures to change the color or the font, see “[View setting] screen” (page 119).



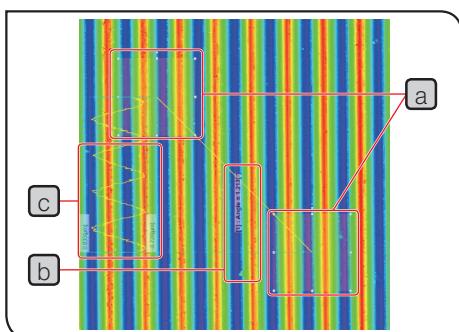
- TIP**
- Clicking the [Volume] button **c** during volume measurement hides the measurement region and measurement results of the volume measurement.
 - Clicking the [Volume] button again shows the measurement region of the volume measurement.

6-3-6 Surface angle measurement

Recognizing each of two regions as a plane, you can obtain the angle of intersection of these two planes in simple procedures.



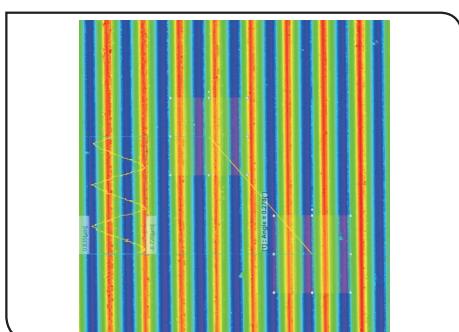
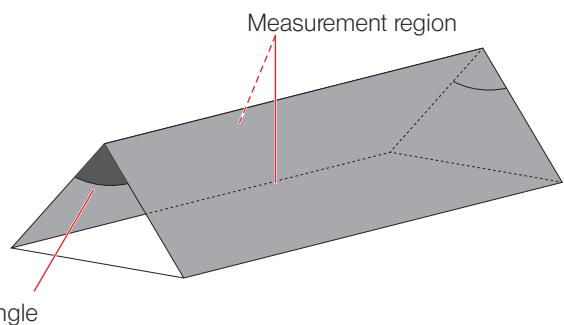
- 1 Click the [Angle] button.



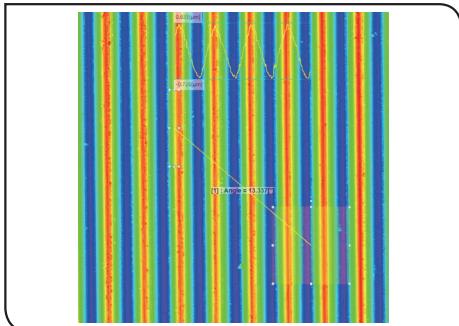
The measurement regions (rectangle) **a**, measurement results **b** and the profile **c** of measurement regions are displayed on the 2D image view area.

Measurement results (Surface angle measurement)

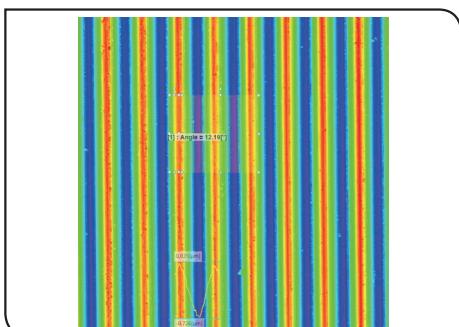
You can obtain the angle between the plane of the first measurement region and the plane of the second measurement region.



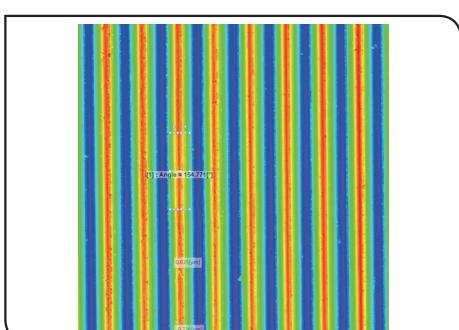
- 2 Drag the first measurement region to the position you want to measure.



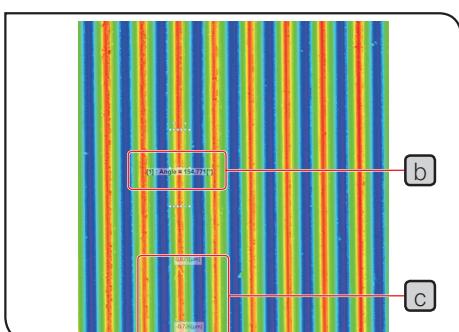
- 3** Drag the handle of the first measurement region to adjust the measurement region size.



- 4** Drag the second measurement region to the position you want to measure.

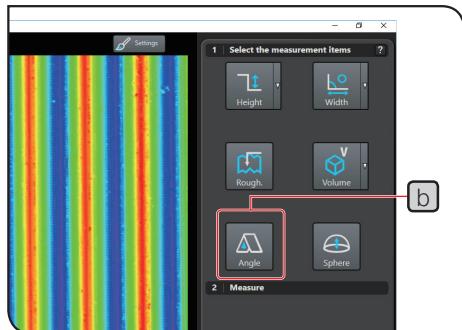


- 5** Drag the handle of the second measurement region to adjust the size of the measurement region.



The measurement results **b** (angle between the plane of the first measurement region and the plane of the second measurement region) are displayed on the 2D image view area.

- TIP**
- You can change the view position of measurement results by dragging measurement results.
 - If you move or resize the measurement region, measurement results are updated. (The view position of measurement results is adjusted automatically)
 - You can change the color of the measurement region and the font and the color of measurement results. For procedures to change the color or the font, see “[View setting] screen” (page 119).
 - You cannot change the view position or the color of the profile **c** between measurement regions.

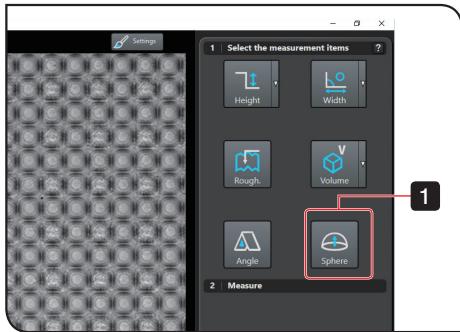


TIP

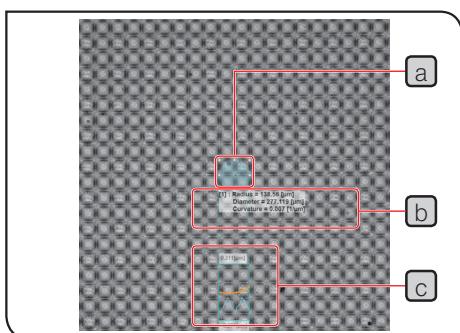
- Clicking the [Angle] button **a** during surface angle measurement hides measurement regions and measurement results of the surface angle measurement.
- Clicking the [Angle] button again shows measurement regions of the surface angle measurement.
- The profile is hidden during other measurements.

6-3-7 Sphere measurement

Recognizing the region as a sphere surface, you can obtain the radius, diameter and curvature of the sphere in simple procedures.



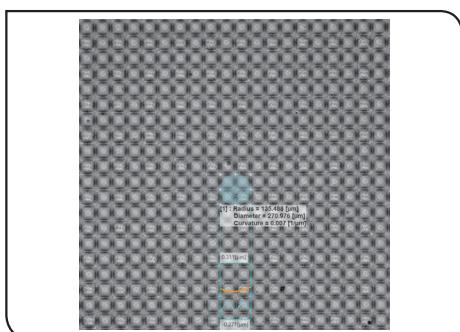
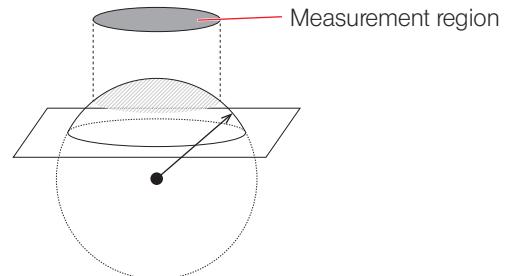
- Click the [Sphere] button.



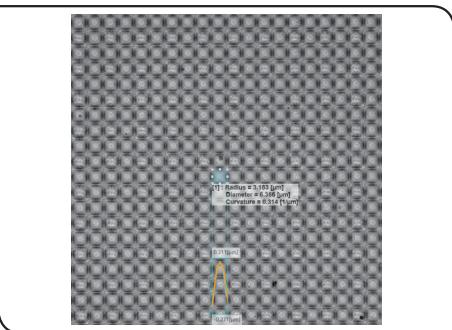
The measurement region (ellipse) **a**, measurement results **b**, the profile of the measurement region and the sphere **c** are displayed on the 2D image view area.

Measurement results (Sphere measurement)

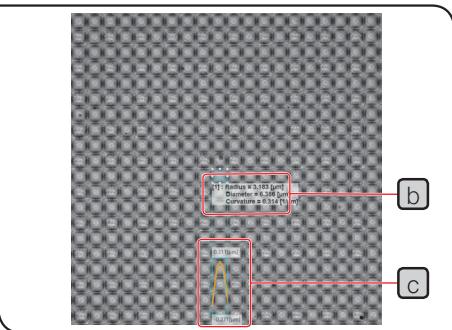
Recognizing the region as a sphere surface, you can obtain the radius, diameter and curvature of the sphere.



- Drag the measurement region to the position you want to measure.

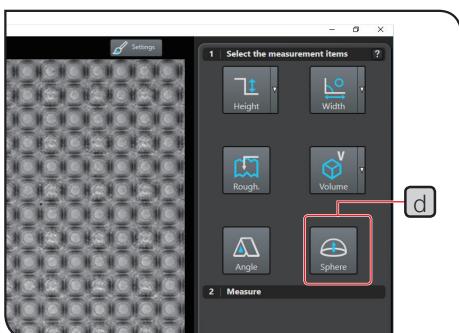


- 3** Drag the handle of the measurement region to adjust the size of the measurement region.



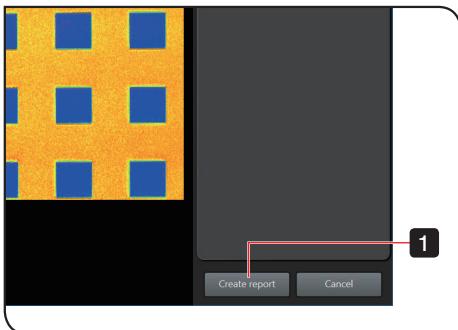
The measurement results **b** (radius, diameter, curvature) are displayed on the 2D image view area.

- TIP**
- You can change the view position of measurement results by dragging measurement results.
 - If you move or resize the measurement region, measurement results are updated. (The view position of measurement results is adjusted automatically)
 - You can change the color of the measurement region and the font and the color of measurement results. For procedures to change the color or the font, see “[View setting] screen” (page 119).
 - You cannot change the view position or the color of the profile of the measurement region and the sphere **c**.



- TIP**
- Clicking the [Sphere] button **d** during sphere measurement hides the measurement line and measurement results of the sphere measurement.
 - Clicking the [Sphere] button again shows the measurement line of the sphere measurement.
 - The profile is hidden during other measurements.

6-3-8 Creating the report



When you finish specifying measurement conditions, create the report.

TIP

The measurement results of all measurements selected by pressing the buttons (ON) on [Select the measurement items] are displayed on the report.

- Click the [Create report] button.



The [Simple] tab **a** is added to the data view window and the report is displayed.

In the simple measurement, the 3D image, the 2D image and following data are displayed by each measurement type on the report as measurement results.

Step (height) measurement

- Height

Width measurement

- Width (width of the number of detected edges)

Areal roughness measurement

- Sa, Sz, Sq

Volume measurement

- Volume

Surface angle measurement

- Surface angle

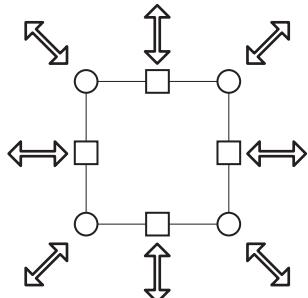
Sphere measurement

- Radius
- Diameter
- Curvature

6-4 Editing the measurement region

You can move the measurement region displayed during each measurement and also can change its size or the aspect ratio.

Changing the size and the aspect ratio of the measurement region



Select the measurement region. The handles are displayed on the outside frame of the measurement region.

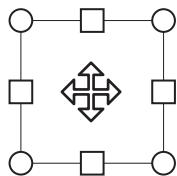
Place the mouse pointer on the measurement region. When the mouse pointer changes its shape to the double-headed arrow, drag the handle to change the size or the aspect ratio of the measurement region.

The diagonal vertex is the base point.

Dragging the handle while holding down the **Shift** key of the keyboard allows you to change the size of the measurement region without changing the aspect ratio.

Dragging the handle while holding down the **Ctrl** key of the keyboard allows you to change the size or the aspect ratio of the measurement region without changing the center of the measurement region.

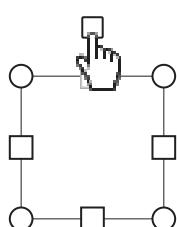
Moving the measurement region



Select the measurement region. The handles are displayed on the outside frame of the measurement region.

Place the mouse pointer on the measurement region. When the mouse pointer changes its shape to the cross arrow, drag the measurement region to move it.

Rotating the measurement region



You can rotate the measurement region in the width measurement, areal roughness measurement, volume measurement and surface angle measurement.

Select the measurement region. The handles are displayed on the outside frame of the measurement region.

Place the mouse pointer on the handle displayed on the measurement region. When the mouse pointer changes its shape to the hand shape, drag the handle to rotate the measurement region.

6-5 Views on the 2D image

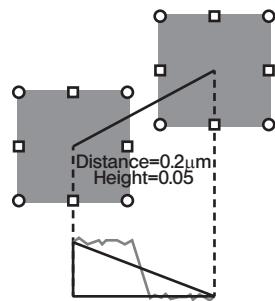
During simple measurement, the measurement region, measurement results and also either the profile or the spherical form depending on the measurement type are displayed on the 2D image.

During other measurements, the measurement region and measurement results are displayed.

The views on the 2D image are explained as follows using the step (height) measurement as an example.

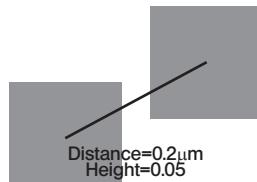
Step (height) measurement

The measurement regions of the step (height) measurement are selected, and measurement results and the profile are displayed.



During other measurements

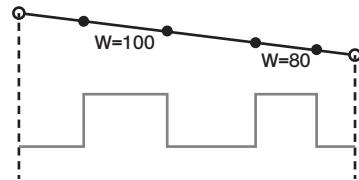
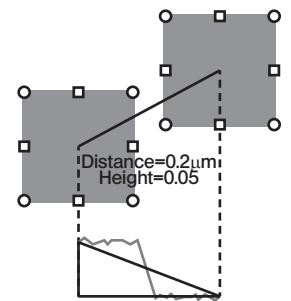
If you start other measurements (example: width measurement), the profile of the step (height) measurement is hidden.



Step (height) measurement

If you move the measurement regions of the step (height) measurement, the measurement regions of the step (height) measurement are selected and you will be back to the step measurement.

The profile of the step (height) measurement is displayed.



(The profiles of other measurements are hidden.)

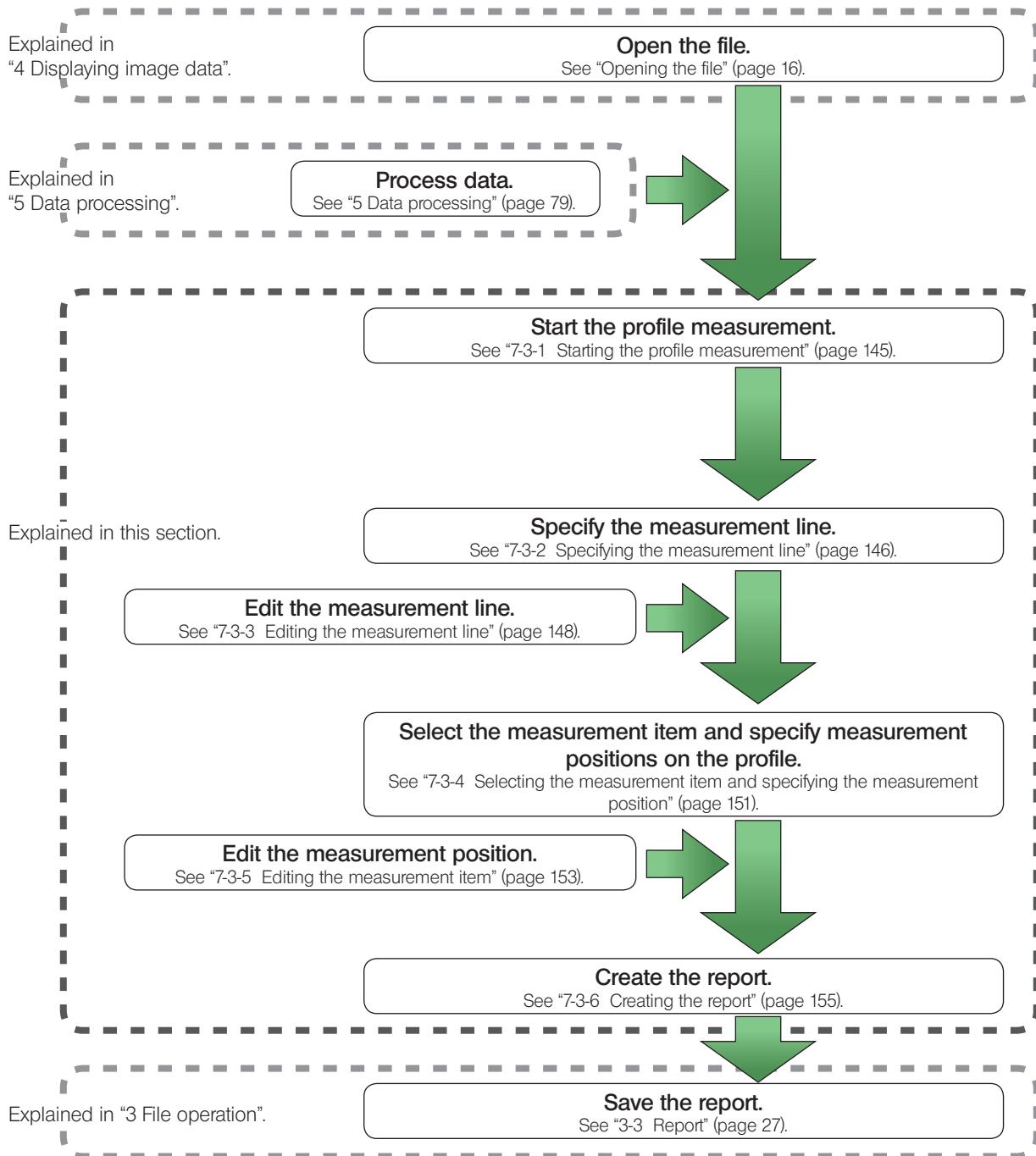
7

Profile measurement

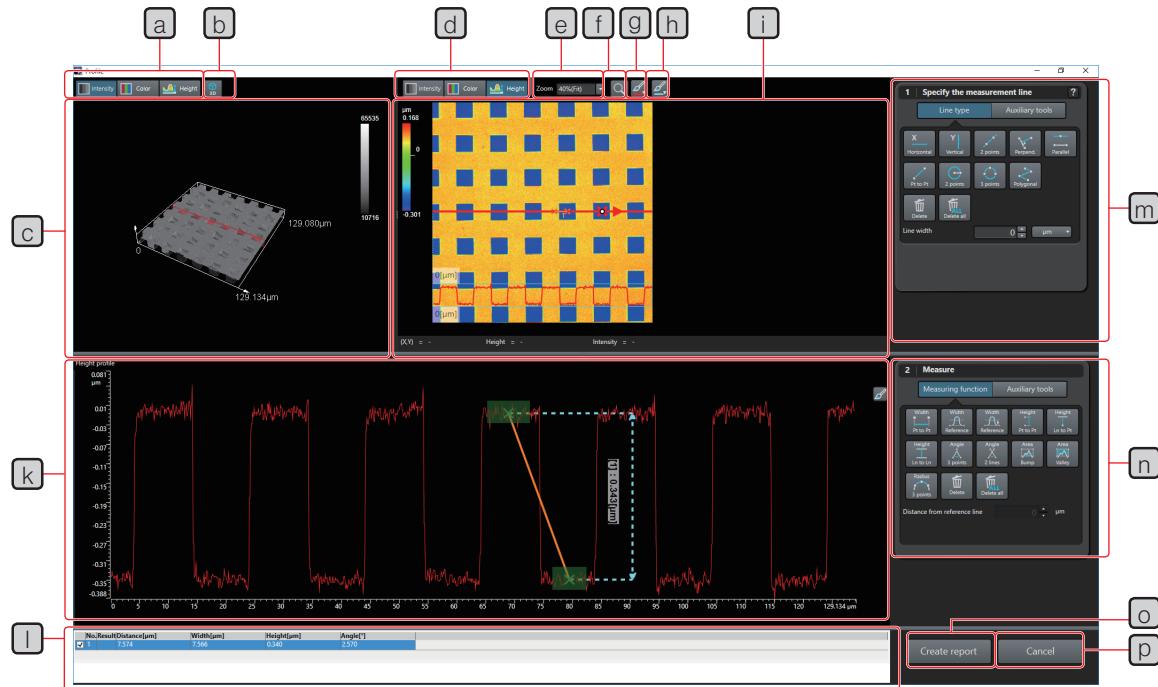
The profile is a shape of the laser intensity or the height data along the arbitrary line on the image data.

You can measure the length, line width, cross-sectional area, curvature, angle of intersection, etc. on the profile of the XZ cross-section or the YZ cross-section.

7-1 Flow of the profile measurement



7-2 Screens used in the profile measurement



[a] 3D image data selection button

Selects either the laser intensity image, the color image or the height image on the 3D image view area.

[b] Advanced setting button for 3D image

Displays the screen to define advanced settings for displaying the 3D image. For details on the screen, see "4-2-1 Screens used with the 3D view" (page 51).

[c] 3D image view area

Displays the 3D image.

Dragging the image allows you to change the angle to display the image.

Rotating the mouse wheel on the image zooms in or out the image.

Dragging the image while holding down the right button of the mouse allows you to move the view position.

[d] 2D image data selection button

Selects either the laser intensity image, the color image or the height image on the 2D image view area.

[e] Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

[f] Loupe button

Zooms in the mouse pointer position on the 2D image view area.

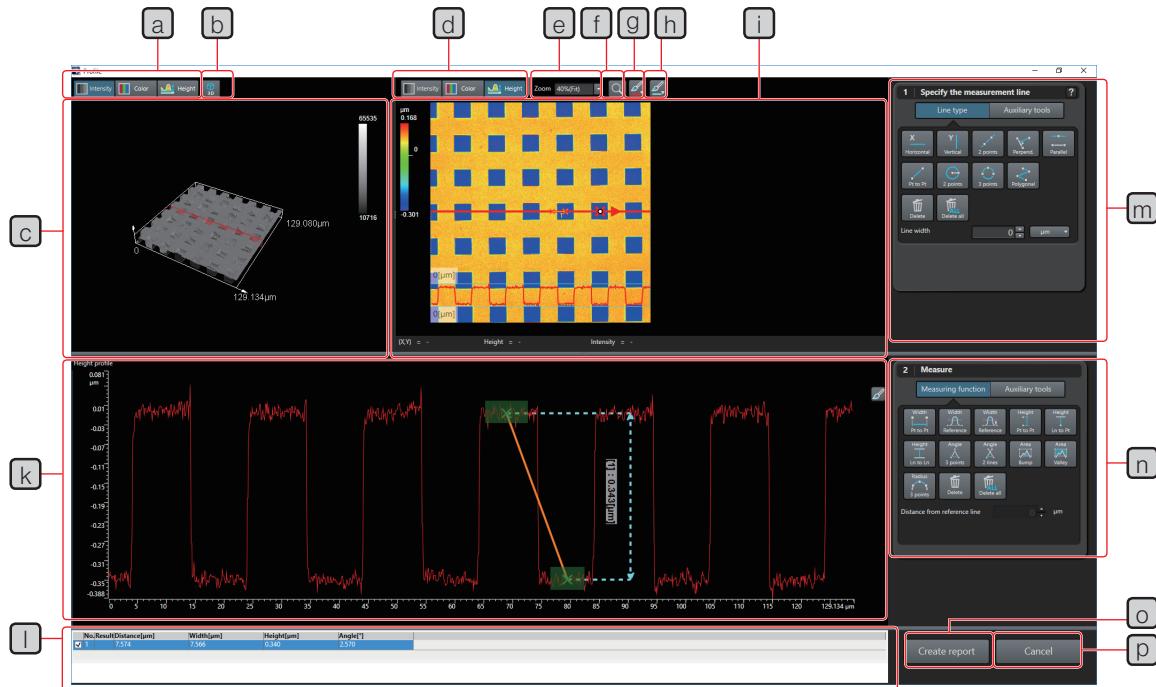
[g] Measurement line color button

Sets the color of the measurement line selected on the 2D image view area.

[h] Auxiliary tool color button

Sets the color of the auxiliary tool on the 2D image view area.

([i] to [p] are described on the next page.)



([a] to [h] are described on the previous page.)

[i] 2D image view area

Displays the 2D image and the measurement line. Rotating the mouse wheel on the image zooms in or out the image. You can change the color of the measurement line and auxiliary tools. Use the measurement line color button [g] or the auxiliary tool color button [h] to display the color pallet. The information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area is displayed on the status bar.

[k] Profile view area

Displays the profile of the measurement line position on the 2D image view area. Specifying the measurement position on the profile displays measurement results. You can change the font and the color of measurement results. For the screen to change the color, see “[View setting] screen” (page 142). Rotating the mouse wheel on the profile zooms in or out the profile.

[l] Measurement results view area

Displays measurement results obtained from the measurement position on the profile.

[m] Measurement line setting area

Select the method to specify the measurement line.

[n] Measurement item setting area

Select the measurement item.

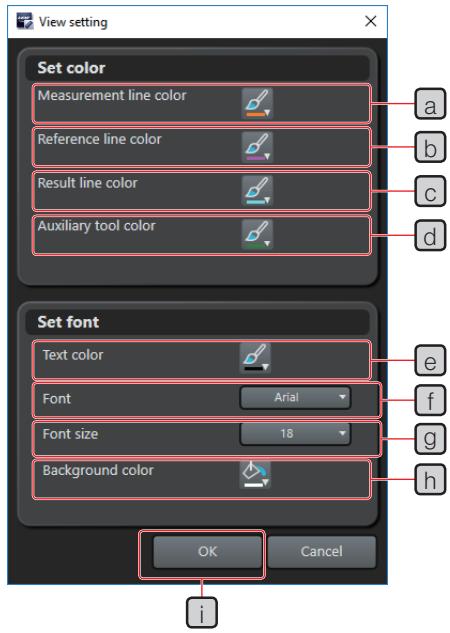
[o] [Create report] button

Creates the report based on measurement results obtained from the measurement position on the profile.

[p] [Cancel] button

Cancels the profile measurement.

[View setting] screen



[a] [Measurement line color] button

Changes the color to display the line used in measurement.

[b] [Reference line color] button

Changes the color of the reference line used in measurement.

[c] [Result line color] button

Changes the color of the line that connects the measurement position with measurement results.

[d] [Auxiliary tool color] button

Changes the color of the position specified by auxiliary tools.

[e] [Text color] button

Changes the color of strings of measurement results.

[f] [Font] dropdown list

Changes the font of strings of measurement results.

[g] [Font size] dropdown list

Changes the font size of strings of measurement results.

[h] [Background color] button

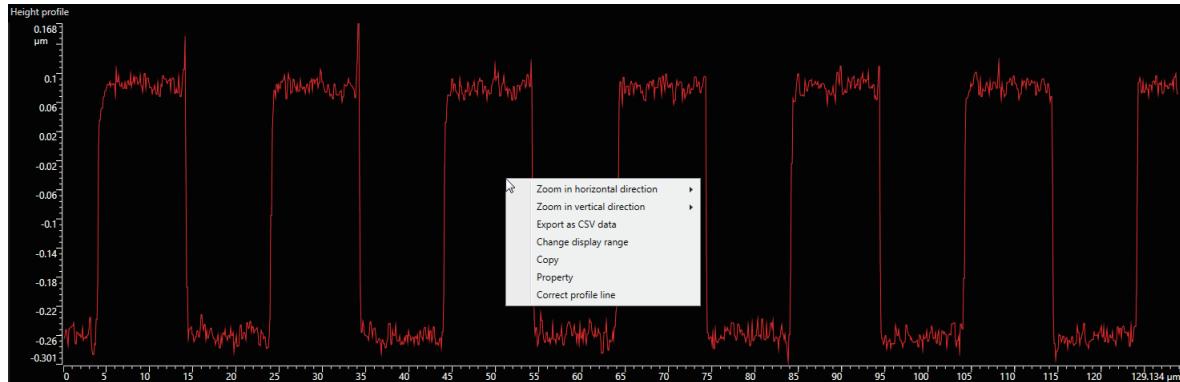
Changes the background color of strings of measurement results.

[i] [OK] button

Changes the settings and close the [View setting] screen.



Profile



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You can define following settings on the profile. Right-click on the profile to display the menu, and select the menu you desire.

- **[Zoom in horizontal direction]**

Sets the horizontal magnification of the profile.

- **[Zoom in vertical direction]**

Sets the vertical magnification of the profile.

- **[Export as CSV data]**

Outputs the profile in CSV file format.

- **[Change display range]**

Sets the display range of the image and the profile. For setting the display range, see “4-4 Setting the display range” (page 60) for details.

- **[Copy]**

Copies the profile as an image.

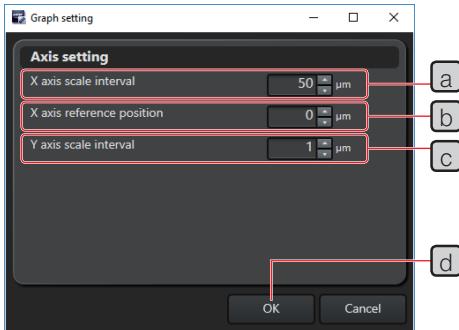
- **[Property]**

Sets the format of the profile. For setting the format, see “Setting the format of the profile” (page 144).

- **[Correct profile line]**

Sets the data processing of the profile. For setting the data processing, see “Correcting the profile” (page 144).

Setting the format of the profile



[a] [X-axis scale interval]

Sets the scale interval on the X-axis.

[b] [X-axis reference position]

Sets the value you want to use as a "0" position on the X-axis.

[c] [Y-axis scale interval]

Sets the scale interval on the Y-axis.

[d] [OK] button

Changes the settings and close the [Graph setting] screen.

Correcting the profile



[a] Profile view area

Displays the profile before correction and the profile after correction (green).

[b] [Tilt removal] checkbox

Check this checkbox to remove the tilt of the profile.

[c] [Filter] checkbox

Check this checkbox to apply the filter processing to the profile.

[d] [Type] radio button

Select the filter type.

[e] [Correction setting]

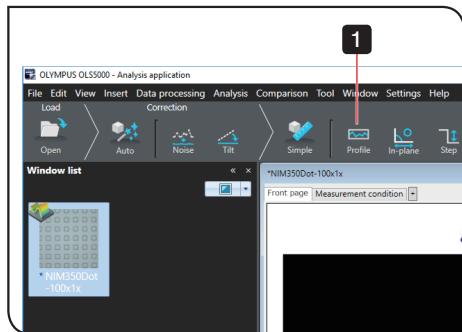
Select either the low pass filter or the high pass filter. If the [Gaussian] or [Spline] radio button is selected in [Type], set the cutoff value.

[f] [OK] button

Changes settings and close the [Correct profile line] screen.

7-3 Operating procedures of the profile measurement

7-3-1 Starting the profile measurement

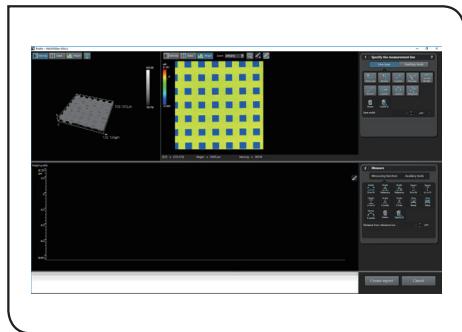


1 Click the [Profile] button.

TIP You can also display the [Profile] screen by selecting [Profile] from the [Analysis] menu.

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The [Profile] screen appears.



7-3-2 Specifying the measurement line

You can specify the measurement line at the measurement position on the 2D image view area on the [Profile] screen. When the measurement line is set, the profile of the measurement line position is displayed on the profile view area.



- If necessary, use the auxiliary tool to draw a point(s) or a line(s) at the position you want to use as a base of the measurement line on the image in advance.
- You can specify the measurement line more efficiently and accurately using auxiliary tools.



For details on auxiliary tools, see “7-4 Measurement line and auxiliary tools” (page 156).



If the [Line type] button is not ON, click the [Line type] button.

The line types are displayed on the measurement line setting area **a**.

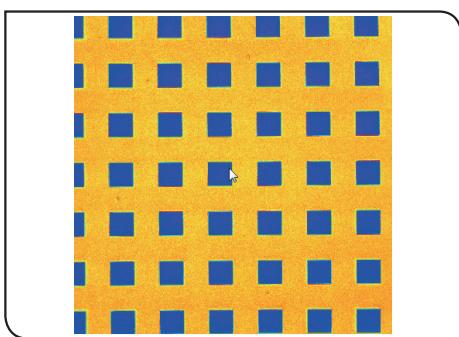
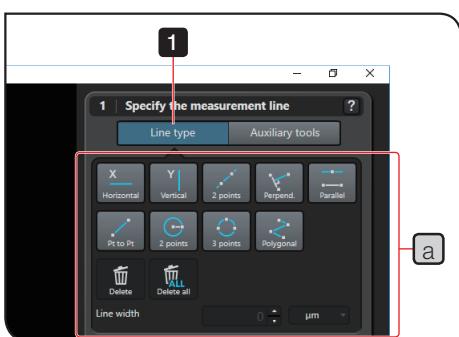


Click the line type button on the measurement line setting area **a**.

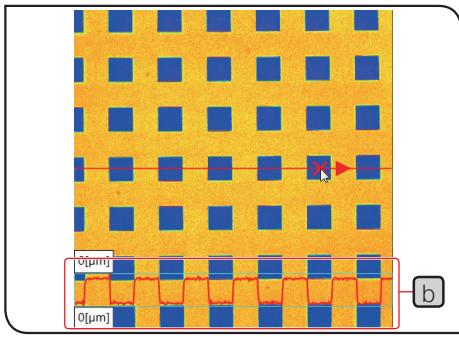
The line type button you selected is pressed (ON).



For details on the line type, see “7-4 Measurement line and auxiliary tools” (page 156).



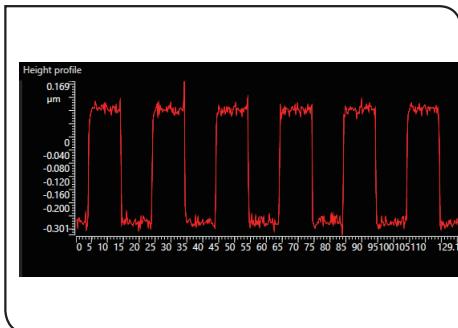
Click any position on the 2D image view area.



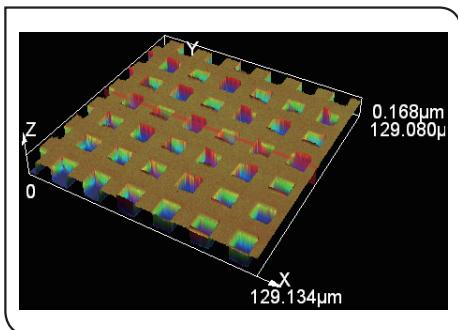
The measurement line is drawn following the movement of the mouse pointer.

The profile (height data) **b** of the measurement line is displayed on the 2D image view area.

The profile is updated following the movement of the measurement line.

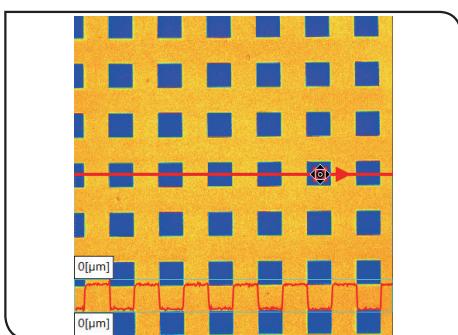


The profile is also displayed on the profile view area.



TIP

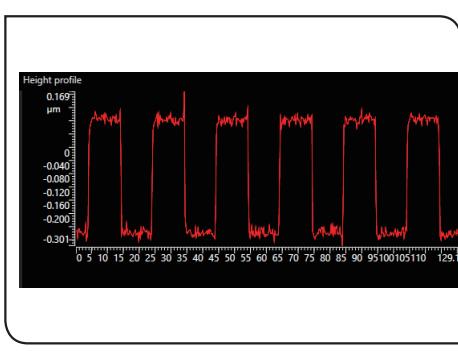
If the measurement line type is set to [Horizontal], [Vertical] or [2 points line], the measurement line (cross-section) position is also displayed on the 3D image view area.



- 4 Move the measurement line position while looking at the profile, and click the mouse at the desired position.

The measurement line is fixed.

The profile is also fixed.



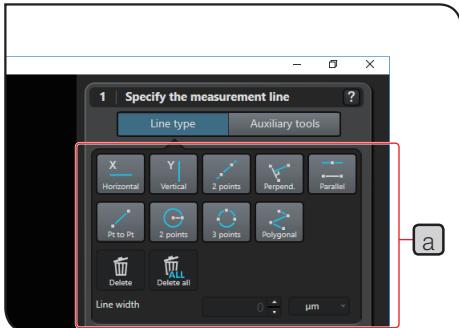
- 5 If you want to specify multiple measurement lines, repeat steps from **2** to **4**.

TIP

The measurement line is added in the order of red, green, blue, pink and yellow.

7-3-3 Editing the measurement line

You can edit or delete the measurement line, if necessary.

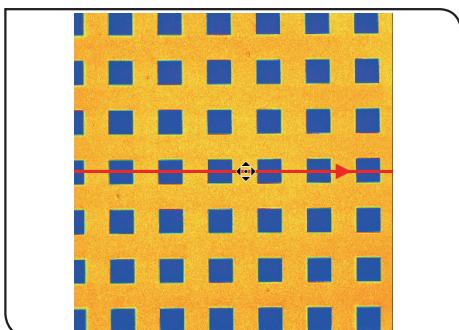


Make sure that all line type buttons on the measurement line setting area **a** are OFF before editing the measurement line.

TIP

If the line type button is ON, when you click on the 2D image view area, the measurement line is specified.

Selecting the measurement line

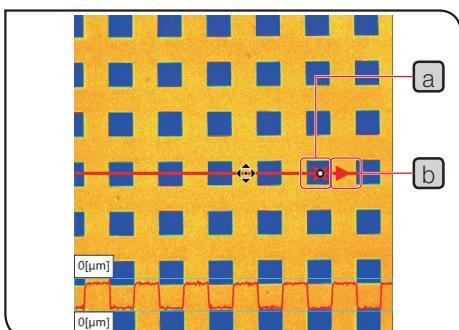


- 1 Click on the measurement line on the 2D image view area.

The measurement line is selected and highlighted.

The mouse pointer position when the measurement line is specified is displayed as a “specified point” **a** with a circle and a cross line.

The arrow **b** indicating the profile direction is displayed.



Changing the size or the position of the measurement line

TIP

For changing the size or the position of the measurement line, see "Measurement line types" (page 411).

Changing the measurement line width

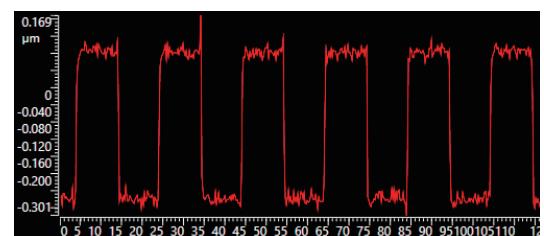
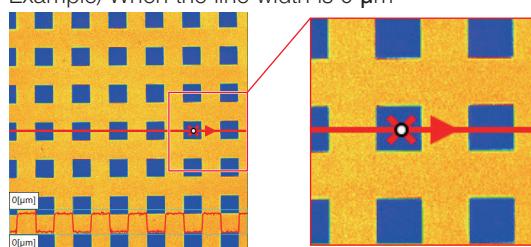
TIP

As the profile is created with the average measurement line width, if you increase the measurement line width, you can make the profile with less noise.

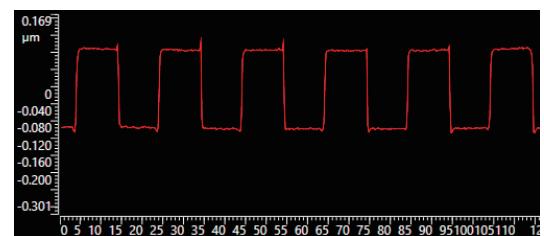
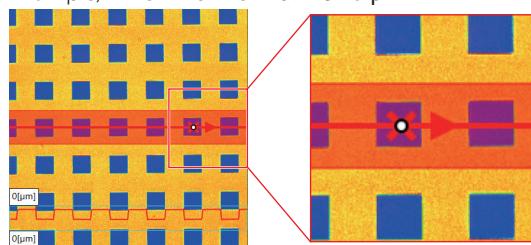
- 1 Select either [μm] or [Pixel] for specifying the line width from the [Line width] dropdown list **c**.
- 2 Specify the line width by either the length or the pixel in the [Line width] setting field **d**.

If you increase the line width, the measurement line width is masked.

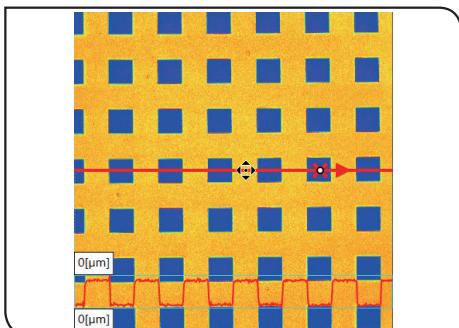
Example) When the line width is 0 μm



Example) When the line width is 18 μm



Deleting the measurement line



7

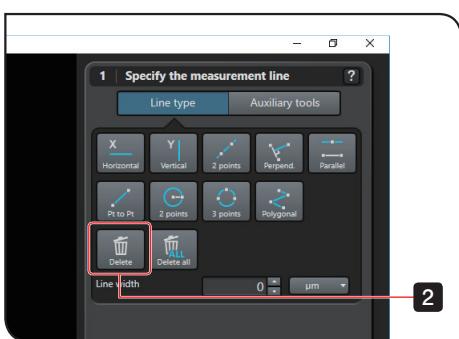
Deleting the selected measurement line

- 1 Click on the measurement line you want to delete on the 2D image view area.

- 2 Click the [Delete] button.

When the message confirming to delete the measurement line appears, click the [Yes] button.

The measurement line is deleted.

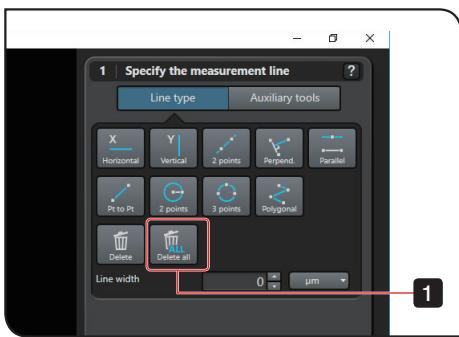


Deleting all measurement lines

- 1 Click the [Delete all] button.

When the message confirming to delete all measurement lines appears, click the [Yes] button.

All measurement lines are deleted.



7-3-4 Selecting the measurement item and specifying the measurement position

 Point

- If necessary, use the auxiliary tool to draw a point(s) or a line(s) at the position you want to use as a base of the measurement position on the profile in advance.
- You can specify the measurement positions more efficiently and accurately using auxiliary tools.

TIP

For details on auxiliary tools, see "7-5 Measurement item and auxiliary tools" (page 160).

- 1 If the [Measuring function] button is not ON, click the [Measuring function] button.

The measurement items are displayed on the measurement item setting area **a**.

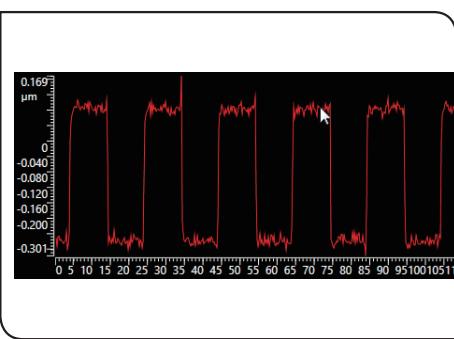
- 2 Click the measurement item button on the measurement item setting area **a**.

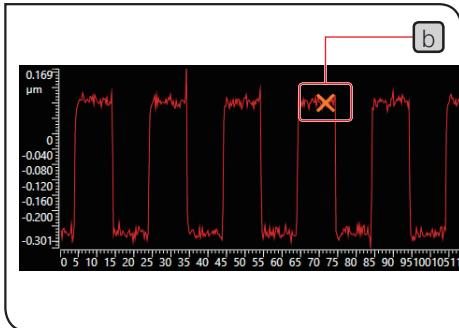
The measurement item button you selected is pressed (ON).

TIP

For details on measurement items, see "7-5 Measurement item and auxiliary tools" (page 160).

- 3 Click a position you want to measure on the profile view area.

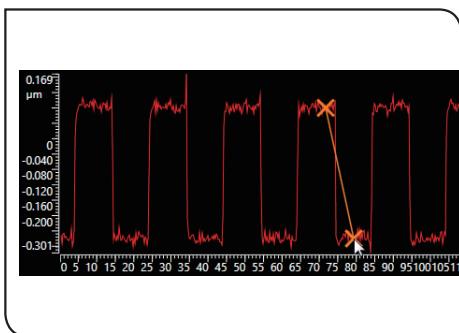
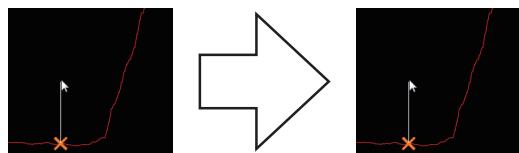




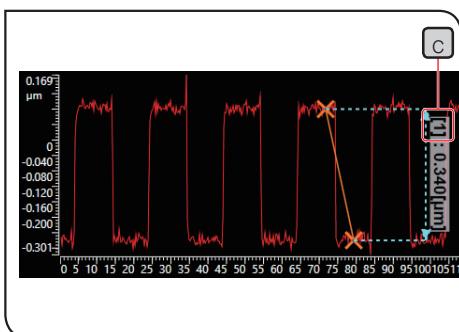
The “specified point” **b** with a cross point is created at the position where you clicked the mouse.

TIP

The “specified point” is created on the profile automatically even though you do not click on the profile. A “specified point” is a point at the intersection of the perpendicular line drawn from the clicked position with the profile.



4 Click a position you want to measure according to the measurement item.



5 Finally, click a position you want to display measurement results.

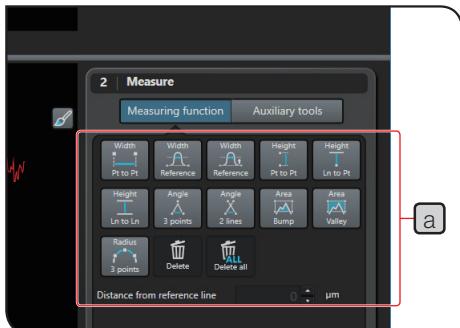
6 If you want to measure on multiple positions, repeat steps from **2** to **5**.

TIP

The sequential number **c** is displayed at the beginning of measurement results in the order of specifying measurement items.

7-3-5 Editing the measurement item

You can edit or delete the measurement item, if necessary.

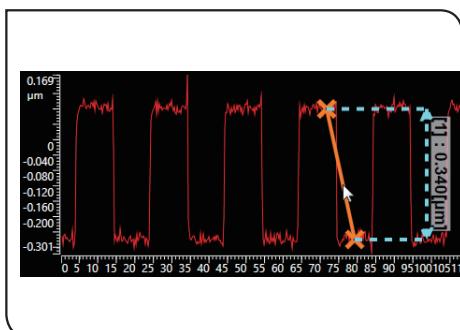


Make sure that all measurement item buttons on the measurement item setting area **a** are OFF before editing the measurement item.

TIP

If the measurement item button is ON, when you click on the profile view area, the measurement position is specified.

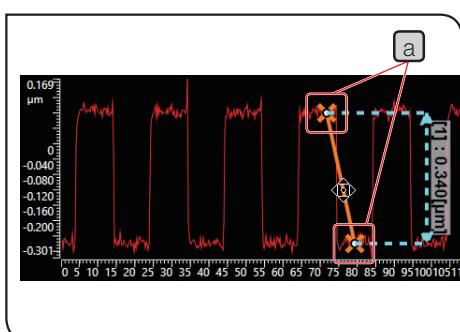
Selecting the measurement item



- Click on the measurement item on the profile view area.

The measurement item is selected and highlighted.

The mouse pointer position when the measurement item is specified is displayed as a "specified point" **a** with a circle and a cross line.

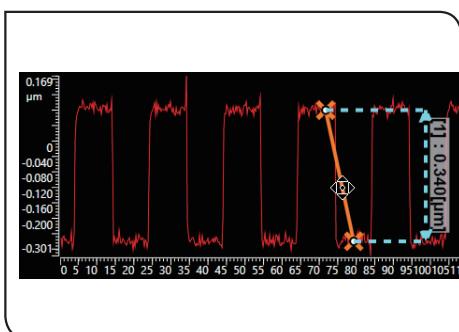


Changing the size or the position of the measurement item

TIP

For changing the size or the position of the measurement item, see “7-5-1 Measurement item types used in the profile measurement” (page 160).

Deleting the measurement item



Deleting the selected measurement item

- 1 Click on the measurement item you want to delete on the profile view area.

- 2 Click the [Delete] button.

When the message confirming to delete the measurement item appears, click the [Yes] button.

The measurement item is deleted.

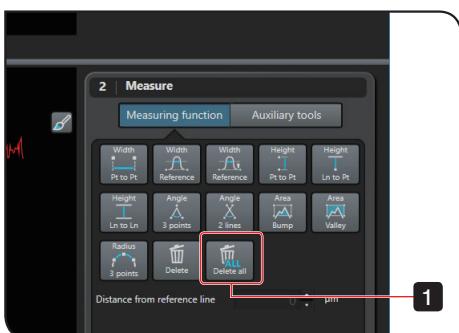


Deleting all measurement items

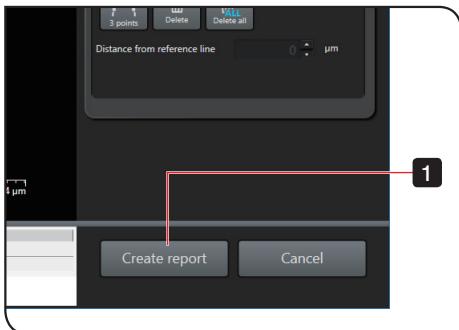
- 1 Click the [Delete all] button.

When the message confirming to delete all measurement items appears, click the [Yes] button.

All measurement items are deleted.

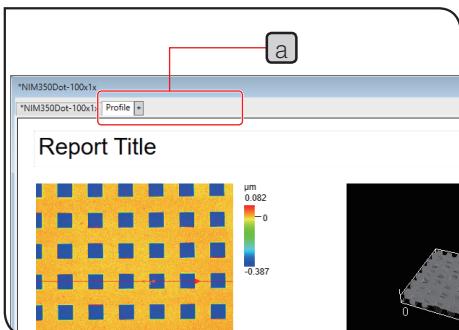


7-3-6 Creating the report



When you finish specifying measurement items, create the report.

- Click the [Create report] button.



The [Profile] tab **a** is added to the data view window and the report is displayed.

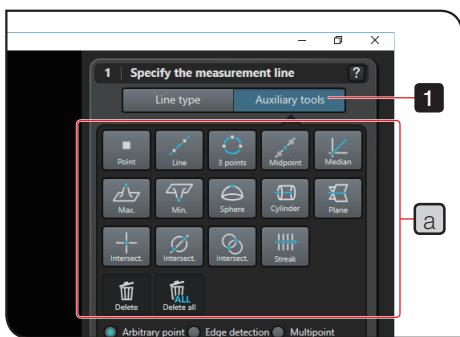
TIP

- You can redo the profile measurement by double-clicking on either the 2D image data, the 3D image data, the profile or measurement results on the report.
- For details on redoing the measurement, see “3-3-4 Redoing the measurement analysis” (page 38).

7-4 Measurement line and auxiliary tools

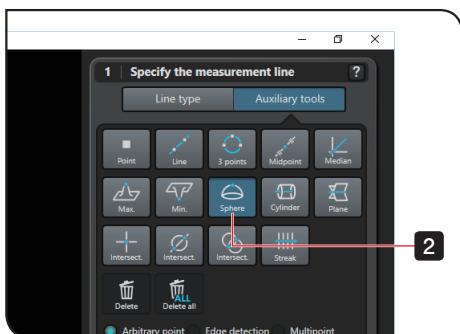
7-4-1 Specifying the measurement line using auxiliary tools

This section describes the procedures to search a sphere center and create a point using auxiliary tools by recognizing the three-dimensional shape in the region specified on the 2D image as a sphere surface, and to specify the measurement line using points created at 2 positions.



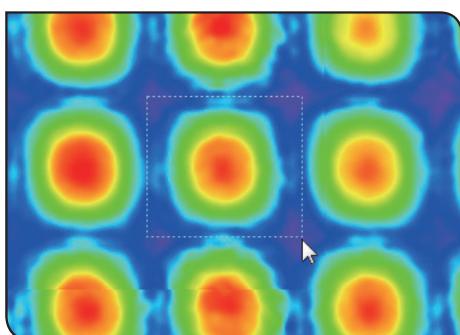
- 1 Click the [Auxiliary tools] button.

The auxiliary tools are displayed on the measurement line setting area **a**.

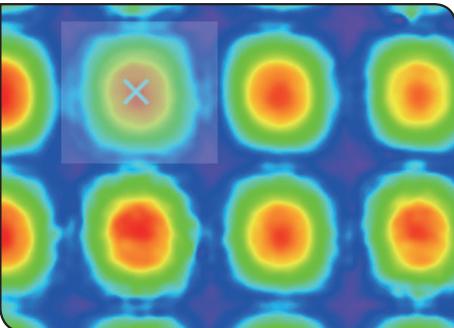


- 2 Click the [Sphere center] button.

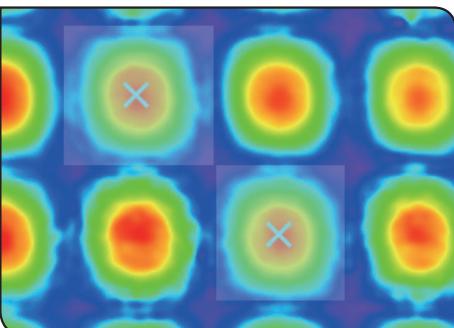
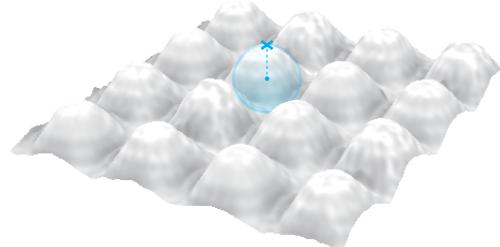
The [Sphere center] button is pressed.



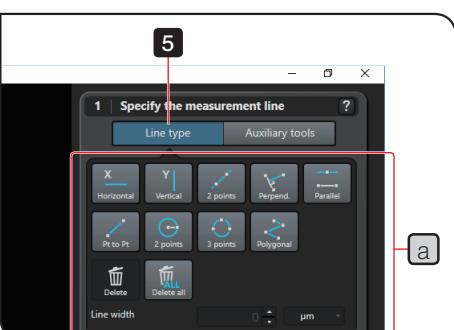
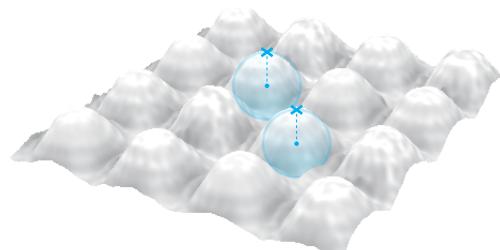
- 3 Drag a position you want to recognize as a sphere surface on the 2D image view area.



The specified region is recognized as a sphere surface, and a “specified point” with a cross line is created at the sphere center position.

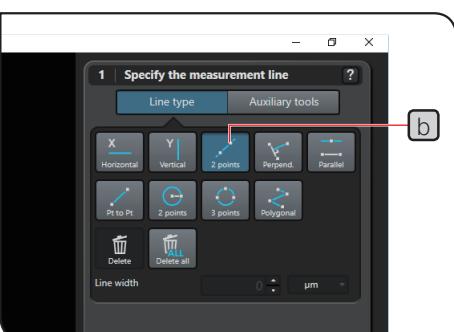


- 4** Repeat step **3** to specify the second specified point.



- 5** Click the [Line type] button.

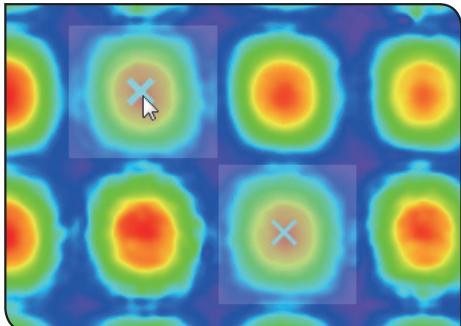
The line types are displayed on the measurement line setting area **a**.



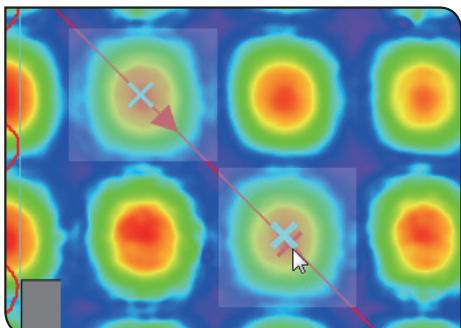
- 6** Click the [2 points line] button **b**.

The [2 points line] button is pressed.

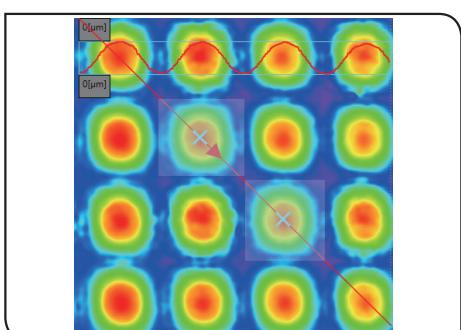
7



- 7 On the 2D image view area, move the mouse pointer closer to the first specified point and click the position where the specified point is highlighted.



- 8 Move the mouse pointer closer to the second specified point and click the position where the specified point is highlighted.



The measurement line passing through two specified points is created.

7-4-2 Measurement line types used in the profile measurement



■[Horizontal]

Draws a horizontal line passing through a single point.



■[2 points line]

Draws a line passing through two points.



■[Parallel line]

Draws a line that is parallel to the line passing through two points and that also passes through a third point.



■[2 points circle]

Draws a circle with a first point as a center of circle and with a second point as a circumference.



■[Multipoint]

Draws a polygonal line with a first point as a start point and with points after a second point as vertexes.



TIP For details on the measurement line, see "Measurement line types" (page 411).



■[Vertical]

Draws a vertical line passing through a single point.



■[Perpendicular line]

Draws a line that is perpendicular to the line passing through two points and that also passes through a third point.



■[Point to point]

Draws a line that connects a start point and an end point.



■[3 points circle]

Draws a circle with three points as a circumference.

7-4-3 Auxiliary tool types used in the profile measurement



■[Point]

Draws a point.



■[3 points circle]

Draws a circle with three points as a circumference.



■[Median line]

Draws a median line of two lines.



■[Minimum height]

Draws the lowest position in Z-axis direction in the region as a point.



■[Cylinder axis]

Recognizing the three-dimensional shape in the region as a side surface of the cylinder, draws a center axis as a line.



■[Intersection line to line]

Draws a point at the intersection of two lines.



■[Intersection circle to circle]

Draws a point at the intersection of two circles.



■[Line]

Draws a line passing through two points.



■[Midpoint]

Draws a midpoint of two points.



■[Maximum height]

Draws the highest position in Z-axis direction in the region as a point.



■[Sphere center]

Recognizing the three-dimensional shape in the region as a sphere, draws a point at the center position of the sphere.



■[Surface intersection line]

Recognizing the three-dimensional shape in the region as a plane, draws its cross line.



■[Intersection circle to line]

Draws a point at the intersection of circle and line.



■[Streak]

Draw a line orthogonal to the texture of the sample surface in the region.



TIP For details on auxiliary tools, see "Auxiliary tool types" (page 416).

7-5 Measurement item and auxiliary tools

7-5-1 Measurement item types used in the profile measurement



Click the [Measuring function] button **a** on the measurement item setting area.

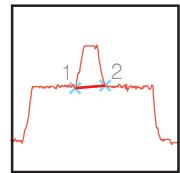
The measurement items are displayed on the measurement item setting area **b**.



- The color of the reference line or the measurement line described in this chapter has been set as default.
- You can change the color of the reference line or the measurement line.
- For details, see “View setting” screen (page 142).



[Width point to point]
Measures the width between two points on the profile.



1 Click the [Width point to point] button.

2 Click a position you want to set as a first point on the profile.

The first point is created on the profile.

Moving the mouse displays the second point on the profile.

3 Click a position you want to set as a second point.

The second point is created on the profile.

Moving the mouse displays measurement results.

4 Click a position you want to display measurement results.

The measurement results are created.

To edit:

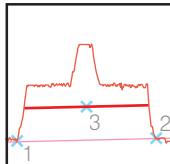
Dragging the line that connects points allows you to move on the profile keeping the distance between points.

Dragging the point allows you to adjust the measurement position.

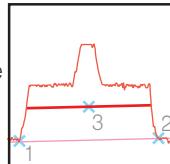
Dragging measurement results allows you to move the view position of measurement results.

**[Width reference line]**

Measures the length of the line (measurement line) inside the profile, that is parallel to the line passing through two points (reference line) and that also passes through a third point.

**[Width reference line]**

Measures the length of the line (measurement line) inside the profile, that is parallel to the line passing through two points (reference line) and that also passes through a third point. You can specify the distance between the reference line and the measurement line.



- 1** Click the [Width reference line] button.
- 2** Click a position you want to set as a first point of the reference line on the profile.
The first point of the reference line is created on the profile.
Moving the mouse displays the second point and the reference line (pink color) on the profile.
- 3** Click a position you want to set as a second point.
The second point and the reference line are created on the profile.
Moving the mouse displays the measurement line (orange color).
- 4** Click a position you want to create a measurement line.
The measurement line is created.
Moving the mouse displays measurement results.
- 5** Click a position you want to display measurement results.
The measurement results are created.

To edit:

Dragging the reference line (pink color) allows you to move the reference line or the measurement line.
Dragging the point on the reference line allows you to adjust the angle of the reference line and the measurement line.
Dragging the point on the measurement line allows you to move the measurement line.
Dragging measurement results allows you to move the view position of measurement results.

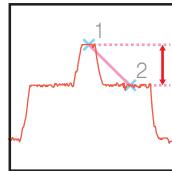
- 1** Click the [Width reference line] button.
- 2** Click a position you want to set as a first point of the reference line on the profile.
The first point of the reference line is created on the profile.
Moving the mouse displays the second point and the reference line (pink color) on the profile.
- 3** Click a position you want to set as a second point.
The second point and the reference line are created on the profile.
Moving the mouse displays the measurement line (orange color).
- 4** Click a position you want to create a measurement line.
The measurement line is created.
Moving the mouse displays measurement results.
- 5** Click a position you want to display measurement results.
The measurement results are created.

To edit:

Dragging the reference line (pink color) allows you to move the reference line.
Dragging the point on the reference line allows you to adjust the angle of the reference line and the measurement line.
Dragging the point on the measurement line allows you to move the measurement line.
You can specify the distance between the reference line and the measurement line in the [Distance from reference line] setting field.
Dragging measurement results allows you to move the view position of measurement results.



[Height point to point]
Measures the difference between two points on the profile.



- 1 Click the [Height point to point] button.
- 2 Click a position you want to set as a first point on the profile.
The first point is created on the profile.
Moving the mouse displays the second point on the profile.
- 3 Click a position you want to set as a second point.
The second point is created on the profile.
Moving the mouse displays measurement results.
- 4 Click a position you want to display measurement results.
The measurement results are created.

To edit:

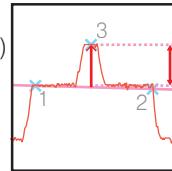
Dragging the line that connects points allows you to move on the profile keeping the distance between points.

Dragging the point allows you to adjust the measurement position.

Dragging measurement results allows you to move the view position of measurement results.



[Height line to point]
Measures the difference (step) between the line passing through two points on the profile and the measurement point.



- 1 Click the [Height line to point] button.
- 2 Click a position you want to set as a first point of the reference line on the profile.
The first point of the reference line is created on the profile.
Moving the mouse displays the second point and the reference line (pink color) on the profile.
- 3 Click a position you want to set as a second point.
The second point and the reference line are created on the profile.
Moving the mouse displays the measurement point (orange color).
- 4 Click a position you want to measure the height from the reference line.
The measurement point is created.
Moving the mouse displays measurement results.

To edit:

Dragging the reference line (pink color) allows you to move the reference line.

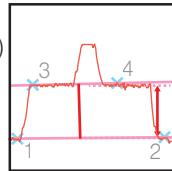
Dragging the point on the reference line allows you to adjust the angle of the reference line.

Dragging the measurement point (orange color) allows you to move the measurement point.

Dragging measurement results allows you to move the view position of measurement results.

**[Height line to line]**

Measures the difference (step) between two lines passing through two points on the profile.



- 1 Click the [Height line to line] button.

- 2 Click a position you want to set as a first point of the line 1.

The first point of the line 1 (pink color) is created.

Moving the mouse displays the second point of the line 1.

- 3 Click a position you want to set as a second point.

The second point and the line 1 are created.

- 4 In the same manner, create the line 2.

Moving the mouse displays measurement results.

- 5 Click a position you want to display measurement results.

The measurement results are created.

To edit:

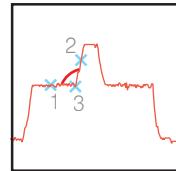
Dragging the line 1 (pink color) or the line 2 (orange color) allows you to move the line 1 or the line 2.

Dragging the point on the line 1 or the line 2 allows you to adjust the line 1 or the line 2.

Dragging measurement results allows you to move the view position of measurement results.

**[Angle 3 points]**

Measures an exterior angle or an interior angle of the intersection point of two lines each of which connects a first point or a second point on the profile with a arbitrary third point.



- 1 Click the [Angle 3 points] button .

- 2 Click a position you want to set as a first point on the profile.

The first point is created.

- 3 Click a position you want to set as a second point on the profile.

The second point is created.

Moving the mouse displays a third point.

- 4 Click a position you want to measure the angle.

The third point is created.

Moving the mouse displays measurement results.

- 5 Click a position you want to display measurement results.

The exterior angle or the interior angle is measured according to the measurement result position.

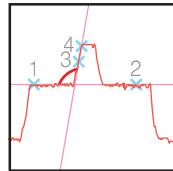
To edit:

Dragging points or lines connecting points allows you to move on the profile keeping the distance between points.

Dragging measurement results allows you to move the view position of measurement results. Also, moving the view position allows you to select measuring the exterior angle or the interior angle.



[Angle 2 lines]
Measures the angle of intersection between two lines passing through two points.



- 1 Click the [Angle 2 lines] button.
- 2 Click a position you want to set as a first point of the line 1.

The first point of the line 1 (pink color) is created.

Moving the mouse displays the second point of the line 1.

- 3 Click a position you want to set as a second point.
The second point and the line 1 are created.
- 4 In the same manner, create the line 2 (orange color).
Moving the mouse displays measurement results.

- 5 Click a position you want to display measurement results.

The measurement results are created.

To edit:

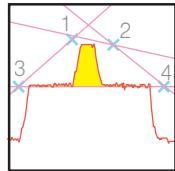
Dragging the line 1 (pink color) or the line 2 (orange color) allows you to move the line 1 or the line 2.

Dragging the point on the line 1 or the line 2 allows you to adjust the line 1 or the line 2.

Dragging measurement results allows you to move the view position of measurement results.



[Area cross-sectional area]
Measures the cross-sectional area of the profile in the polygon.



- 1 Click the [Area cross-sectional area] button.
- 2 Click a position you want to set as a vertex 1 of the polygon.

The vertex 1 is created.

- 3 In the same manner, create up to the vertex 4.

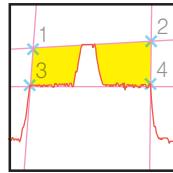
The polygon, measurement region(s) and measurement results are created.

To edit:

Dragging the vertex 1, 2, 3 or 4 allows you to adjust the polygon.

**[Area dent]**

Measures the dent of the profile in the polygon.



- 1** Click the [Area dent] button.

- 2** Click a position you want to set as a vertex 1 of the polygon.

The vertex 1 is created.

- 3** In the same manner, create up to the vertex 4.

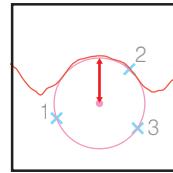
The polygon, measurement region(s) and measurement results are created.

To edit:

Dragging the point allows you to adjust the polygon.

**[Radius 3 points]**

Measures the radius of a circle with three points as a circumference.



- 1** Click the [Radius 3 points] button .

- 2** Click a position you want to set as a first point of a circle.

- 3** Click a position you want to set as a second point.

Moving the mouse displays the circle.

- 4** Click a position you want to set as a third point.

The circle is created.

Moving the mouse displays measurement results.

- 5** Click a position you want to display measurement results.

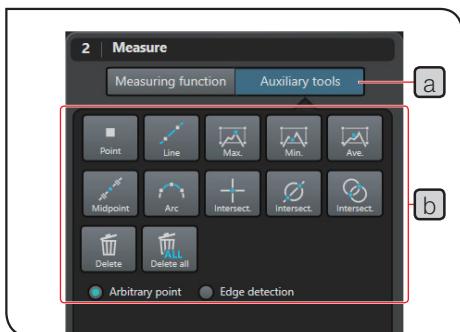
The measurement results are created.

To edit:

Dragging on the circumference or the center of the circle allows you to move the circle.

Dragging the point on the circumference allows you to adjust the position or the size of the circle.

7-5-2 Auxiliary tool types used in the profile measurement



Click the [Auxiliary tools] button **a** on the measurement item setting area.

The auxiliary tools are displayed on the measurement item setting area **b**.



[Point]
Draws a point.



[Line]
Draws a line passing through two points.

1 Click the [Point] button .

2 Click any position on the profile view area.

The point is created.

To edit:

Dragging the point allows you to adjust the point position.

1 Click the [Line] button .

2 Click a position you want to set as a first point of the line on the profile view area.

Moving the mouse displays the line.

3 Click a position you want to set as a second point of the line.

The line is created.

To edit:

Dragging the line allows you to move the line.

Dragging the point allows you to adjust the angle of the line.

**[Maximum height]**

Draws the highest position in Z-axis direction in the region as a point.

- 1** Click the [Maximum height] button.
- 2** On the profile view area, drag from a position you want to set as a start point to a position you want to set as an end point of the region.

The region is created on the profile, and the point is created at the highest position of the region.

To edit:

Dragging the region allows you to move the region.

Dragging the handle on the outside frame of the region allows you to adjust the position and the size of the region.

Editing the region allows you to update the point at the highest position.

**[Minimum height]**

Draws the lowest position in Z-axis direction in the region as a point.

- 1** Click the [Minimum height] button.
- 2** On the profile view area, drag from a position you have set as a start point to the position you want to set as an end point of the region.

The region is created on the profile, and the point is created at the lowest position of the region.

7

To edit:

Dragging the region allows you to move the region.

Dragging the handle on the outside frame of the region allows you to adjust the position and the size of the region.

Editing the region allows you to update the point at the lowest position.

**■[Average]**

Draws a position of the average of height data in the region as a point.

- 1 Click the [Average] button .

- 2 On the profile view area, drag from a position you want to set as a start point to a position you want to set as an end point of the region.

The region is created on the profile and the point is created at the average position of height data in the region.

To edit:

Dragging the region allows you to move the region.

Dragging the handle on the outside frame of the region allows you to adjust the position and the size of the region.

Editing the region allows you to update the point at the average position of height data.

**■[Midpoint]**

Draws a midpoint of two points.

- 1 Click the [Midpoint] button .

- 2 Click a position you want to set as a first point on the profile view area.

Moving the mouse displays the line.

- 3 Click a position you want to set as a second point.

The midpoint of the line that connects two points is created on the profile.

To edit:

Dragging the line allows you to move the line.

Dragging the point at the end of the line allows you to adjust the angle or the length of the line.

Editing the line allows you to update the midpoint.



[Arc]
Draws an arc on the profile.



[Intersection line to line]
Draws a point at the intersection of two lines.

- 1 Click the [Arc] button.
- 2 Click a position you want to set as a first point on the profile view area.
Moving the mouse displays a second point.
- 3 Click a position you want to set as a second point.
Moving the mouse displays a third point.
- 4 Click a position you want to set as a third point.
The arc is created on the profile.

To edit:

Dragging the arc allows you to move the arc.
Dragging the point allows you to adjust the arc.

- 1 Click the [Intersection line to line] button .
- 2 Click a position you want to set as a first point of the line 1.
Moving the mouse displays a second point of the line 1 (pink color).
- 3 Click a position you want to set as a second point.
In the same manner, create a line 2 (green color).
- 4 The intersection point of two lines is created on the profile.

7

To edit:

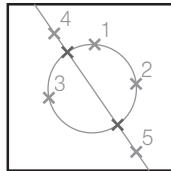
Dragging the line 1 (pink color) or the line 2 (green color) allows you to move the line 1 or the line 2.

Dragging the point on the line 1 or the line 2 allows you to adjust the line 1 or the line 2.



■ [Intersection circle to line]

Draws a point at the intersection of circle and line.



- 1 Click the [Intersection circle to line] button.
 - 2 Click a position you want to set as a first point of the circle on the 2D image view area.
 - 3 Click a position you want to set as a second point.
- Moving the mouse displays the circle.
- 4 Click a position you want to set as a third point.
- The circle is created.
- 5 Click a position you want to set as a first point of the line.
- Moving the mouse displays the line.
- 6 Click a position you want to set as a second point of the line.
- The line and the intersection points (circle and line) are created.

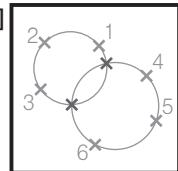
To edit:

Dragging the circumference allows you to move the circle.
 Dragging the point at the center of the circle allows you to move the circle.
 Dragging the point on the circumference allows you to adjust the position or the size of the circle.
 Dragging the line allows you to move the line.
 Dragging the point on the line allows you to adjust the angle of the line.
 Editing the circle or the line allows you to update the intersection point.



■ [Intersection circle to circle]

Draws a point at the intersection of two circles.

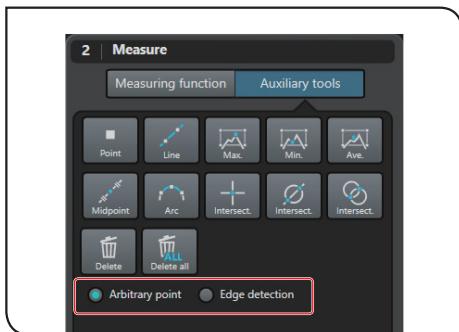


- 1 Click the [Intersection circle to circle] button.
 - 2 Click a position you want to set as a first point of the circle 1 on the 2D image view area.
 - 3 Click a position you want to set as a second point.
- Moving the mouse displays the circle.
- 4 Click a position you want to set as a third point.
- The circle 1 is created.
- 5 In the same manner, create the circle 2.
- The intersection points (circle 1 and circle 2) are created.

To edit:

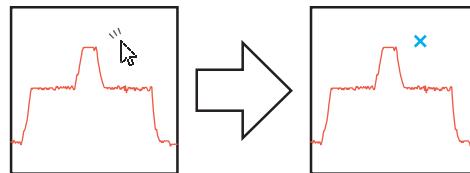
Dragging the circumference allows you to move the circle.
 Dragging the point at the center of the circle allows you to move the circle.
 Dragging the point on the circumference allows you to adjust the position or the size of the circle.
 Editing the circle allows you to update the intersection point.

Detecting a point or a line



■[Arbitrary point]

Creates a “point” or a “line” on the clicked position.

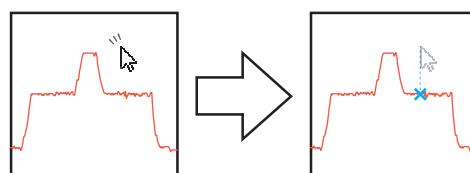


■[Auto edge detection]

Detects the position on the profile in perpendicular direction from the clicked position and creates a “point” or a “midpoint”.

Creates a “line”, etc. that fits the profile automatically from the surrounding area of the clicked position.

This function is not available for [Maximum height], [Minimum height] or [Average].

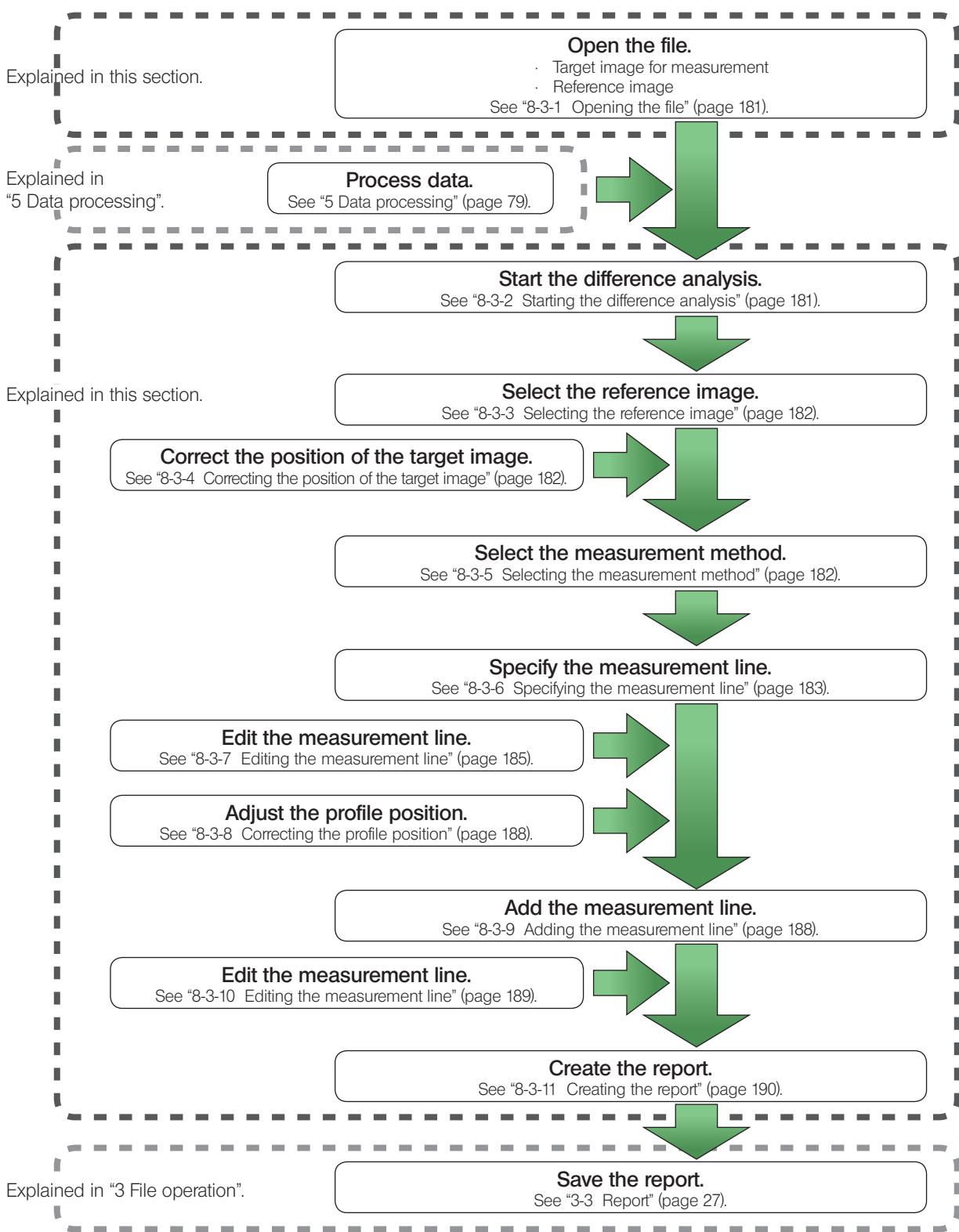


8 Difference analysis

You can measure the difference (area or height difference) between the height profile of two image data.

8-1 Flow of the difference analysis

8-1-1 Flow of the difference analysis on line



8-1-2 Flow of the difference analysis on surface

Explained in this section.

Explained in
“5 Data processing”.

Explained in this section.

Open the file.

- Target image for measurement
- Reference image

See “8-4-1 Opening the file” (page 191).

Process data.

See “5 Data processing” (page 79).

Start the difference analysis.

See “8-4-2 Starting the difference analysis” (page 191).

Correct the position of the target image.

See “8-4-4 Correcting the position of the target image” (page 192).

Select the measurement method.

See “8-4-5 Selecting the measurement method” (page 192).

Specify the measurement region.

See “8-4-6 Specifying the measurement region” (page 193).

Edit the measurement region.

See “8-4-7 Editing the measurement region” (page 193).

Set the sectioning level. (Specify the threshold)

See “8-4-8 Setting the sectioning level” (page 194).

Create the report.

See “8-4-9 Creating the report” (page 197).

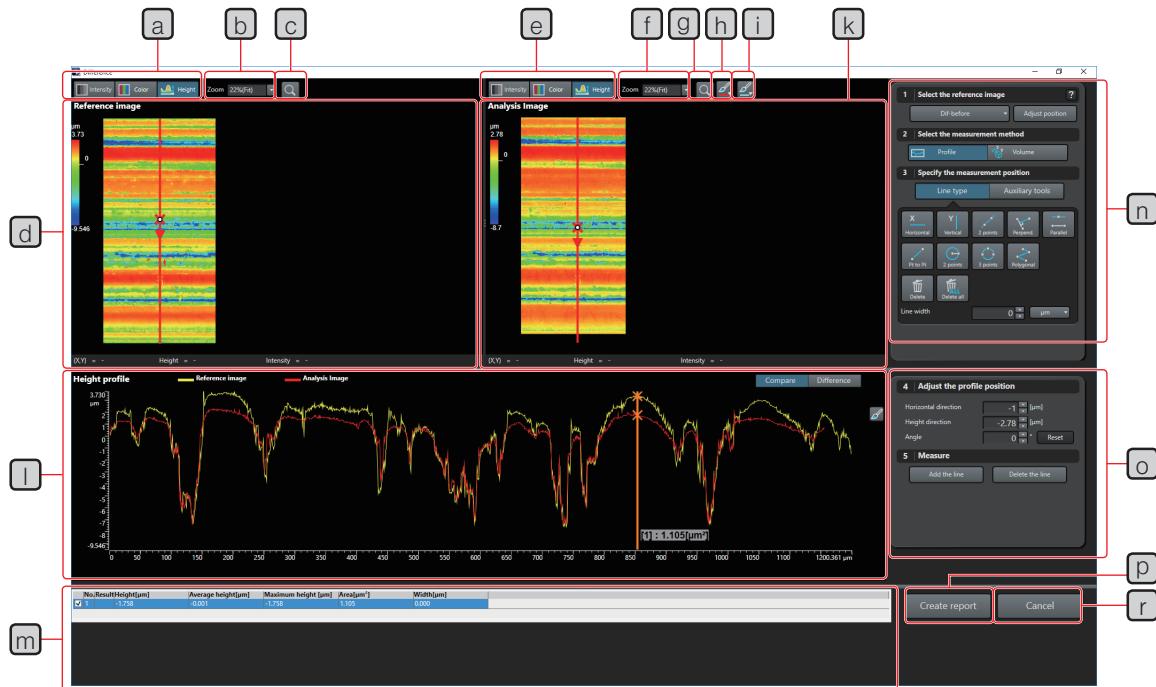
Save the report.

See “3-3 Report” (page 27).

Explained in “3 File operation”.

8-2 Screen used in the difference analysis

8-2-1 [Difference] screen used in the difference analysis on line



a Reference image data selection button

Selects either the laser intensity image, the color image or the height image on the reference image view area of the difference analysis.

b Reference image magnification dropdown list

Select the magnification to display the reference image. Or input the numerical value.

c Loupe button

Zooms in the mouse pointer position on the reference image view area.

d Reference image view area

Displays the reference image in 2D.
Rotating the mouse wheel on the image zooms in or out the image.
The information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the reference image view area is displayed on the status bar.

e Target image data selection button

Selects either the laser intensity image, the color image or the height image on the target image view area of the difference analysis.

f Magnification dropdown list

Select the magnification to display the target image. Or input the numerical value.

g Loupe button

Zooms in the mouse pointer position on the target image view area.

h Measurement line color button

Sets the color of the measurement line selected on the target image view area.

i Auxiliary tool color button

Sets the color of the auxiliary tool on the target image view area.

(**k** to **r** are described on the next page.)



(a) to (i) are described on the previous page.)

[k] Target image view area

Displays the target image and the measurement line. Rotating the mouse wheel on the image zooms in or out the image.

You can change the color of the measurement line. Click the button for selecting the measurement line color (h), and select the color from the color pallet. The information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the target image view area is displayed on the status bar.

[l] Profile view area

The profile of the measurement line position on the target image view area is displayed. Specifying the measurement position on the profile displays analysis results. You can change the font and the color of analysis results. For the screen to change the color, see “[View setting] screen” (page 176).

Rotating the mouse wheel on the profile zooms in or out the profile.

[m] Analysis results view area

Displays analysis results obtained from the measurement position on the profile.

[n] Measurement line setting area

Select the method to specify the measurement line.

[o] Measurement item setting area

Select the measurement item.

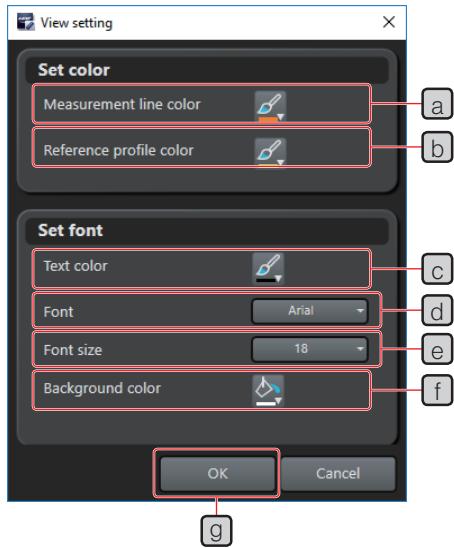
[p] [Create report] button

Creates the report based on analysis results obtained from the measurement position on the profile.

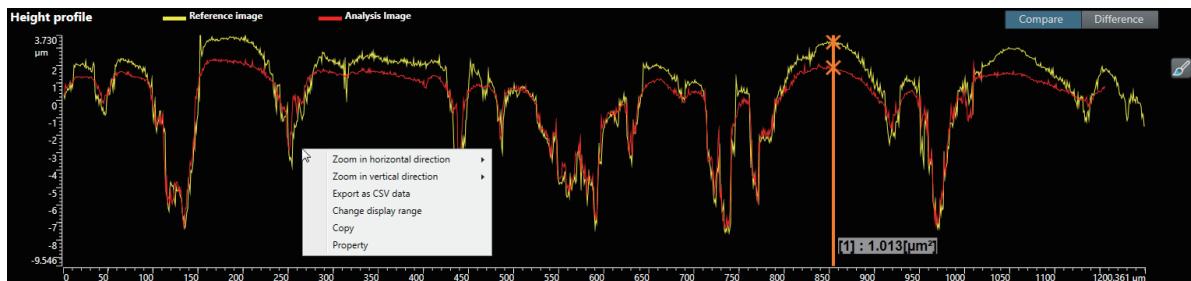
[r] [Cancel] button

Cancels the difference analysis.

[View setting] screen



- [a] **[Measurement line color] button**
Changes the color to display the measurement line.
- [b] **[Reference profile color] button**
Changes the color of the profile of the reference image.
- [c] **[Text color] button**
Changes the color of strings of measurement results.
- [d] **[Font] dropdown list**
Changes the font of strings of measurement results.
- [e] **[Font size] dropdown list**
Changes the font size of strings of measurement results.
- [f] **[Background color] button**
Changes the background color of strings of measurement results.
- [g] **[OK] button**
Changes the settings and close the [View setting] screen.

Profile

You can define following settings on the profile. Right-click on the profile to display the menu, and select the menu you desire.

• **[Zoom in horizontal direction]**

Sets the horizontal magnification of the profile.

• **[Zoom in vertical direction]**

Sets the vertical magnification of the profile.

• **[Export as CSV data]**

Outputs the profile in CSV file format.

• **[Change display range]**

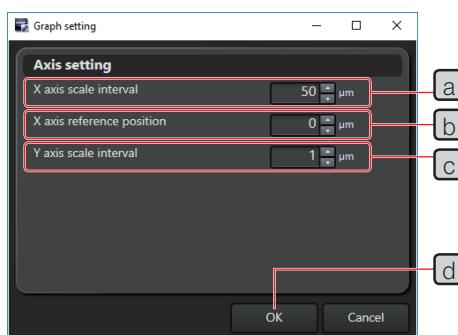
Sets the display range of the image and the profile. For setting the display range, see “4-4 Setting the display range” (page 60) for details.

• **[Copy]**

Copies the profile as an image.

• **[Property]**

Sets the format of the profile. For setting the format, see “Setting the format of the profile” (page 177).

Setting the format of the profile

a [X-axis scale interval]

Sets the scale interval on the X-axis.

b [X-axis reference position]

Sets the value you want to use as a “0” position on the X-axis.

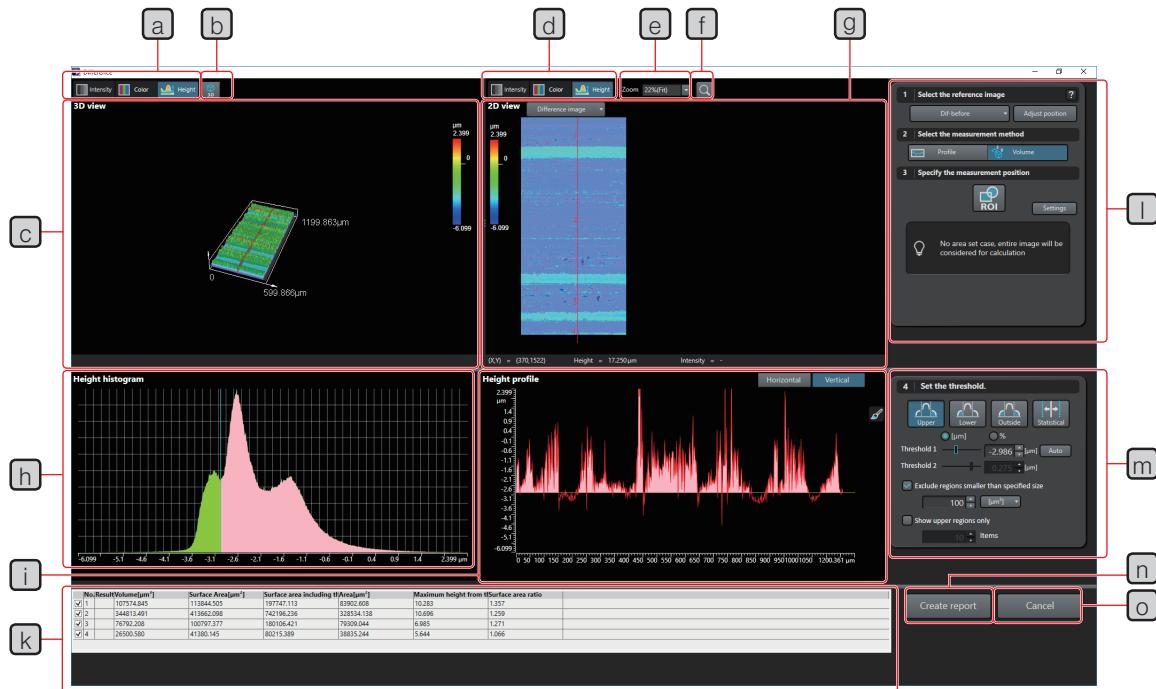
c [Y-axis scale interval]

Sets the scale interval on the Y-axis.

d [OK] button

Changes the settings and close the [Graph setting] screen.

8-2-2 [Difference] screen used in the difference analysis on surface



a 3D image data selection button

Selects either the laser intensity image, the color image or the height image on the 3D image view area.

b Advanced setting button for 3D image

Displays the screen to define advanced settings for displaying the 3D image. For details on the screen, see "4-2-1 Screens used with the 3D view" (page 51).

c 3D image view area

Displays the 3D image.

Dragging the image allows you to change the angle to display the image.

Rotating the mouse wheel on the image zooms in or out the image.

Dragging the image while holding down the right button of the mouse allows you to move the view position.

d 2D image data selection button

Selects either the laser intensity image, the color image or the height image on the 2D image view area.

e Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

f Loupe button

Zooms in the mouse pointer position on the 2D image view area.

g 2D image view area

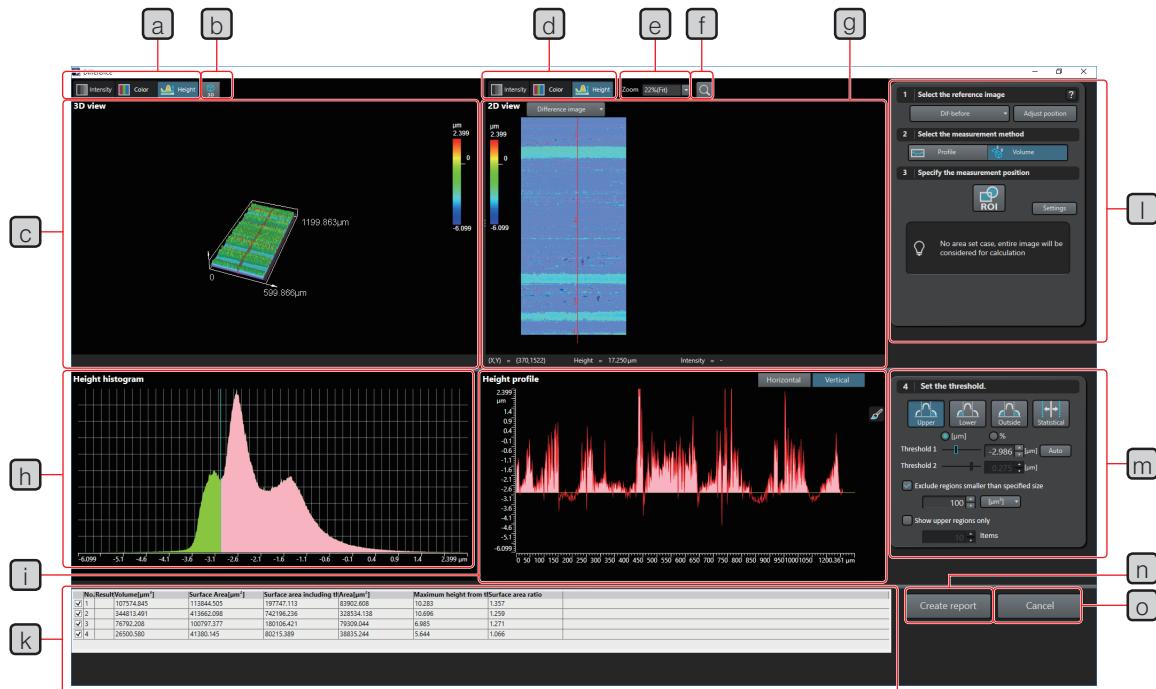
Displays the target image and the measurement region.

You can change the view by selecting either the reference image alone, the target image alone, the height difference image between reference image and target image, or both of reference image and target image.

Rotating the mouse wheel on the image zooms in or out the image.

The information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area is displayed on the status bar.

(h) to (o) are described on the next page.)



(a) to (g) are described on the previous page.)

(h) Histogram view area

Displays the height histogram of the target image. Dragging the bar on the histogram allows you to specify the sectioning level.

(i) Profile view area

Displays the profile of the measurement line position on the 2D image view area. Dragging the bar on the profile allows you to specify the sectioning level. You can select the direction of the measurement line on the 2D image either horizontal or vertical.

Rotating the mouse wheel on the profile zooms in or out the profile.

(k) Analysis results view area

Displays analysis results obtained from the sectioning level on the histogram or the profile.

(l) Difference analysis setting area

Sets the reference image to perform the difference analysis, the measurement method and the measurement region.

(m) Sectioning level setting area

Set the sectioning level.

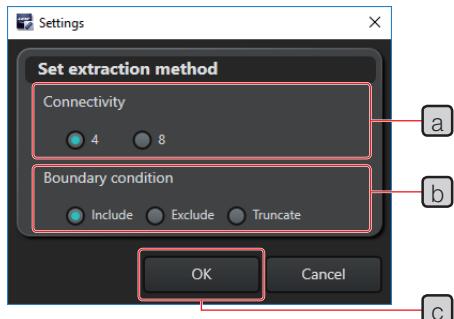
(n) [Create report] button

Creates the report based on analysis results obtained from the sectioning level on the histogram or the profile.

(o) [Cancel] button

Cancels the difference analysis.

Setting the number of particles to connect and particles to extract



[a] [Connectivity] radio button

Recognizes the pixels connected according to the specified number of connection as a single particle.

[b] [Boundary condition] radio button

Selects the target particles for extraction on the boundary of the ROI.

[c] [OK] button

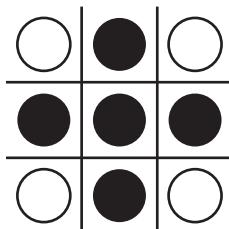
Changes ROI settings and closes the [Settings] screen.

8

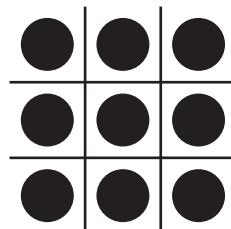
Point

Number of connection:

The number of particles to be recognized or the binarization process operation differs depending on the number of connection.



4-connection



8-connection

mark indicates the pixel of image data 1.

The pixels connected to the center pixel of the 3 X 3 vicinity are illustrated above:

4-connection: Pixels up/down/right/left of the center pixel

8-connection: Diagonal pixels are added to pixels in case of 4-connection.

Point

Target particles for extraction on the boundary of the ROI

[Include]: Extracts the particle inside and outside of the boundary of the ROI.

[Exclude]: Excludes the particle on the boundary of the ROI.

[Truncate]: Extracts only the particle inside the boundary of the ROI.

8-3 Operating procedures of the difference analysis on line

8-3-1 Opening the file

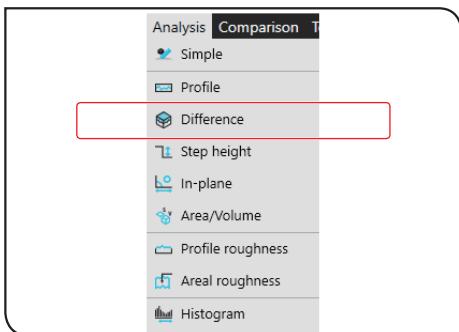
- 1 Open the file of the image you want to use as a reference (reference image) in the difference analysis and the file of the image you want to measure (target image).

TIP For procedures to open the file, see "Opening the file" (page 16).

- 2 Display the data view window of the target image file on the front.

8-3-2 Starting the difference analysis

8

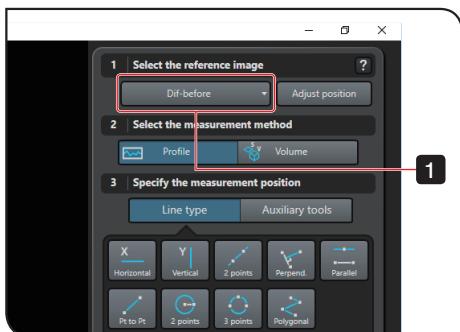


- 1 Select [Difference] from the [Analysis] menu.



The [Difference] screen appears.

8-3-3 Selecting the reference image

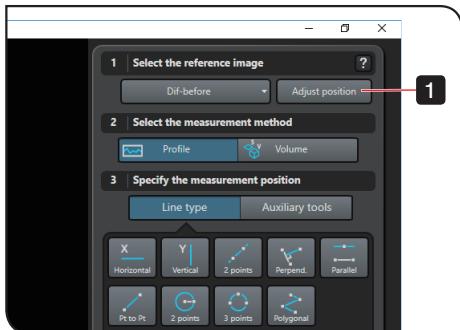


- 1** Select the reference image from the [Select the reference image] dropdown list.

TIP The dropdown list shows the list of image files currently opened.

8-3-4 Correcting the position of the target image

If necessary, correct the image position so that the position you want to analyze on the target image matches with that on the reference image.



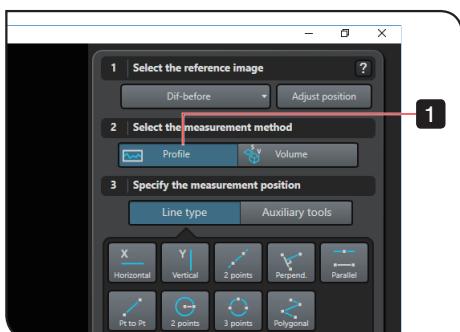
- 1** Click the [Adjust position] button.

The [Position adjustment] screen appears.

- 2** Correct the image position so that the position you want to measure on the target image matches with that on the reference image.

TIP For procedures to correct the image position, see “5-8-4 Correcting the image position” (page 109).

8-3-5 Selecting the measurement method



- 1** Click the [Profile] button.

[Profile]: Analyzes the height difference between two images with the height profile on the arbitrary line on the 2D image.

[Volume]: Analyzes the difference in area or volume between 2D images in the region specified in the height profile of all regions or a partial region on the 2D image.

8-3-6 Specifying the measurement line

Specify the measurement line at the measurement position on the 2D image view area (target image) on the [Difference] screen. When the measurement line is specified, the profile of the measurement line position is displayed on the profile view area.

Point

- If necessary, use the auxiliary tool to draw a point(s) or a line(s) at the position you want to use as a base of the measurement line on the image in advance.
- You can specify the measurement line more efficiently and accurately using auxiliary tools.

TIP

For details on auxiliary tools, see “8-5 Measurement line and auxiliary tools” (page 198).

- 1 If the [Line type] button is not ON, click the [Line type] button.

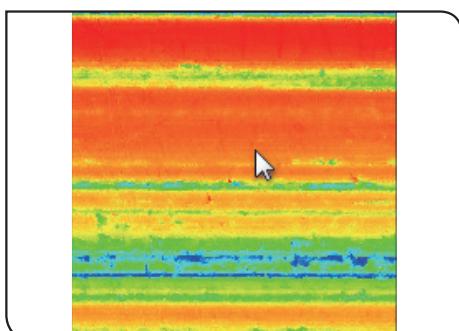
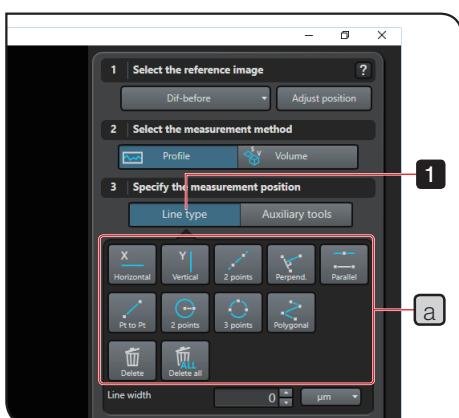
The line types are displayed on the measurement line setting area **a**.

- 2 Click the line type button on the measurement line setting area **a**.

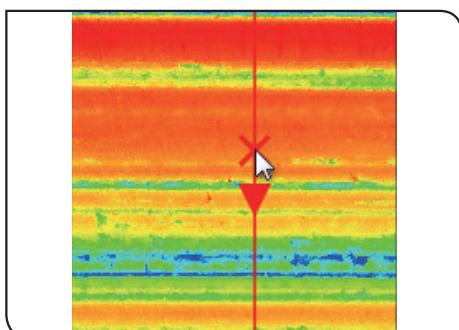
The line type button you selected is pressed (ON).

TIP

For details on the line type, see “8-5 Measurement line and auxiliary tools” (page 198).



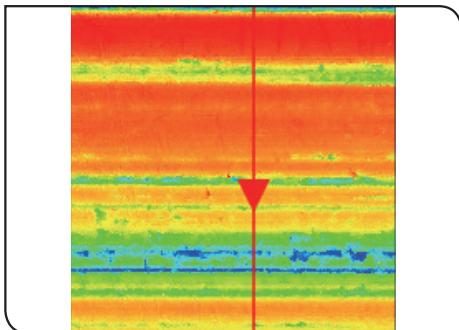
- 3 Click any position on the 2D image view area (target image).



The measurement line is drawn following the movement of the mouse pointer.

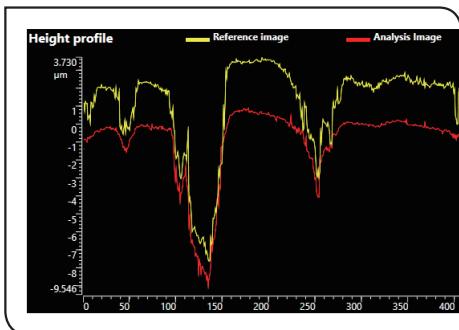
The profile is displayed on the profile view area.

The profile is updated following the movement of the measurement line.



- 4** Move the measurement line position while looking at the profile, and click the mouse at the desired position.

The measurement line is fixed.



The profile is also fixed.

The profile of the target image is displayed in the same color as the measurement line.

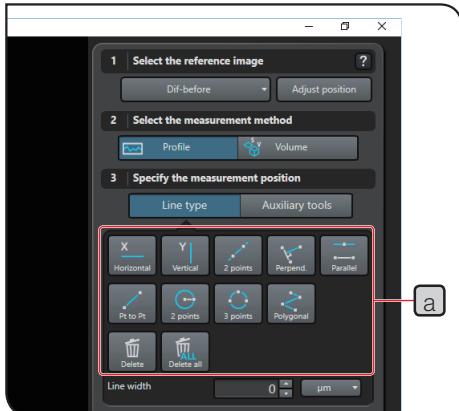
The profile of the reference image is displayed in yellow.

- 5** If you want to specify multiple measurement lines, repeat steps from **2** to **4**.

TIP The measurement line is added in the order of red, green, blue, pink and yellow.

8-3-7 Editing the measurement line

You can edit or delete the measurement line, if necessary.

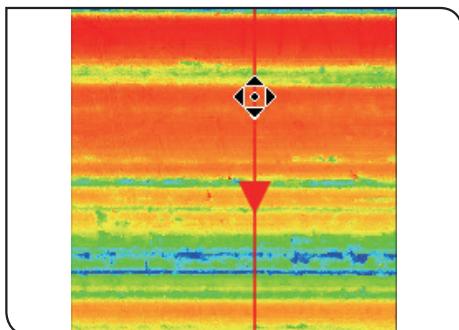


Make sure that all line type buttons on the measurement line setting area **a** are OFF before editing the measurement line.

TIP

If the line type button is ON, when you click on the 2D image view area, the measurement line is specified.

Selecting the measurement line

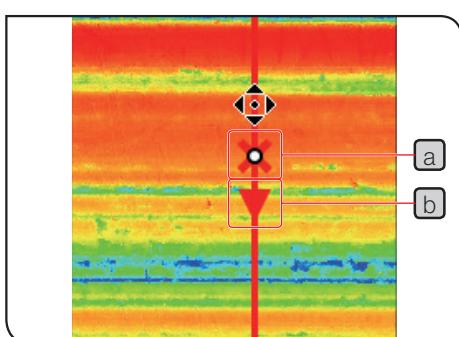


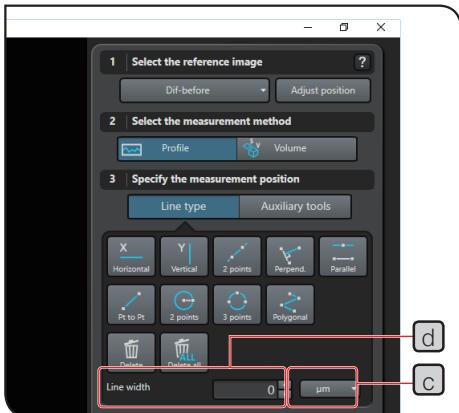
- 1 Click on the measurement line on the 2D image view area (target image).

The measurement line is selected and highlighted.

The mouse pointer position when the measurement line is specified is displayed as a “specified point” **a** with a circle and a cross line.

The arrow **b** indicating the profile direction is displayed.





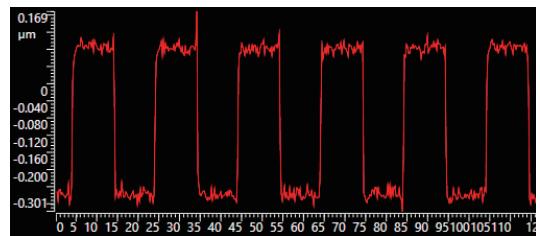
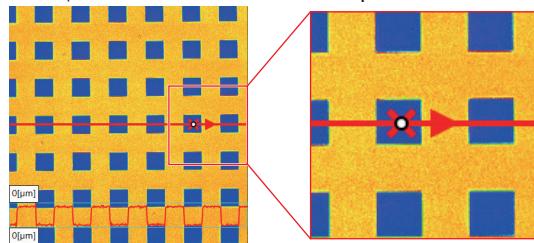
TIP

As the profile is created with the average measurement line width, if you increase the measurement line width, you can make the profile with less noise.

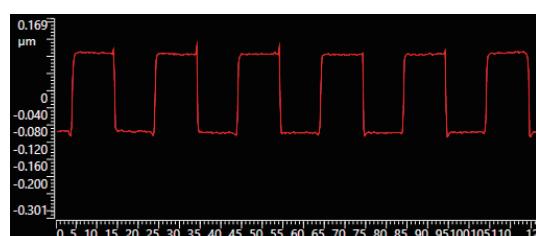
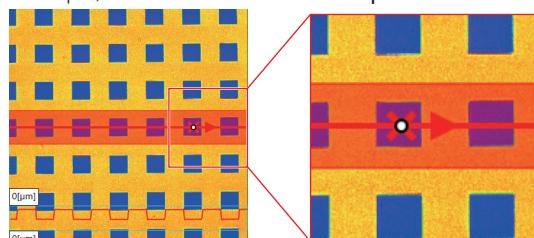
- 1** Select either [μm] or [Pixels] for specifying the line width from the [Line width] dropdown list **C**.
- 2** Specify the line width by either the length or the pixel in the [Line width] setting field **D**.

If you increase the line width, the measurement line width is masked.

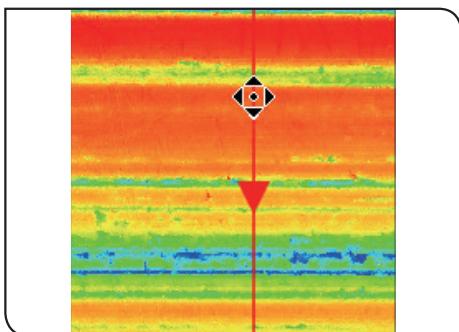
Example) When the line width is 0 μm



Example) When the line width is 18 μm



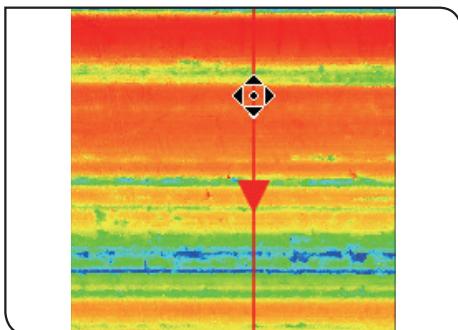
Copying the measurement line

**1**

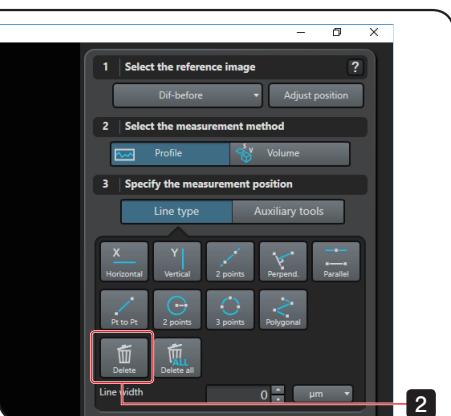
- Right-click on the measurement line you want to copy on the 2D image view area (target image) to display the menu, and select [Copy].



Deleting the measurement line

**Deleting the selected measurement line**

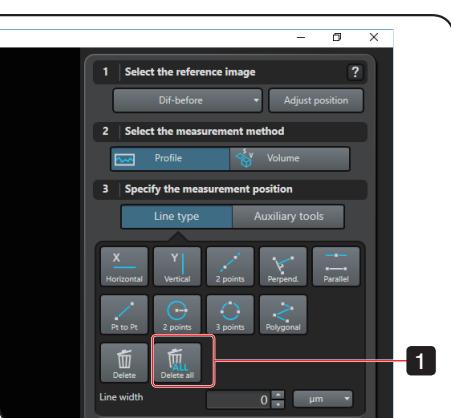
- 1 Click on the measurement line you want to delete on the 2D image view area (target image).



- 2 Click the [Delete] button.

When the message confirming to delete the measurement line appears, click the [Yes] button.

The measurement line is deleted.

**Deleting all measurement lines**

- 1 Click the [Delete all] button.

When the message confirming to delete all measurement lines appears, click the [Yes] button.

All measurement lines are deleted.

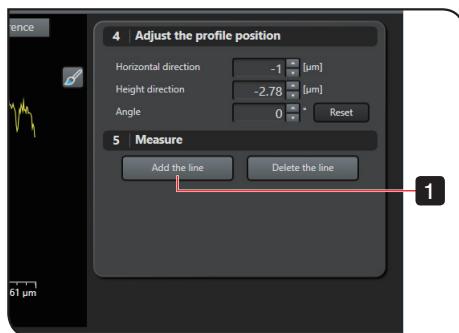
8-3-8 Correcting the profile position

If necessary, adjust the profile position of the target image so that the profile position of the reference image matches with the profile position of the target image.

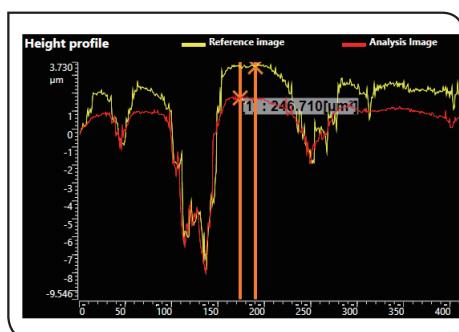


- 1** If you want to adjust the profile in horizontal direction, set the movement distance in the [Horizontal direction] setting field.
- 2** If you want to adjust the profile in vertical direction, set the movement distance in the [Height direction] setting field.
- 3** If you want to adjust the angle of the profile, set the rotation quantity in the [Angle] setting field.

8-3-9 Adding the measurement line



- 1** Click the [Add the line] button.



The two measurement lines (orange color) are added on the profile.

The left side measurement line plots the profile of the target image.

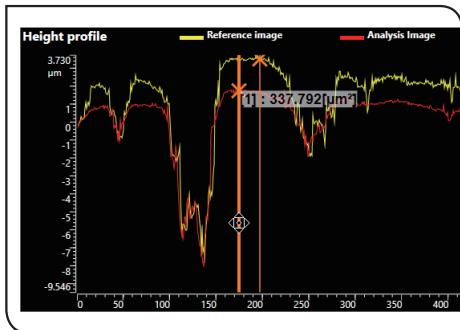
The right side measurement line plots the profile of the reference image.

- 2** Drag the measurement line to the position you want to measure on the profile view area.
- 3** If you use the one measurement line only, double-click on the measurement line you want to use.
The other measurement line is deleted.
- 4** If you want to measure multiple positions, repeat steps from **1** to **3**.

8-3-10 Editing the measurement line

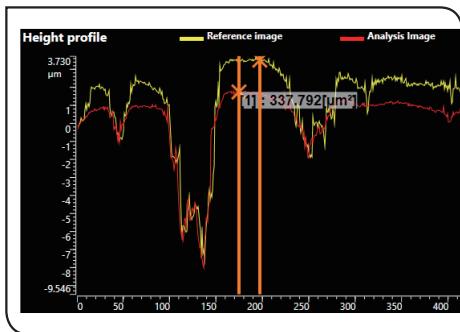
You can edit or delete the measurement line, if necessary.

Selecting the measurement line

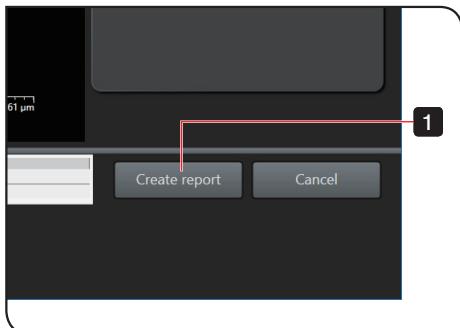


- 1 Click on the measurement line on the profile.

The measurement line is selected and highlighted.

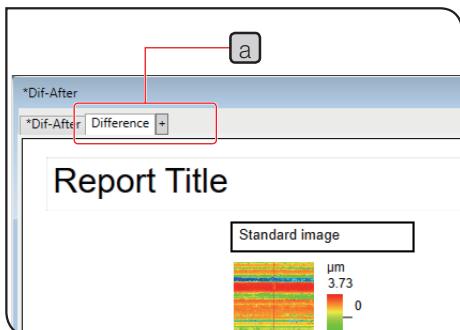


8-3-11 Creating the report



When you finish specifying measurement items, create the report.

- 1 Click the [Create report] button.

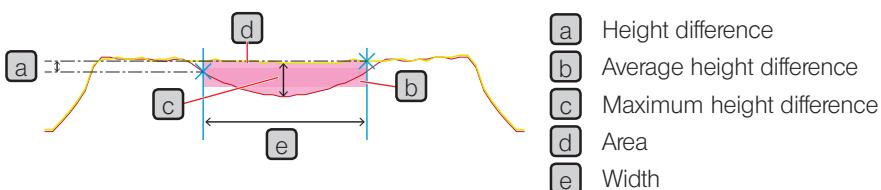


The [Difference] tab **a** is added to the data view window and the report is displayed.

TIP

- You can redo the difference analysis on line by double-clicking on either 2D image data, profile or measurement results on the report.
- For details on redoing the measurement, see “3-3-4 Redoing the measurement analysis” (page 38).

Results when selecting [Profile] as a measurement method



8-4 Operating procedures of the difference analysis on surface

8-4-1 Opening the file

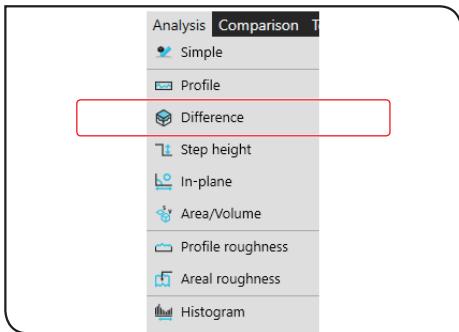
- 1 Open the file of the image you want to use as a reference (reference image) in the difference analysis and the file of the image you want to measure (target image).

TIP For procedures to open the file, see "Opening the file" (page 16).

- 2 Display the data view window of the target image file on the front.

8-4-2 Starting the difference analysis

8

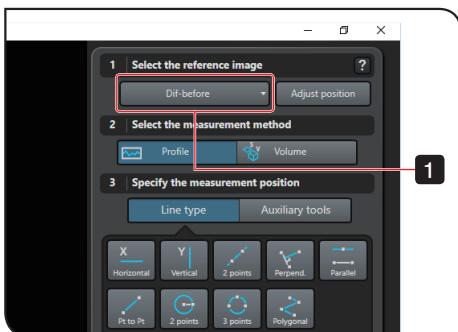


- 1 Select [Difference] from the [Analysis] menu.



The [Difference] screen appears.

8-4-3 Selecting the reference image

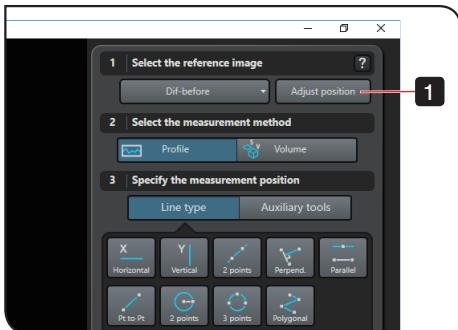


- 1** Select the reference image from the [Select the reference image] dropdown list.

TIP The dropdown list shows the list of image files currently opened.

8-4-4 Correcting the position of the target image

If necessary, correct the image position so that the position you want to analyze on the target image matches with that on the reference image.



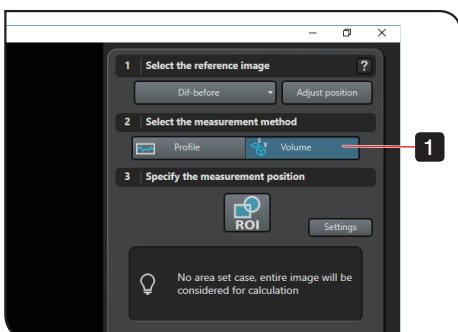
- 1** Click the [Adjust position] button.

The [Position adjustment] screen appears.

- 2** Correct the image position so that the position you want to measure on the target image matches with that on the reference image.

TIP For procedures to correct the image position, see "5-8-4 Correcting the image position" (page 109).

8-4-5 Selecting the measurement method



- 1** Click the [Volume] button.

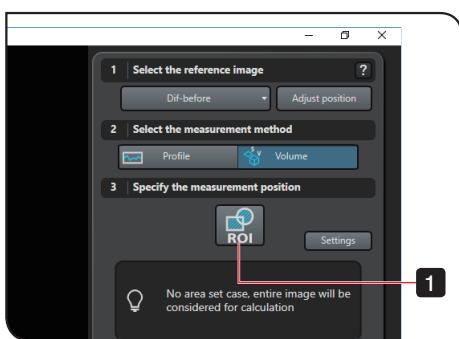
[Profile]: Analyzes the height difference between two images with the height profile on the arbitrary line on the 2D image.

[Volume]: Analyzes the difference in area or volume between 2D images in the region specified in the height profile of all regions or a partial region on the 2D image.

8-4-6 Specifying the measurement region

Specify the measurement region on the 2D image view area (target image), if necessary.

TIP If the measurement region is not specified, all regions are measured.



1 Click the [ROI] button.

The [Set the region] screen appears.

2 Add the measurement region to the position you want to measure.

TIP For adding the measurement region, see "Adding the ROI" (page 399).

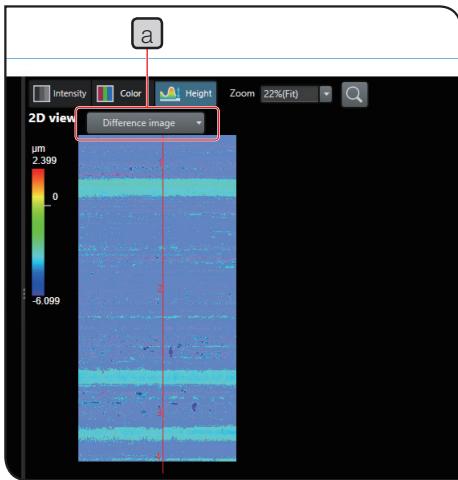
8-4-7 Editing the measurement region

Edit the measurement region, if necessary.

TIP For editing the measurement region, see "Editing the ROI" (page 406).

8-4-8 Setting the sectioning level

Set the sectioning level (threshold) in the region you want to analyze on the profile.



TIP

You can select the image type you want to display on the 2D image view area and the 3D image view area from the [View] dropdown list **a**. Display the image type easy to set the threshold.

There are four image types as described below.

- Reference image
- Target image
- Difference image
- Reference image and target image

There are two methods to specify the sectioning level as described below.

- Specify the sectioning level (threshold) manually
- Specify the sectioning level (threshold) automatically.

Specifying the sectioning level (threshold) manually

- 1 Click the [Upper limit], [Lower limit] or [Outside] button.

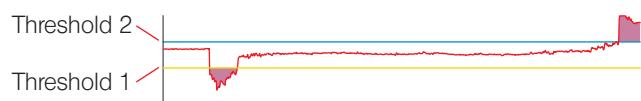
[Upper limit]: Sets the region higher than the threshold as a measurement region.



[Lower limit]: Sets the region lower than the threshold as a measurement region.



[Outside]: Sets the region outside of the region between the threshold 1 and threshold 2 as a measurement region.

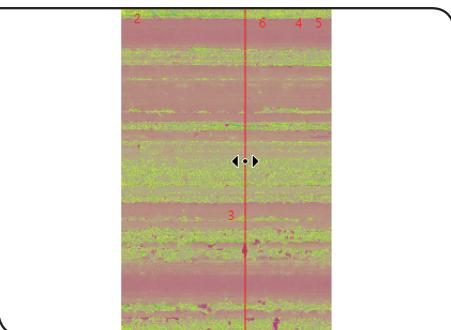


- 2 Set the threshold on the histogram or on the profile.

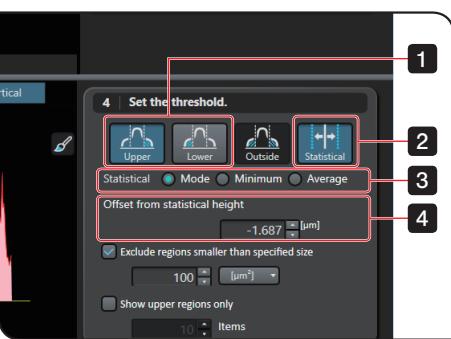
Or set the threshold using the [Threshold 1] or [Threshold 2] slider in the [Set the threshold].

The measurement region on the histogram or the profile is displayed in pink color.

The measurement region you created is masked on the 2D image.

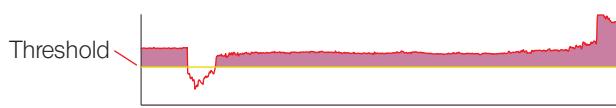


When you move the measurement line position, move it on the 2D image view area while looking at the histogram or the profile.



Specifying the sectioning level (threshold) automatically

- 1 Click the [Upper limit] button or the [Lower limit] button.
 [Upper limit]: Sets the region higher than the threshold as a measurement region.



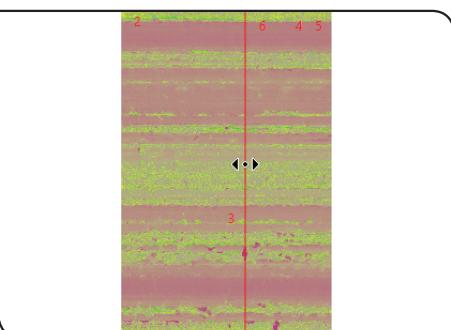
- [Lower limit]: Sets the region lower than the threshold as a measurement region.

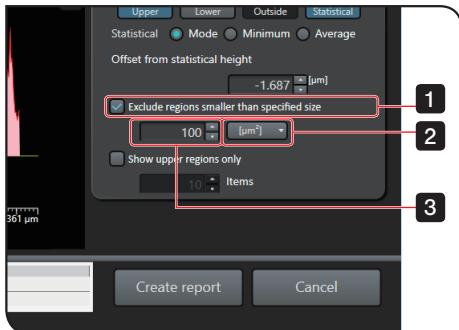


- 2 Click the [Statistical] button.
 3 Click either the [Mode], [Minimum] or [Average] radio button.
 [Mode]: Detects the mode of the height of the histogram and sets it as a sectioning level.
 [Minimum]: Detects the minimum value of the height of the histogram and sets it as a sectioning level.
 [Average]: Detects the average of the height of the histogram and sets it as a sectioning level.
 4 To offset the sectioning level detected automatically, set the offset value in the [Offset from statistical height] setting field.

- 5 Set the threshold on the histogram or on the profile.
 The measurement region on the histogram or the profile is displayed in pink color.

The measurement region you created is masked on the 2D image.
 When you move the measurement line position, move it on the 2D image view area while looking at the histogram or the profile.
 You can also specify the sectioning level on the 3D image view area.

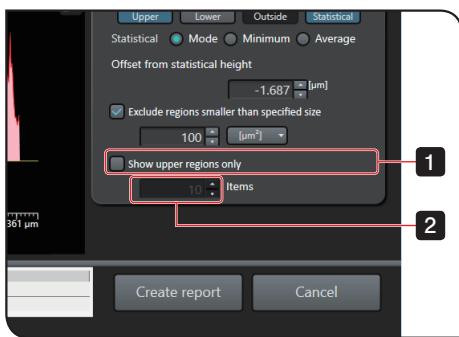




Excluding small regions from measurement

Exclude small regions from the measurement, if necessary.

- 1 Check the [Exclude regions smaller than specified size] checkbox.
- 2 Select either [μm^2] or [Pixels] to specify the region size to exclude from the [Exclude regions smaller than specified size] dropdown list.
- 3 Specify the region size to exclude by selecting the area or the pixel from the [Exclude regions smaller than specified size] setting field.

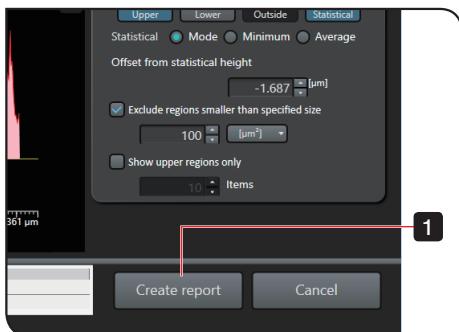


Measuring only measurement regions up to those you specify the number

The measurement regions are numbered in the order of the larger area. Measure the measurement regions up to those you specify the number, if necessary.

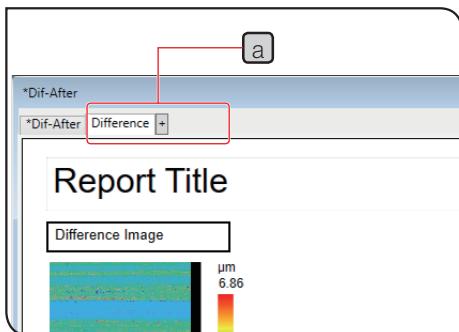
- 1 Check the [Show upper regions only] checkbox.
- 2 Specify the number in the [Show upper regions only] setting field.

8-4-9 Creating the report



When you finish specifying measurement items, create the report.

- Click the [Create report] button.

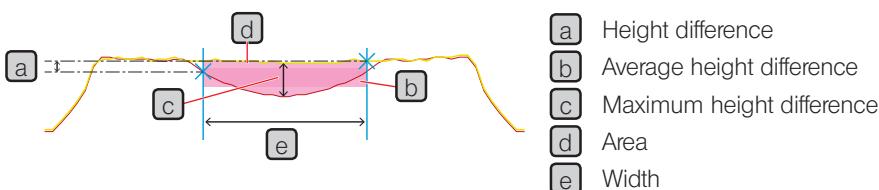


The [Difference] tab **a** is added to the data view window and the report is displayed.

TIP

- You can redo the difference analysis on surface by double-clicking on either the 2D image data, the 3D image data, the histogram, the profile or measurement results on the report.
- For details on redoing the measurement, see “3-3-4 Redoing the measurement analysis” (page 38).

Results when selecting [Profile] as a measurement method

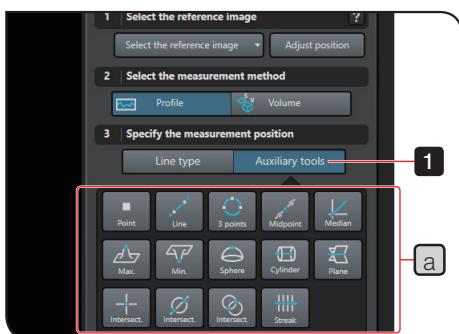


8-5 Measurement line and auxiliary tools

This section describes the measurement line and auxiliary tools for the difference analysis on line.

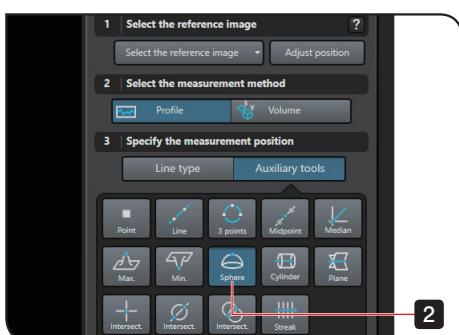
8-5-1 Specifying the measurement line using auxiliary tools

This section describes the procedures to search a sphere center and create a point using auxiliary tools by recognizing the three-dimensional shape in the region specified on the 2D image as a sphere surface, and to specify the measurement line using points created at 2 positions.



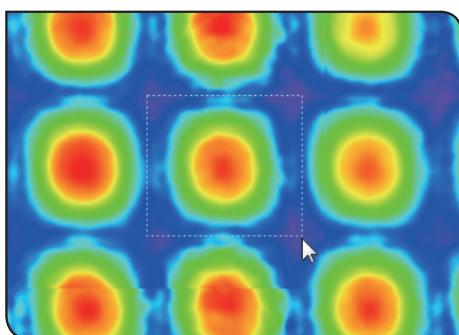
- Click the [Auxiliary tools] button.

The auxiliary tools are displayed on the measurement line setting area **a**.

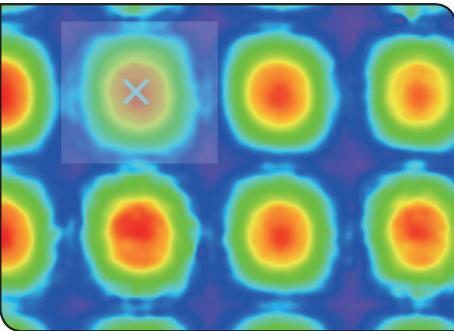


- Click the [Sphere center] button.

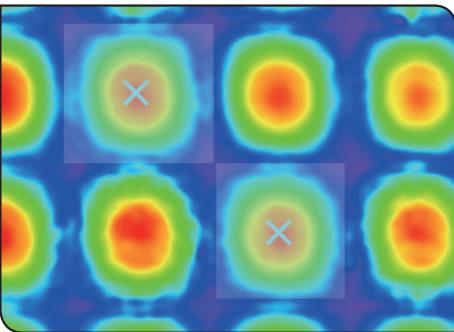
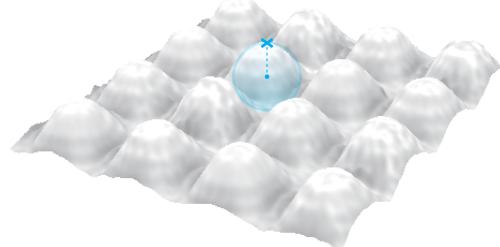
The [Sphere center] button is pressed.



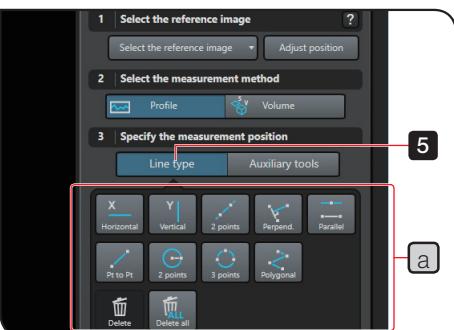
- Drag a position you want to recognize as a sphere surface on the 2D image view area.



The specified region is recognized as a sphere surface, and a “specified point” with a cross line is created at the sphere center position.

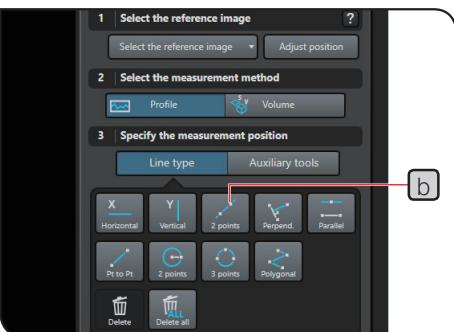
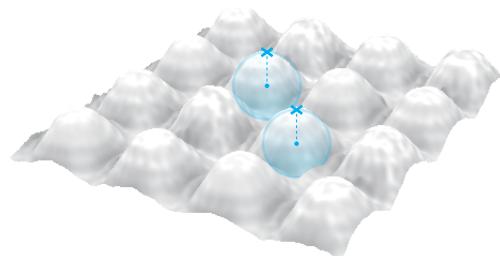


- 4** Repeat step **3** to specify the second specified point.



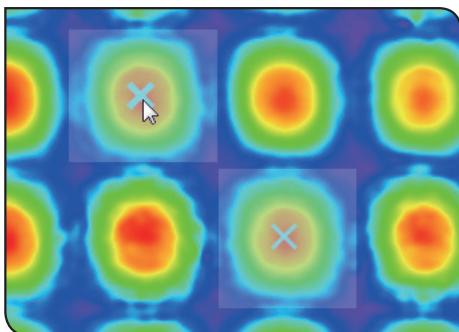
- 5** Click the [Line type] button.

The line types are displayed on the measurement line setting area **a**.

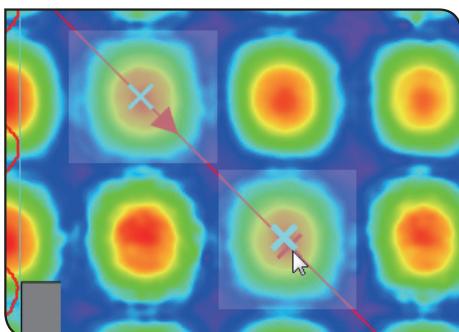


- 6** Click the [2 points line] button **b**.

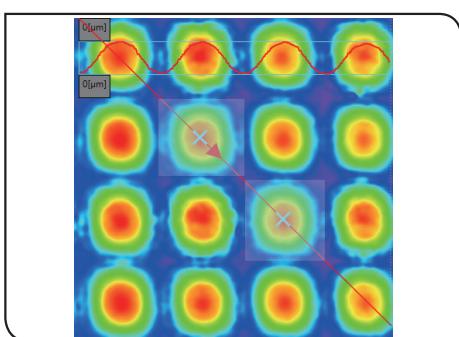
The [2 points line] button is pressed.



- 7 On the 2D image view area, move the mouse pointer closer to the first specified point and click the position where the specified point is highlighted.



- 8 Move the mouse pointer closer to the second specified point and click the position where the specified point is highlighted.



The measurement line passing through two specified points is created.

8-5-2 Measurement line types used in the difference analysis



■[Horizontal]

Draws a horizontal line passing through a single point.



■[2 points line]

Draws a line passing through two points.



■[Parallel line]

Draws a line that is parallel to the line passing through two points and that also passes through a third point.



■[2 points circle]

Draws a circle with a first point as a center of circle and with a second point as a circumference.



■[Multipoint]

Draws a polygonal line with a first point as a start point and with points after a second point as vertexes.



■[Vertical]

Draws a vertical line passing through a single point.



■[Perpendicular line]

Draws a line that is perpendicular to the line passing through two points and that also passes through a third point.



■[Point to point]

Draws a line that connects a start point and an end point.



■[3 points circle]

Draws a circle with three points as a circumference.

TIP

For details on the measurement line, see "Measurement line types" (page 411).

8-5-3 Auxiliary tools used in the difference analysis



■[Point]

Draws a point.



■[Line]

Draws a line passing through two points.



■[3 points circle]

Draws a circle with three points as a circumference.



■[Midpoint]

Draws a midpoint of two points.



■[Maximum height]

Draws the highest position in Z-axis direction in the region as a point.



■[Minimum height]

Draws the lowest position in Z-axis direction in the region as a point.



■[Sphere center]

Recognizing the three-dimensional shape in the region as a sphere, draws a point at the center position of the sphere.



■[Cylinder axis]

Recognizing the three-dimensional shape in the region as a side surface of the cylinder, draws a center axis as a line.



■[Surface intersection line]

Recognizing the three-dimensional shape in the region as a plane, draws its cross line.



■[Intersection line to line]

Draws a point at the intersection of two lines.



■[Streak]

Draw a line orthogonal to the texture of the sample surface in the region.

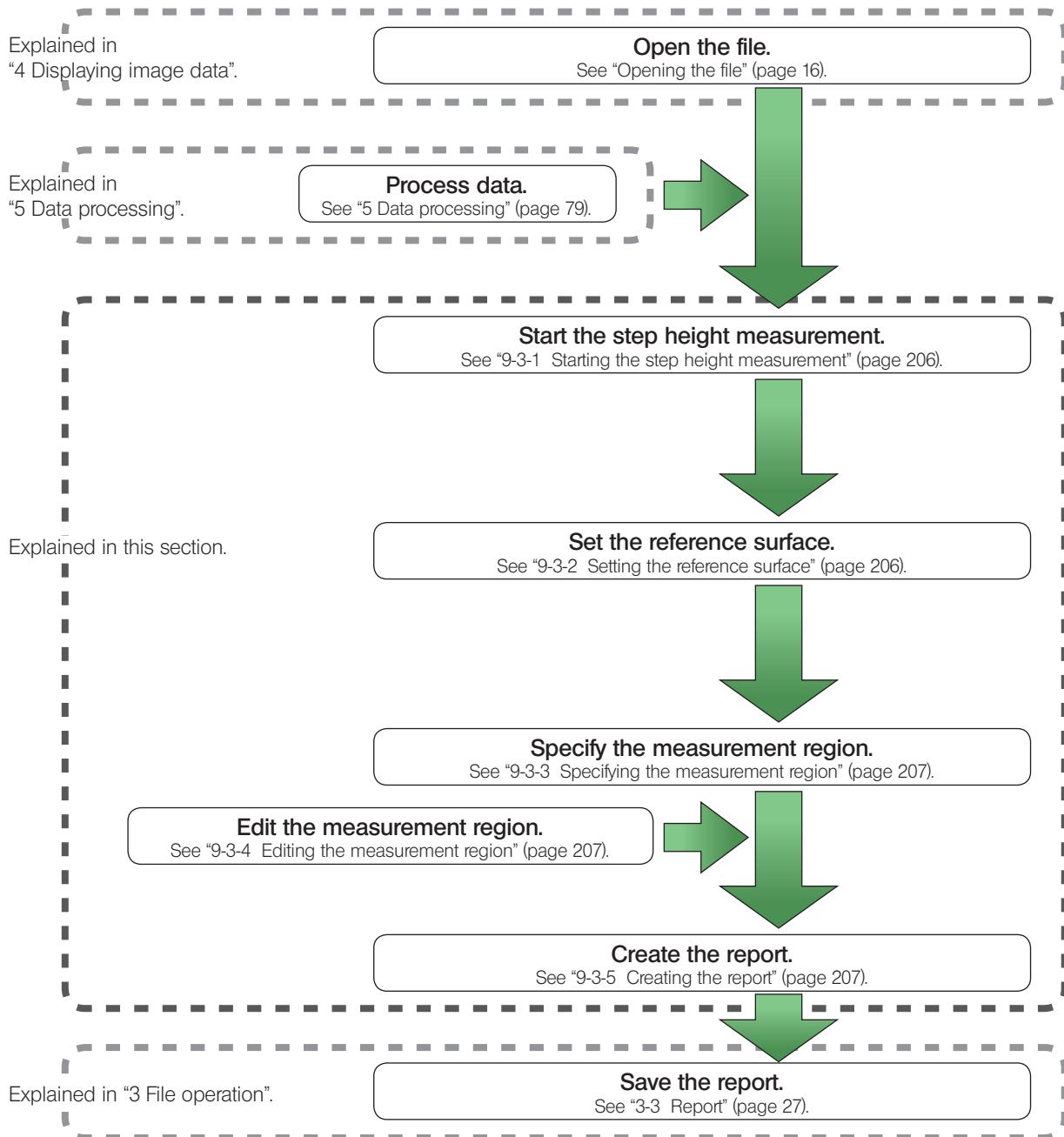
TIP

For details on auxiliary tools, see "Auxiliary tool types" (page 416).

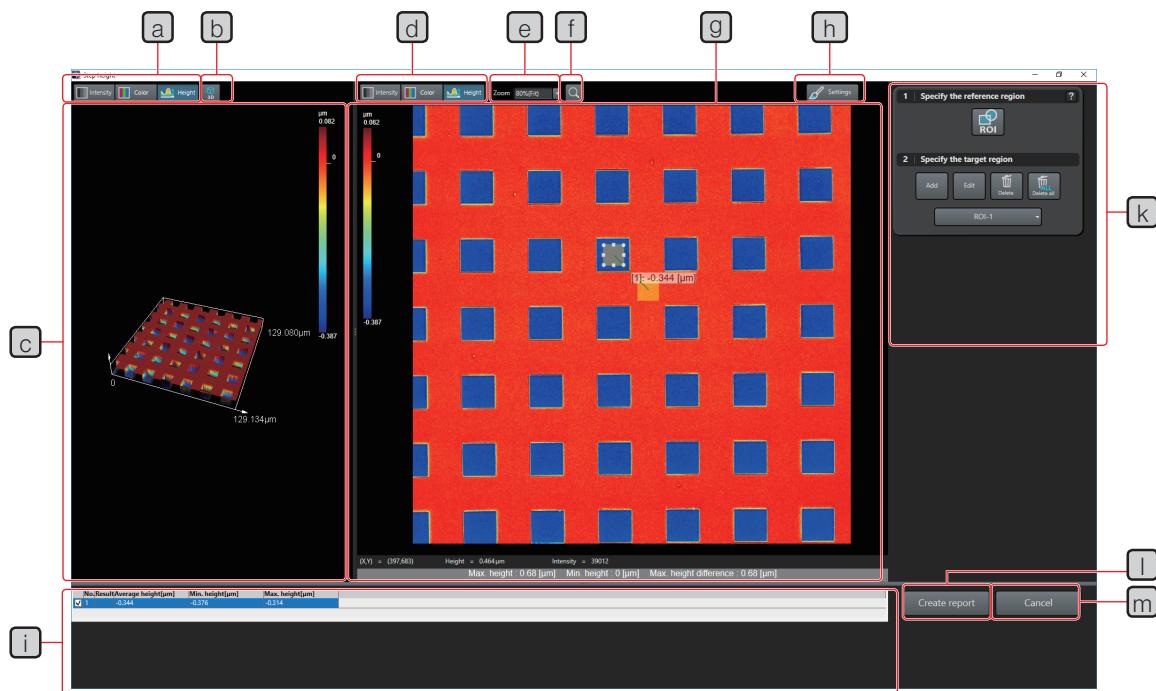
9 Step height measurement

You can measure the average step (height), the maximum height and the minimum height by specifying two regions on the image.

9-1 Flow of the step height measurement



9-2 Screens used in the step height measurement



[a] 3D image data selection button

Selects either the laser intensity image, the color image or the height image on the 3D image view area.

[b] Advanced setting button for 3D image

Displays the screen to define advanced settings for displaying the 3D image. For details on the screen, see "4-2-1 Screens used with the 3D view" (page 51).

[c] 3D image view area

Displays the 3D image.

Dragging the image allows you to change the angle to display the image.

Rotating the mouse wheel on the image zooms in or out the image.

Dragging the image while holding down the right button of the mouse allows you to move the view position.

[d] 2D image data selection button

Selects either the laser intensity image, the color image or the height image on the 2D image view area.

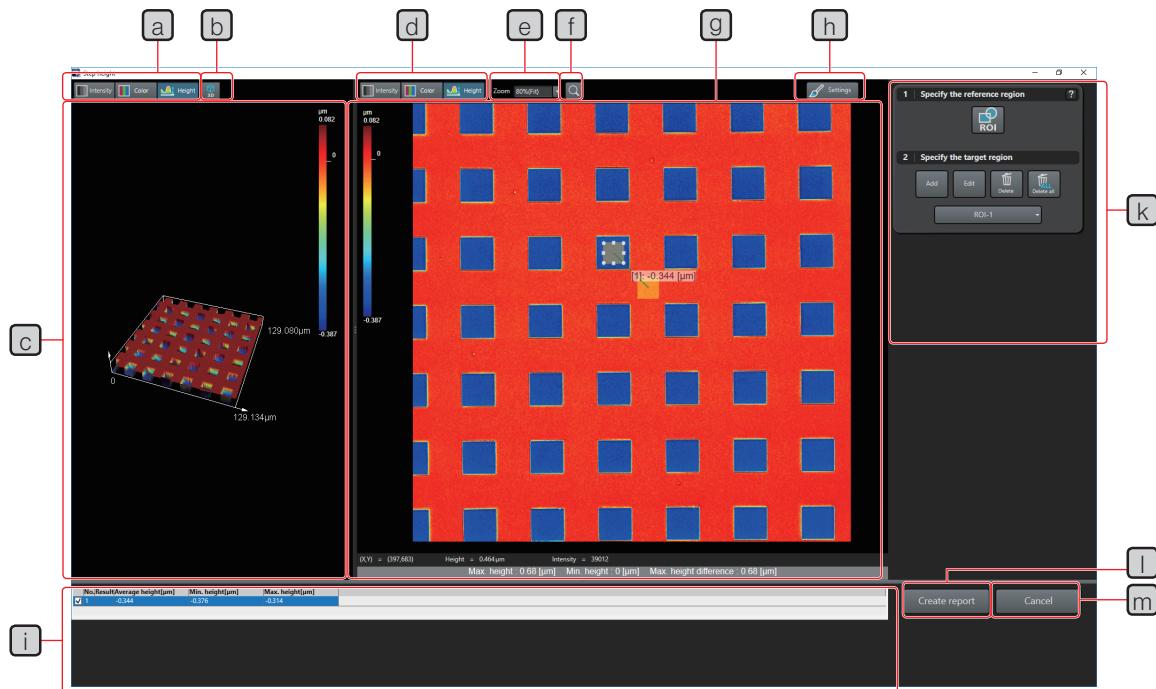
[e] Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

[f] Loupe button

Zooms in the mouse pointer position on the 2D image view area.

[g] to [m] are described on the next page.)



(a) to (f) are described on the previous page.)

(g) 2D image view area

Displays the 2D image, reference surface, measurement region and measurement results. You can change the font and the color of measurement results. You can also display the maximum height and the minimum height of the reference surface or the measurement region. Use the view setting button (h) to display the setting screen.

Rotating the mouse wheel on the image zooms in or out the image.

The information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area is displayed on the status bar.

(h) View setting button

Sets the color of height information or measurement results displayed on the 2D image. For details on the screen, see "[View setting] screen" (page 205).

(i) Measurement results view area

Displays measurement results obtained from the reference surface and the measurement region on the 2D image.

(k) Step height measurement setting area

Sets the reference surface and the measurement region.

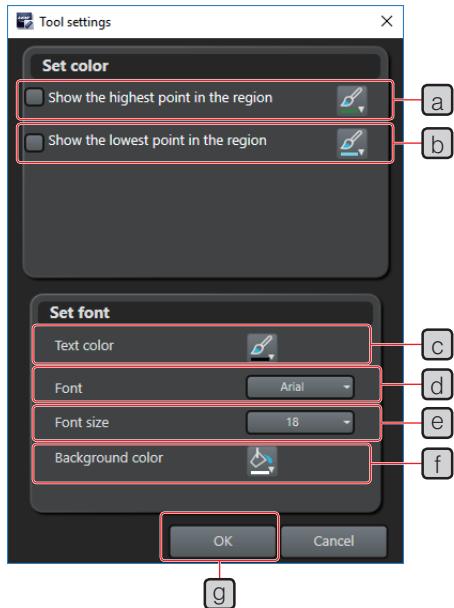
(l) [Create report] button

Creates the report based on measurement results obtained from the reference surface and the measurement region on the 2D image.

(m) [Cancel] button

Cancels the step height measurement.

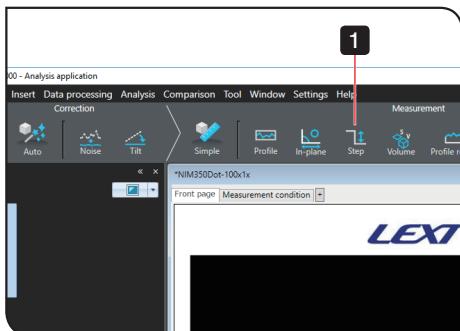
[View setting] screen



- [a] **[Show the maximum height point in the region] checkbox**
Changes whether to highlight the maximum height position and the color to display it in the reference surface and the measurement region specified on the 2D image.
- [b] **[Show the minimum height point in the region] checkbox**
Changes whether to highlight the minimum height position and the color to display it in the reference surface and the measurement region specified on the 2D image.
- [c] **[Text color] button**
Changes the color of strings of measurement results.
- [d] **[Font] dropdown list**
Changes the font of strings of measurement results.
- [e] **[Font size] dropdown list**
Changes the font size of strings of measurement results.
- [f] **[Background color] button**
Changes the background color of strings of measurement results.
- [g] **[OK] button**
Changes the settings and close the [View setting] screen.

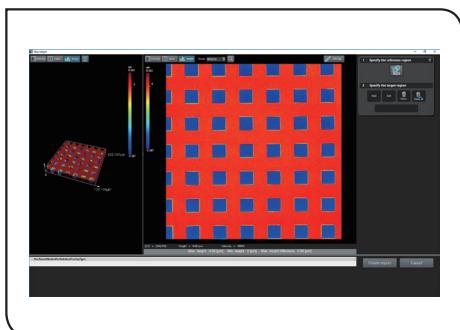
9-3 Operating procedures of the step height measurement

9-3-1 Starting the step height measurement



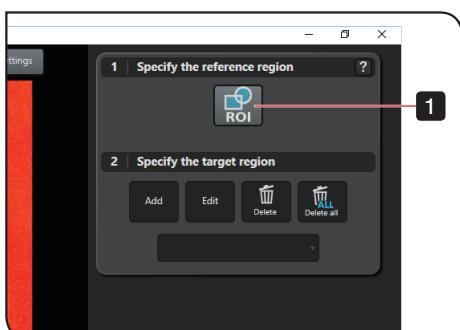
1 Click the [Step] button.

TIP You can also display the [Step height] screen by selecting [Step height] in the [Analysis] menu.



The [Step height] screen appears.

9-3-2 Setting the reference surface



1 Click the [ROI] button.

The [Set the region] screen appears.

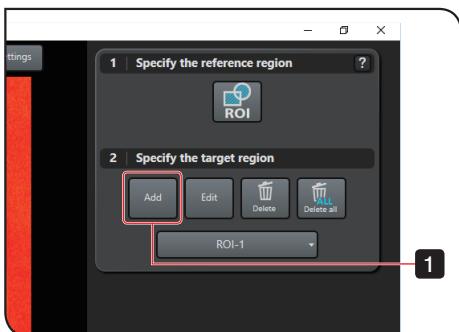
2 Add the ROI to the position you want to set as a reference surface

TIP • For adding the ROI, see "Adding the ROI" (page 399).

- If you specify multiple ROIs, the height of the center position of the ROI becomes the reference surface.



9-3-3 Specifying the measurement region



1 Click the [Add] button.

The [Set the region] screen appears.

2 Add a ROI to the position you want to measure.

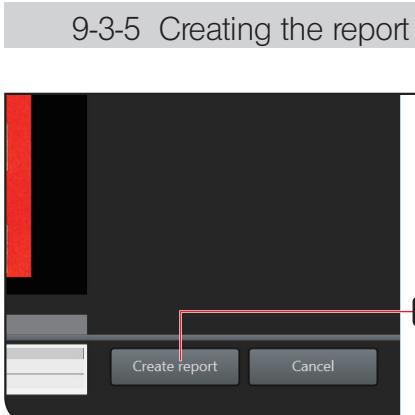
TIP • For adding the ROI, see "Adding the ROI" (page 399).

9-3-4 Editing the measurement region

9

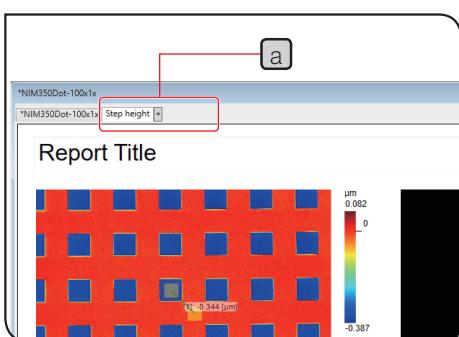
Edit the measurement region, if necessary.

TIP For editing the ROI, see "Editing the ROI" (page 406).



When you finish specifying the measurement region, create the report.

1 Click the [Create report] button.



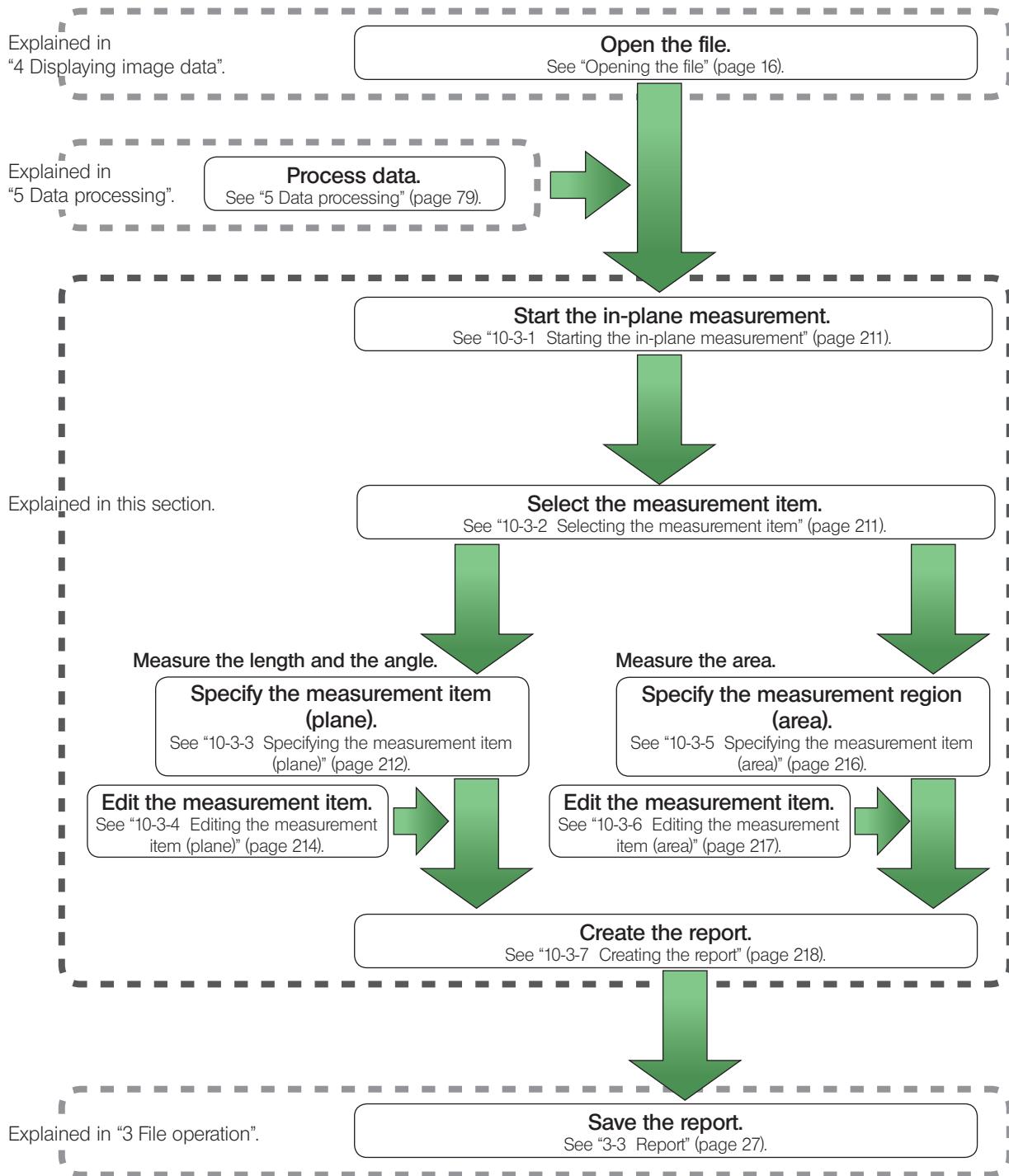
The [Step height] tab **a** is added to the data view window and the report is displayed.

- TIP**
- You can redo the step height measurement by double-clicking on either 2D image data, 3D image data or measurement results on the report.
 - For details on redoing the measurement, see "3-3-4 Redoing the measurement analysis" (page 38).
 - For hiding unnecessary measurement results, see "22-10 Measurement analysis options" (page 396).

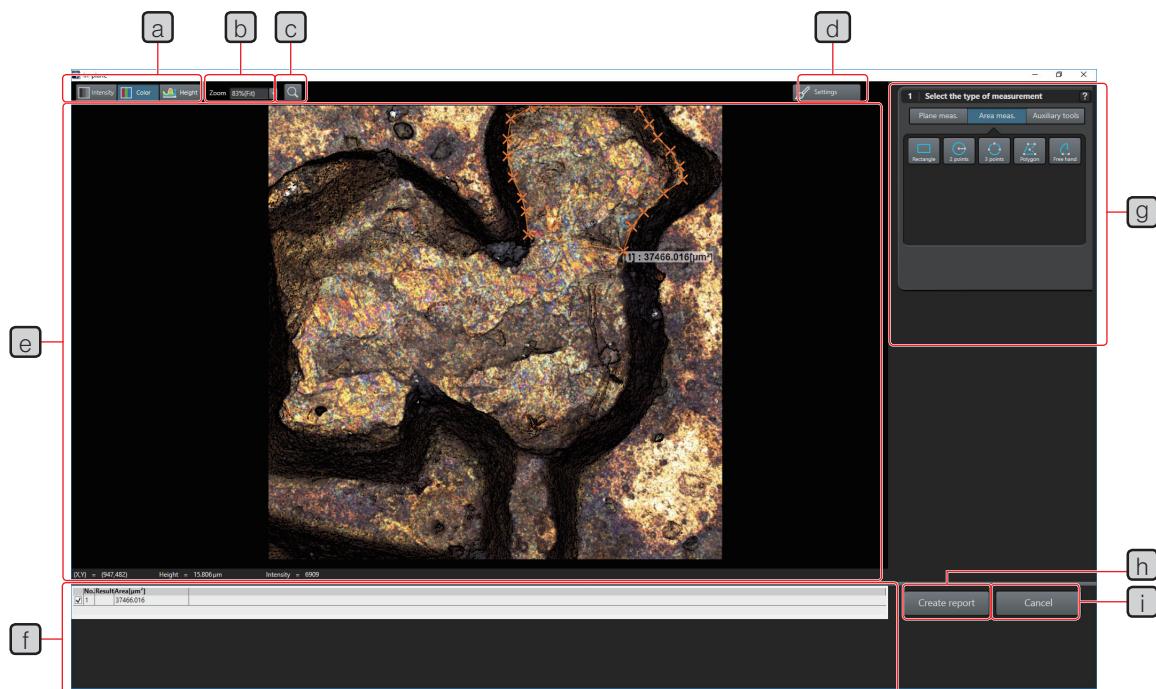
10 In-plane measurement

You can measure the length, angle, quantity, area, etc. of the circle or the rectangle on the image.

10-1 Flow of the in-plane measurement



10-2 Screens used in the in-plane measurement



[a] 2D image data selection button

Selects either the laser intensity image, the color image or the height image on the 2D image view area.

[b] Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

[c] Loupe button

Zooms in the mouse pointer position on the 2D image view area.

[d] View setting button

Sets the color of the measurement line or auxiliary tools displayed on the 2D image. For details on the screen, see “[View setting] screen” (page 210).

[e] 2D image view area

Displays the 2D image, the measurement line and measurement results.

You can change the font and the color of measurement results. Use the view setting button **[d]** to display the setting screen.

Rotating the mouse wheel on the image zooms in or out the image.

The information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area is displayed on the status bar.

[f] Measurement results view area

Displays measurement results of the in-plane measurement.

[g] Measurement item setting area

Sets the measurement item.

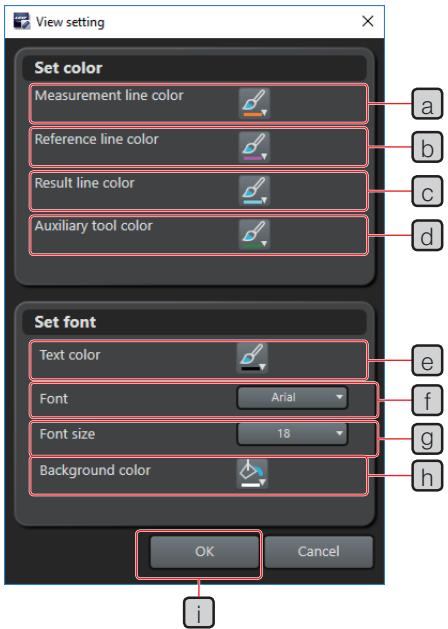
[h] [Create report] button

Creates the report based on measurement results obtained from the measurement item on the 2D image.

[i] [Cancel] button

Cancels the in-plane measurement.

[View setting] screen



[a] [Measurement line color] button

Changes the color to display the line used in measurement.

[b] [Reference line color] button

Changes the color of the reference line used in measurement.

[c] [Result line color] button

Changes the color of the line that connects the measurement position with measurement results.

[d] [Auxiliary tool color] button

Changes the color of the position specified by auxiliary tools.

[e] [Text color] button

Changes the color of strings of measurement results.

[f] [Font] dropdown list

Changes the font of strings of measurement results.

[g] [Font size] dropdown list

Changes the font size of strings of measurement results.

[h] [Background color] button

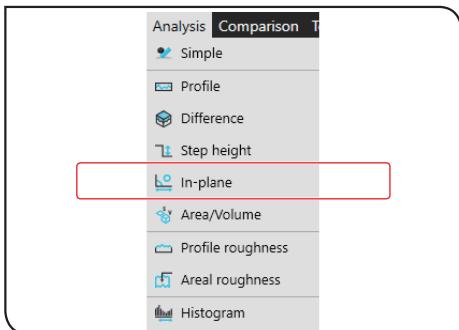
Changes the background color of strings of measurement results.

[i] [OK] button

Changes the settings and closes the [View setting] screen.

10-3 Operating procedures of the in-plane measurement

10-3-1 Starting the in-plane measurement



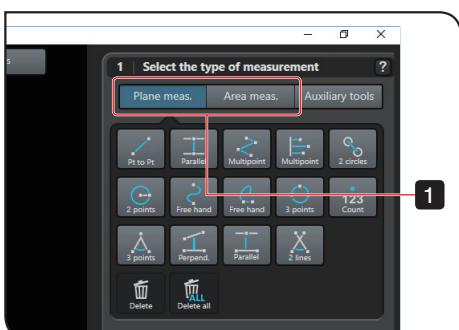
- 1 Select [In-plane] from the [Analysis] menu.



The [In-plane] screen appears.

10

10-3-2 Selecting the measurement item



- 1 Select a measurement item either from [Plane measurement] or [Area measurement].

[Plane measurement]: Measures the line length or the angle specified on the image.

[Area measurement]: Measures the area, etc. of the region specified on the image.

- TIP**
- If you select [Plane measurement], go to the next section "10-3-3 Specifying the measurement item (plane)" (page 212).
 - If you select [Area measurement], go to the section "10-3-5 Specifying the measurement item (area)" (page 216).

10-3-3 Specifying the measurement item (plane)

Specify the measurement line at the measurement position on the 2D image view area on the [In-plane] screen.

💡 Point

- If necessary, use the auxiliary tool to draw a point(s) or a line(s) at the position you want to use as a base of the measurement line on the image in advance.
- You can specify the measurement line more efficiently and accurately using auxiliary tools.

TIP

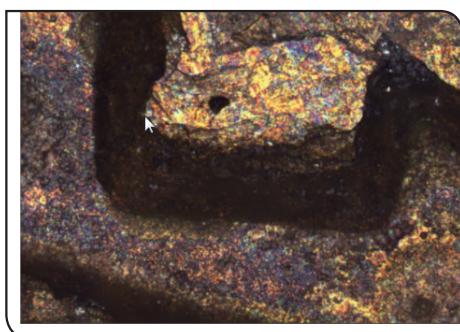
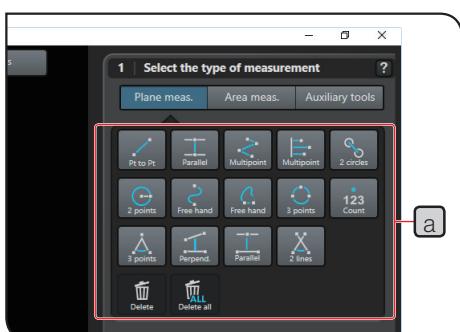
For details on auxiliary tools, see “10-4 Measurement line, measurement region and auxiliary tools” (page 219).

- 1 Click the line type button on the measurement item setting area **a**.

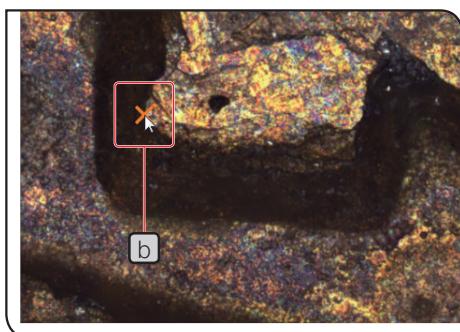
The line type button you selected is pressed (ON).

TIP

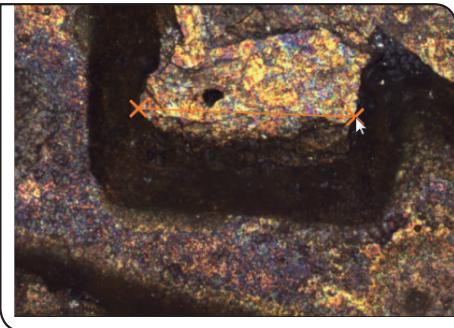
For details on the line type, see “10-4 Measurement line, measurement region and auxiliary tools” (page 219).



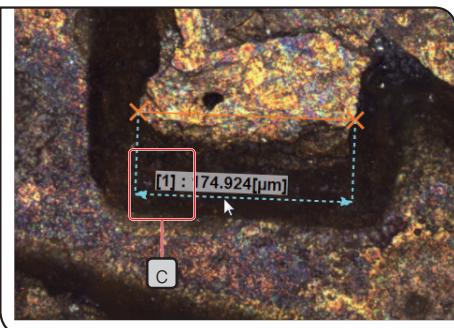
- 2 Click a position you want to measure on the 2D image view area.



The “specified point” **b** with a cross point is created at the position where you clicked the mouse.



- 4 Click a position you want to measure according to the measurement item.



- 5 Finally, click a position you want to display measurement results.

10

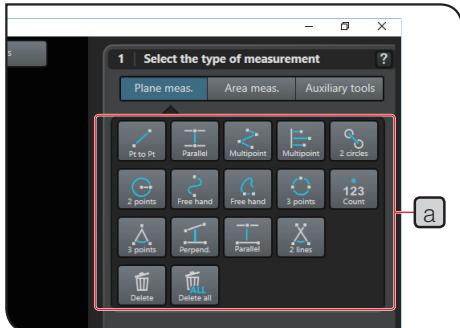
- 6 If you want to measure on multiple positions, repeat steps from 1 to 5.

TIP The sequential number C is displayed at the beginning of measurement results in the order of specifying measurement items.

- TIP**
- If you edit the measurement line, go to the next section "10-3-4 Editing the measurement item (plane)" (page 214).
 - If you do not edit the measurement line, go to "10-3-7 Creating the report" (page 218).

10-3-4 Editing the measurement item (plane)

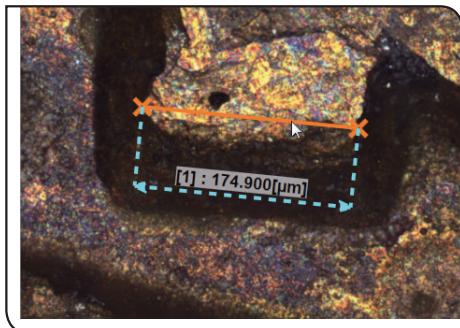
You can edit or delete the measurement line, if necessary.



Make sure that all measurement item buttons on the measurement item setting area **a** are OFF before editing the measurement line.

TIP If the measurement item button is ON, when you click on the profile view area, the measurement position is specified.

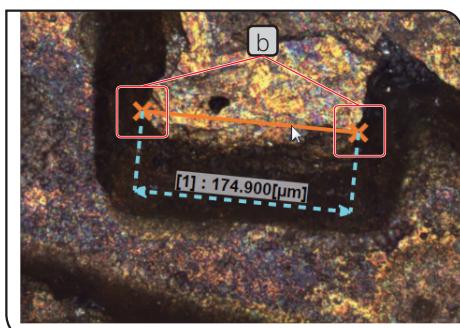
Selecting the measurement item



- 1 Click on the measurement line on the 2D image view area.

The measurement line is selected and highlighted.

The mouse pointer position when the measurement line is specified is displayed as a “specified point” **b** with a circle and a cross line.

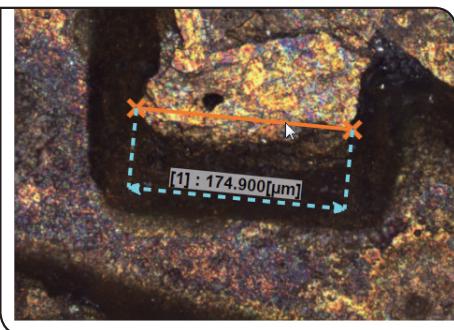


Changing the size or the position of the measurement line

TIP

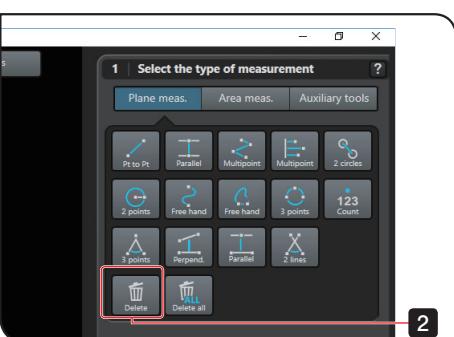
For changing the size or the position of the measurement line, see "Measurement line types" (page 411).

Deleting the measurement line



Deleting the selected measurement line

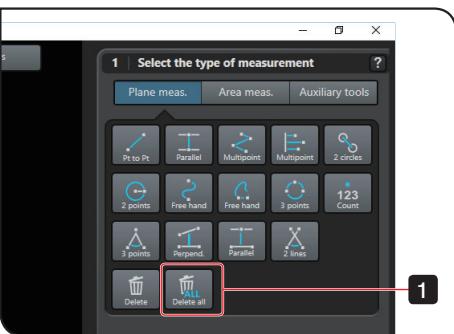
- 1 Click on the measurement line you want to delete on the 2D image view area.



- 2 Click the [Delete] button.

When the message confirming to delete the measurement line appears, click the [Yes] button.

The measurement line is deleted.



Deleting all measurement lines

- 1 Click the [Delete all] button.

When the message confirming to delete all measurement lines appears, click the [Yes] button.

All measurement lines are deleted.

TIP

Go to the next section "10-3-7 Creating the report" (page 218).

10-3-5 Specifying the measurement item (area)

Specify the measurement region at the measurement position on the 2D image view area on the [In-plane] screen.



- If necessary, use the auxiliary tool to draw a point(s) or a line(s) at the position you want to use as a base of the measurement item on the image in advance.
- You can specify the measurement items more efficiently and accurately using auxiliary tools.



For details on auxiliary tools, see “10-4 Measurement line, measurement region and auxiliary tools” (page 219).

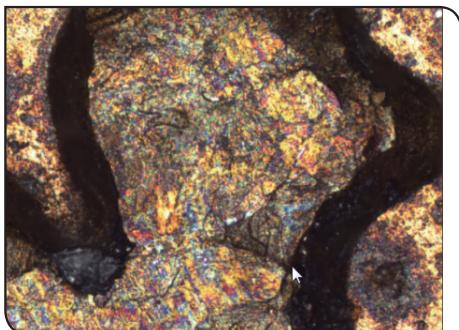
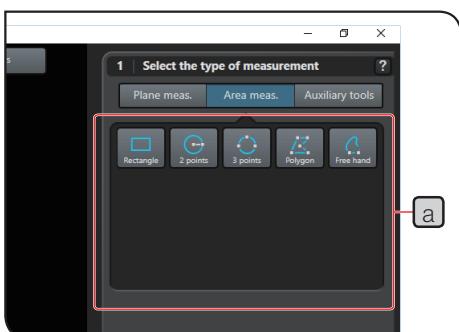


- Click the measurement region type button on the measurement item setting area **a**.

The measurement region type button you selected is pressed (ON).

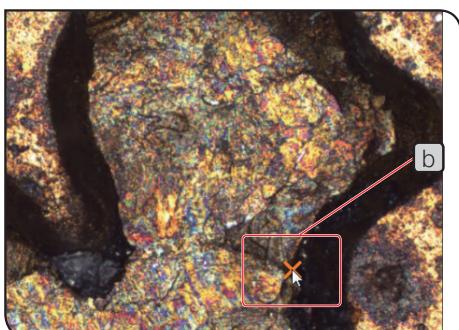


For measurement region types, see “10-4 Measurement line, measurement region and auxiliary tools” (page 219).

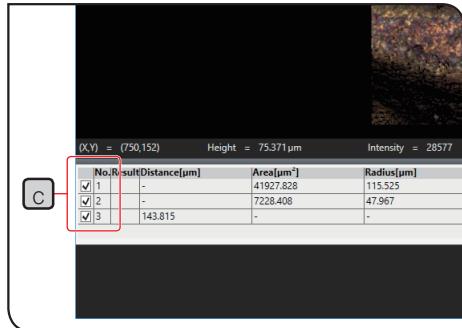


- Specify a position you want to measure on the 2D image view area according to the measurement item.

If the polygon is specified, double-click a position you want to set as an end point.



The “specified point” **b** with a cross point is created at the position where you clicked the mouse.



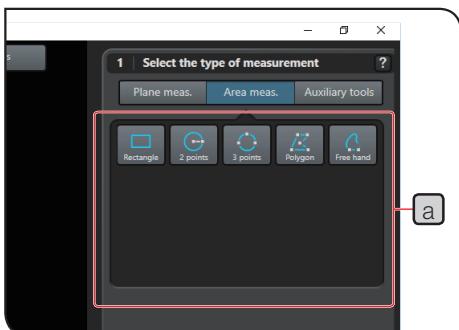
- 3** If you want to measure on multiple positions, repeat steps from **1** to **2**.

TIP The sequential number **C** is displayed at the beginning of measurement results in the order of specifying measurement items.

10-3-6 Editing the measurement item (area)

You can edit or delete the measurement region, if necessary.

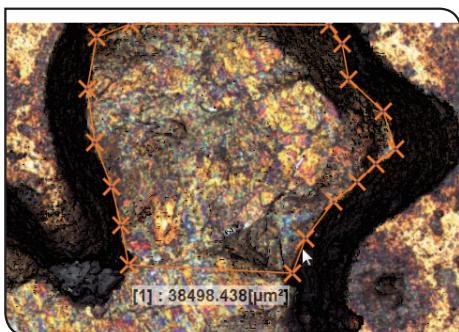
10



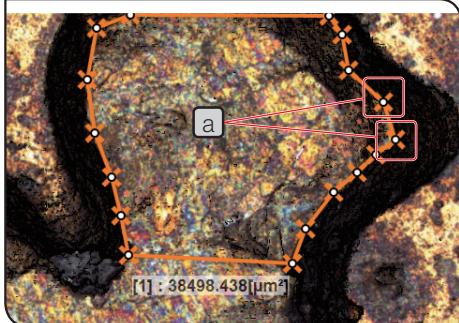
Make sure that all measurement item buttons on the measurement item setting area **a** are OFF before editing the measurement region.

TIP If the measurement item button is ON, when you click on the 2D image view area, the measurement position is specified.

Selecting the measurement region



- 1** Click on the measurement region on the 2D image view area.



The measurement region is selected and highlighted.

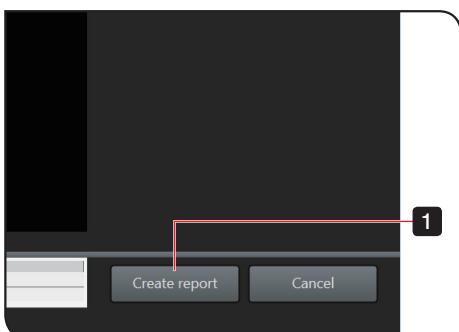
The mouse pointer position when the measurement region is specified is displayed as a “specified point” **a** with a circle and a cross line.

Changing the size or the position of the measurement region

TIP

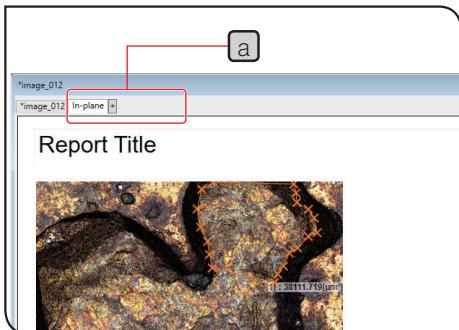
For changing the size or the position of the measurement region, see “10-4-3 Measurement region types used in the in-plane measurement” (page 229).

10-3-7 Creating the report



When you finish specifying the measurement line or the measurement region, create the report.

- 1 Click the [Create report] button.



The [In-plane] tab **a** is added to the data view window and the report is displayed.

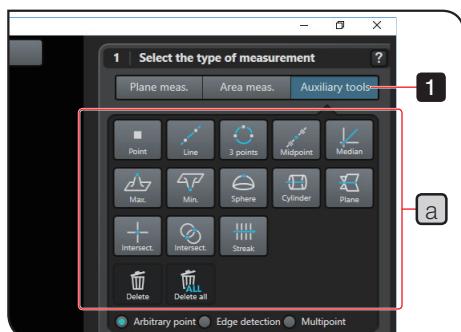
TIP

- You can redo the in-plane measurement by double-clicking on either the 2D image data or measurement results on the report.
- For details on redoing the measurement, see “3-3-4 Redoing the measurement analysis” (page 38).

10-4 Measurement line, measurement region and auxiliary tools

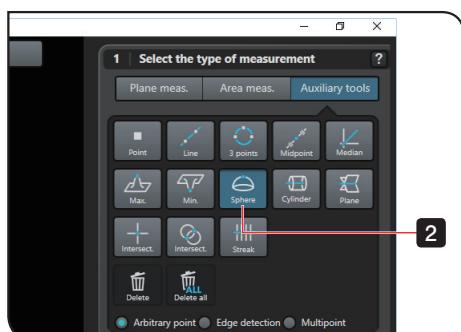
10-4-1 Specifying the measurement line using auxiliary tools

This section describes the procedures to search a sphere center and create a point using auxiliary tools by recognizing the three-dimensional shape in the region specified on the 2D image as a sphere surface, and to measure the distance between points created at 2 positions.



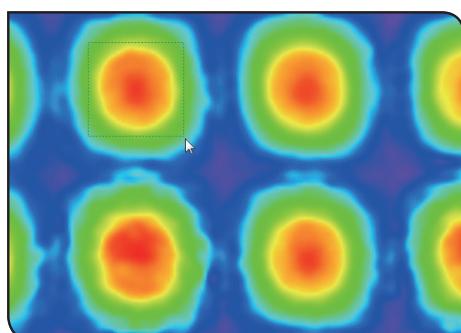
- Click the [Auxiliary tools] button.

The auxiliary tools are displayed on the measurement line setting area **a**.

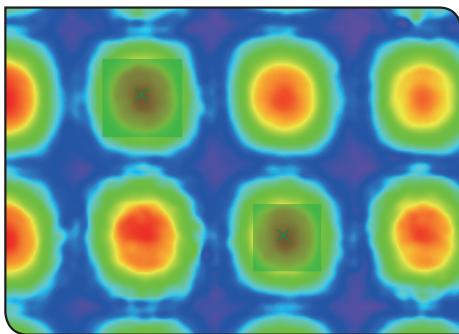
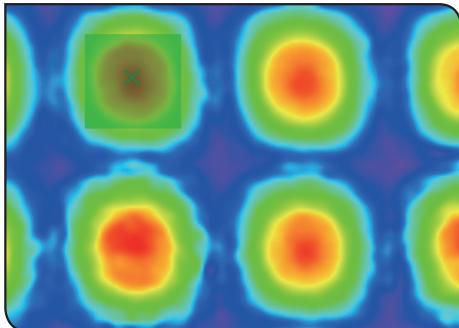


- Click the [Sphere center] button.

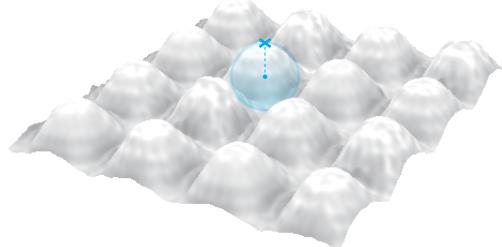
The [Sphere center] button is pressed.



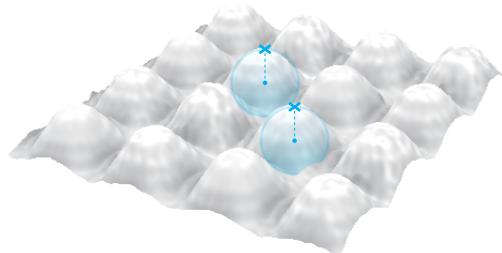
- Drag a position you want to recognize as a sphere surface on the 2D image view area.



The specified region is recognized as a sphere surface, and a “specified point” with a cross line is created at the sphere center position.

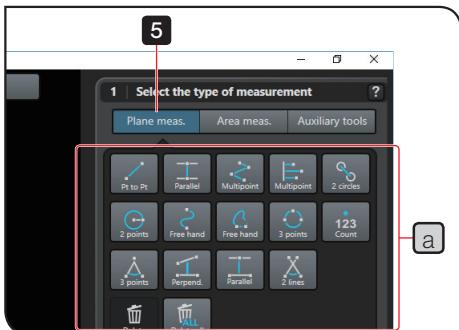


4 Repeat step **3** to specify the second specified point.



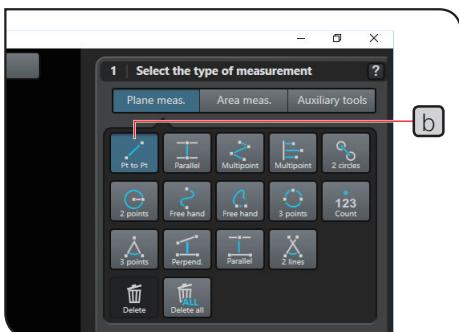
5 Click the [Plane measurement] button.

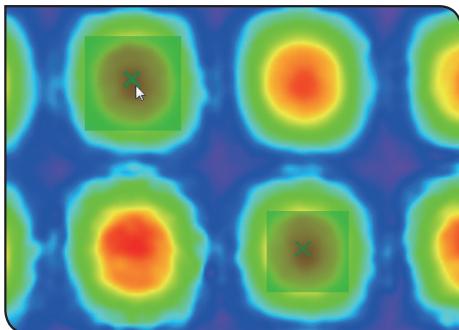
The line types are displayed on the measurement item setting area **a**.



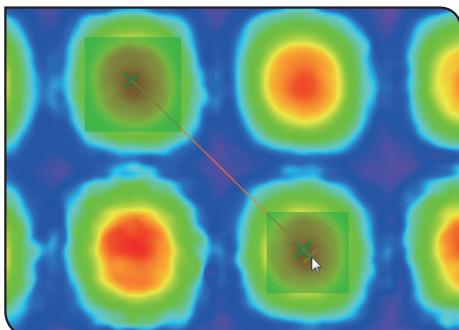
6 Click the [Point to point] button **b**.

The [Point to point] button is pressed.



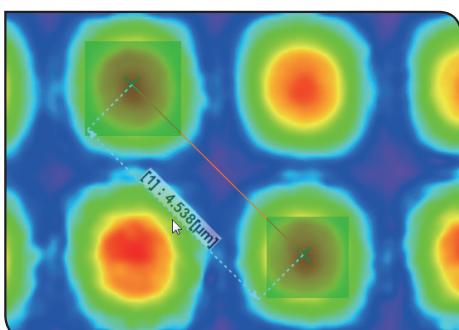


- 7 On the 2D image view area, move the mouse pointer closer to the first specified point and click the position where the specified point is highlighted.



- 8 Move the mouse pointer closer to the second specified point and click the position where the specified point is highlighted.

10

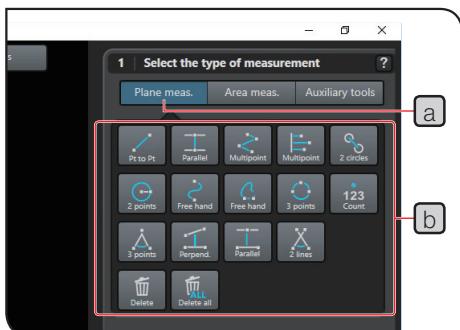


The measurement line passing through two specified points is created.

- 9 Click a position you want to display measurement results.

The measurement results are displayed.

10-4-2 Measurement line types used in the in-plane measurement



Click the [Plane measurement] button **a** on the measurement item setting area.

The measurement items are displayed on the measurement item setting area **b**.

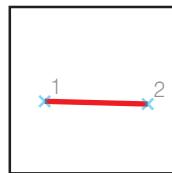
Point

- The color of the reference line or the measurement line described in this chapter has been set as default.
- You can change the color of the reference line or the measurement line.
- For details, see “[View setting] screen” (page 142).



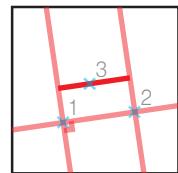
■[Point to point]

Draws a line that connects a start point and an end point.



■[Parallel width]

Draws a line that is parallel to the line passing through two points and that also passes through a third point perpendicular to the parallel line.



1 Click the [Point to point] button .

2 Click a position you want to set as a start point of the line on the 2D image view area.

Moving the mouse displays the line.

3 Click a position you want to set as an end point of the line.

The measurement line is created.

Moving the mouse displays measurement results.

4 Click a position you want to display measurement results.

The measurement results are created.

To edit:

Dragging the measurement line allows you to move the measurement line.

Dragging the point allows you to move the start point or the end point of the measurement line.

Dragging measurement results allows you to move the view position of measurement results.

1 Click the [Parallel width] button.

2 Click a position you want to set as a first point of the reference line on the 2D image view area.

Moving the mouse displays the reference line.

3 Click a position you want to set as a second point of the reference line.

The reference line is created. Moving the mouse displays the parallel line.

4 Click a position you want to create a parallel line.

The measurement line and measurement results are created.

To edit:

Dragging the reference line or the parallel line allows you to move the line.

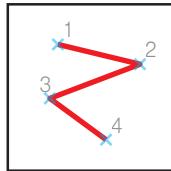
Dragging the point on the reference line allows you to adjust the angle of the reference line.

Dragging the point on the parallel line allows you to move the parallel line.

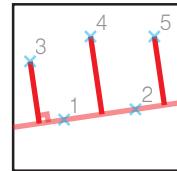
Dragging measurement results allows you to move the view position of measurement results.

**[Multipoint]**

Draws a polygonal line with a first point as a start point and with points after a second point as vertexes.

**[Parallel multipoint]**

Draws lines that are perpendicular to the line passing through two points (reference line) and that also pass through a third point and after.



- 1 Click the [Multipoint] button .

- 2 Click a position you want to set as a start point on the 2D image view area.

Moving the mouse displays the line.

- 3 Click a position you want to set as a vertex.

- 4 Double-click on a position you want to set as an end point.

The measurement line and measurement results are created.

To edit:

Dragging the point allows you to adjust the vertex position of the polygonal line.

Dragging measurement results allows you to move the view position of measurement results.

- 1 Click the [Parallel multipoint] button .

- 2 Click a position you want to set as a first point of the reference line on the 2D image view area.

Moving the mouse displays the reference line.

- 3 Click a position you want to set as a second point of the reference line.

The reference line is created. Moving the mouse displays the perpendicular line.

- 4 Click a position you want to create a perpendicular line.

The measurement line and measurement results are created.

- 5 Double-click at the position you want to create the last perpendicular line.

To edit:

Dragging the reference line allows you to move the line.

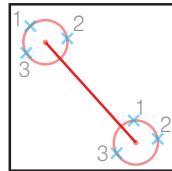
Dragging the point on the reference line allows you to adjust the angle of the reference line.

Dragging the point on the perpendicular line allows you to move the perpendicular line.

Dragging measurement results allows you to move the view position of measurement results.



[Circle to circle]
Draws a line that connects the center of two circles with three points as a circumference.



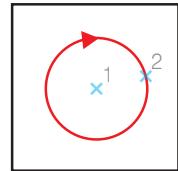
- 1 Click the [Circle to circle] button.
- 2 Click a position you want to set as a first point of the circle 1 on the 2D image view area.
- 3 Click the position you want to set as a second point.
Moving the mouse displays the circle.
- 4 Click a position you want to set as a third point.
The circle 1 is created.
- 5 In the same manner, create the circle 2.
The measurement line is created.
Moving the mouse displays measurement results.
- 6 Click a position you want to display measurement results.
The measurement results are created.

To edit:

Dragging the circle allows you to move the circle.
Dragging the point at the center of the circle allows you to move the circle.
Dragging the point on the circumference allows you to adjust the position or the size of the circle.
Dragging measurement results allows you to move the view position of measurement results.



[2 points circle]
Draws a circle with a first point as a center of circle and with a second point as a circumference.



- 1 Click the [2 points circle] button .
- 2 Click a position you want to set as a center of the circle on the 2D image view area.
- 3 Click a position you want to set as a circumference.
The measurement line is created.

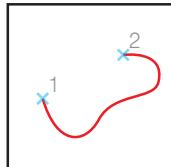
To edit:

Dragging the measurement line (circle) allows you to move the measurement line (circle).
Dragging the point at the center of the measurement line (circle) allows you to move the measurement line (circle).
Dragging the point on the circumference of the measurement line (circle) allows you to adjust the size of the measurement line (circle).

**[Free hand polyline]**

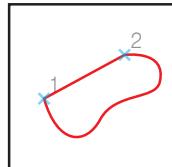
Draws graphics freely.

Hold down the mouse button at the position you want to set as a start point on the image, and drag freely.
The graphic is not closed.

**[Free hand]**

Draws graphics freely.

Hold down the mouse button at the position you want to set as a start point on the image, and drag freely.
The graphic is closed with the start point and the end point.



- 1 Click the [Free hand polyline] button.

- 2 Drag from a position you want to set as a start point of the measurement line to a position you want to set as an end point on the 2D image view area.

The measurement line and measurement results are created.

To edit:

Dragging the measurement line allows you to move the measurement line.

Dragging the point allows you to extend the measurement line.

Dragging measurement results allows you to move the view position of measurement results.

- 1 Click the [Free hand] button.

- 2 Drag from a position you want to set as a start point of the measurement line to a position you want to set as an end point on the 2D image view area.

The measurement line is created.

The start point is connect to the end point.

The measurement results of the measurement line including the line that connects the start point with the end point are created.

To edit:

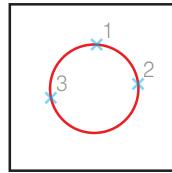
Dragging the measurement line allows you to move the measurement line.

Dragging the point allows you to extend the measurement line.

Dragging measurement results allows you to move the view position of measurement results.



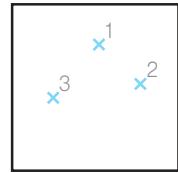
■[3 points circle]
Draws a circle with three points as a circumference.



- 1 Click the [3 points circle] button .
- 2 Click a position you want to set as a first point of the circle on the 2D image view area.
- 3 Click a position you want to set as a second point.
Moving the mouse displays the circle.
- 4 Click a position you want to set as a third point.
The measurement line is created.
Moving the mouse displays measurement results.
- 5 Click a position you want to display measurement results.
The measurement results are created.



■[Count]
Draws a point.



- 1 Click the [Count] button.
- 2 Click a position you want to count the quantity on the 2D image view area.
- 3 Double-click a last position.

To edit:

Dragging the point allows you to move the point.

To edit:

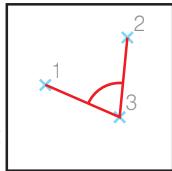
Dragging the measurement line (circle) allows you to move the measurement line (circle).

Dragging the point at the center of the measurement line (circle) allows you to move the measurement line (circle).

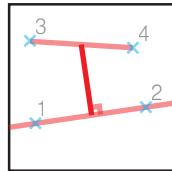
Dragging the point on the circumference of the measurement line (circle) allows you to adjust the position or the size of the measurement line (circle).

**[Angle 3 points]**

Measures an exterior angle or an interior angle of the intersection point of two lines each of which connects a first point or a second point with a third point.

**[Perpendicular]**

Draws a perpendicular to the line passing through two points (line 1) from the center of the line connecting two points (line 2).



- 1** Click the [Angle 3 points] button.

- 2** Click a position you want to set as a first point on the 2D image view area.

The first point is created.

- 3** Click a position you want to set as a second point.

The second point is created.

Moving the mouse displays a third point.

- 4** Click a position you want to measure the angle.

The third point is created.

Moving the mouse displays measurement results.

- 5** Click a position you want to display measurement results.

The exterior angle or the interior angle is measured according to the measurement result position.

To edit:

Dragging points or lines connecting points allows you to move on the profile keeping the distance between points.

Dragging measurement results allows you to move the view position of measurement results. Also, moving the view position allows you to select measuring the exterior angle or the interior angle.

- 1** Click the [Perpendicular] button.

- 2** Click a position you want to set as a first point of the line 1 on the 2D image view area.

Moving the mouse displays the reference line.

- 3** Click a position you want to set as a second point of the line 1.

The reference line is created.

- 4** Click a position you want to set as a start point of the line 2.

Moving the mouse displays the line 2 and the perpendicular.

- 5** Click a position you want to set as an end point of the line 2.

The line 2 and the perpendicular are created.

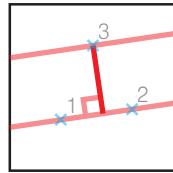
To edit:

Dragging the line 1 (pink color) or the line 2 (orange color) allows you to move the line 1 or the line 2.

Dragging the point on the line 1 or the line 2 allows you to adjust the line 1 or the line 2.

**[Parallel width]**

Draws a line that is parallel to the line passing through two points (reference line) and that also passes through a third point.



- 1 Click the [Parallel line] button.

- 2 Click a position you want to set as a first point of the reference line on the 2D image view area.

Moving the mouse displays the reference line.

- 3 Click a position you want to set as a second point of the reference line.

The reference line is created. Moving the mouse displays the parallel line.

- 4 Click a position you want to create a parallel line.

The measurement line is created.

To edit:

Dragging the reference line or the parallel line allows you to move the line.

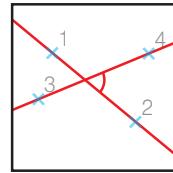
Dragging the point on the reference line allows you to adjust the angle of the reference line.

Dragging the point on the parallel line allows you to move the parallel line.

Dragging measurement results allows you to move the view position of measurement results.

**[Angle 2 lines]**

Measures the angle of intersection between two lines passing through two points.



- 1 Click the [Angle 2 lines] button.

- 2 Click a position you want to set as a first point of the line 1.

The first point of the line 1 (pink color) is created.

Moving the mouse displays the second point of the line 1.

- 3 Click a position you want to set as a second point.

The second point and the line 1 are created.

- 4 In the same manner, create the line 2 (orange color).

Moving the mouse displays measurement results.

- 5 Click a position you want to display measurement results.

The measurement results are created.

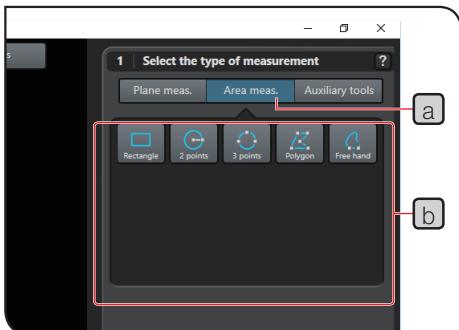
To edit:

Dragging the line 1 (pink color) or the line 2 (orange color) allows you to move the line 1 or the line 2.

Dragging the point on the line 1 or the line 2 allows you to adjust the line 1 or the line 2.

Dragging measurement results allows you to move the view position of measurement results.

10-4-3 Measurement region types used in the in-plane measurement



Click the [Area measurement] button **a** on the measurement item setting area.

The measurement items are displayed on the measurement item setting area **b**.

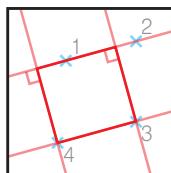
Point

- The color of the reference line or the measurement line described in this chapter has been set as default.
- You can change the color of the reference line or the measurement line.
- For details, see “[View setting] screen” (page 142).



■[Rectangle]

Draws a rectangle using four points.



- 1 Click the [Rectangle] button.
- 2 Click a position you want to set as a first point of the line 1 on the 2D image view area.
Moving the mouse displays the line 1.
- 3 Click a position you want to set as a second point.
The line 1 is created.
Moving the mouse displays the line 2 that is perpendicular to the line 1.
- 4 Click a position you want to set as a third point.
The line 2 is created.
Moving the mouse displays the line 3 that is parallel to the line 1 and the line 4 that is parallel to the line 2.
- 5 Click a position you want to set as a fourth point.
The rectangle with vertexes at the intersections of the line 1, line 2, line 3 and line 4 is created.

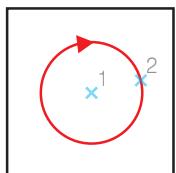
To edit:

Dragging the point on the line 1 allows you to adjust the line.
Dragging the point on either the line 2, line 3 or line 4 allows you to move the line.
Dragging measurement results allows you to move the view position of measurement results.



■[2 points circle]

Draws a circle with a first point as a center of circle and with a second point as a circumference.



- 1 Click the [2 points circle] button .
- 2 Click a position you want to set as a center of the circle on the 2D image view area.
Moving the mouse displays the circle.
- 3 Click a position you want to set as a circumference.
The measurement line is created.

To edit:

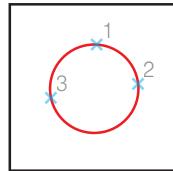
Dragging the measurement line (circle) allows you to move the measurement line (circle).

Dragging the point at the center of the measurement line (circle) allows you to move the measurement line (circle).

Dragging the point on the circumference of the measurement line (circle) allows you to adjust the size of the measurement line (circle).



■[3 points circle]
Draws a circle with three points as a circumference.



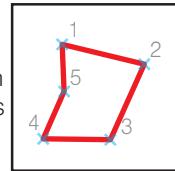
- 1 Click the [3 points circle] button .
- 2 Click a position you want to set as a first point of the circle on the 2D image view area.
- 3 Click a position you want to set as a second point.
Moving the mouse displays the circle.
- 4 Click a position you want to set as a third point.
The measurement region is created.
Moving the mouse displays measurement results.
- 5 Click a position you want to display measurement results.
The measurement results are created.

To edit:

Dragging the measurement region allows you to move the measurement region.
Dragging the point at the center of the measurement region allows you to move the measurement region.
Dragging the point on the circumference of the measurement region allows you to adjust the position or the size of the measurement region.



■[Polygon]
Draws a polygon with a first point as a start point and with points after a second point as vertexes.



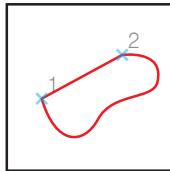
- 1 Click the [Polygon] button.
- 2 Click a position you want to set as a start point on the 2D image view area.
Moving the mouse displays the line.
- 3 Click a position you want to set as a vertex.
- 4 Double-click a position you want to set as an end point.
The measurement region and measurement results are created.

To edit:

Dragging the measurement region allows you to move the region.
Dragging the point allows you to adjust the vertex position of the measurement region.
Dragging measurement results allows you to move the view position of measurement results.

**[Free hand]**

Draws graphics freely.
Hold down the mouse button at the position you want to set as a start point on the image, and drag freely.
The graphic is closed with the start point and the end point.



1 Click the [Free hand] button.

2 Drag from a position you want to set as a start point of the measurement line to a position you want to set as an end point on the 2D image view area.

The measurement line is created.

The start point is connect to the end point.

The measurement results of the measurement line including the line that connects the start point with the end point are created.

To edit:

Dragging the measurement line allows you to move the measurement line.

Dragging the point allows you to extend the measurement line.

Dragging measurement results allows you to move the view position of measurement results.

10-4-4 Auxiliary tool types used in the in-plane measurement



- [Point]
Draws a point.



- [Line]
Draws a line passing through two points.



- [3 points circle]
Draws a circle with three points as a circumference.



- [Midpoint]
Draws a midpoint of two points.



- [Median line]
Draws a median line of two lines.



- [Maximum height]
Draws the highest position in Z-axis direction in the region as a point.



- [Minimum height]
Draws the lowest position in Z-axis direction in the region as a point.



- [Sphere center]
Recognizing the three-dimensional shape in the region as a sphere, draws a point at the center position of the sphere.



- [Cylinder axis]
Recognizing the three-dimensional shape in the region as a side surface of the cylinder, draws a center axis as a line.



- [Surface intersection line]
Recognizing the three-dimensional shape in the region as a plane, draws its cross line.



- [Intersection line to line]
Draws a intersection point of 2 lines.



- [Intersection circle to circle]
Draws a point at the intersection of two circles.



- [Streak]
Draw a line orthogonal to the texture of the sample surface in the region.

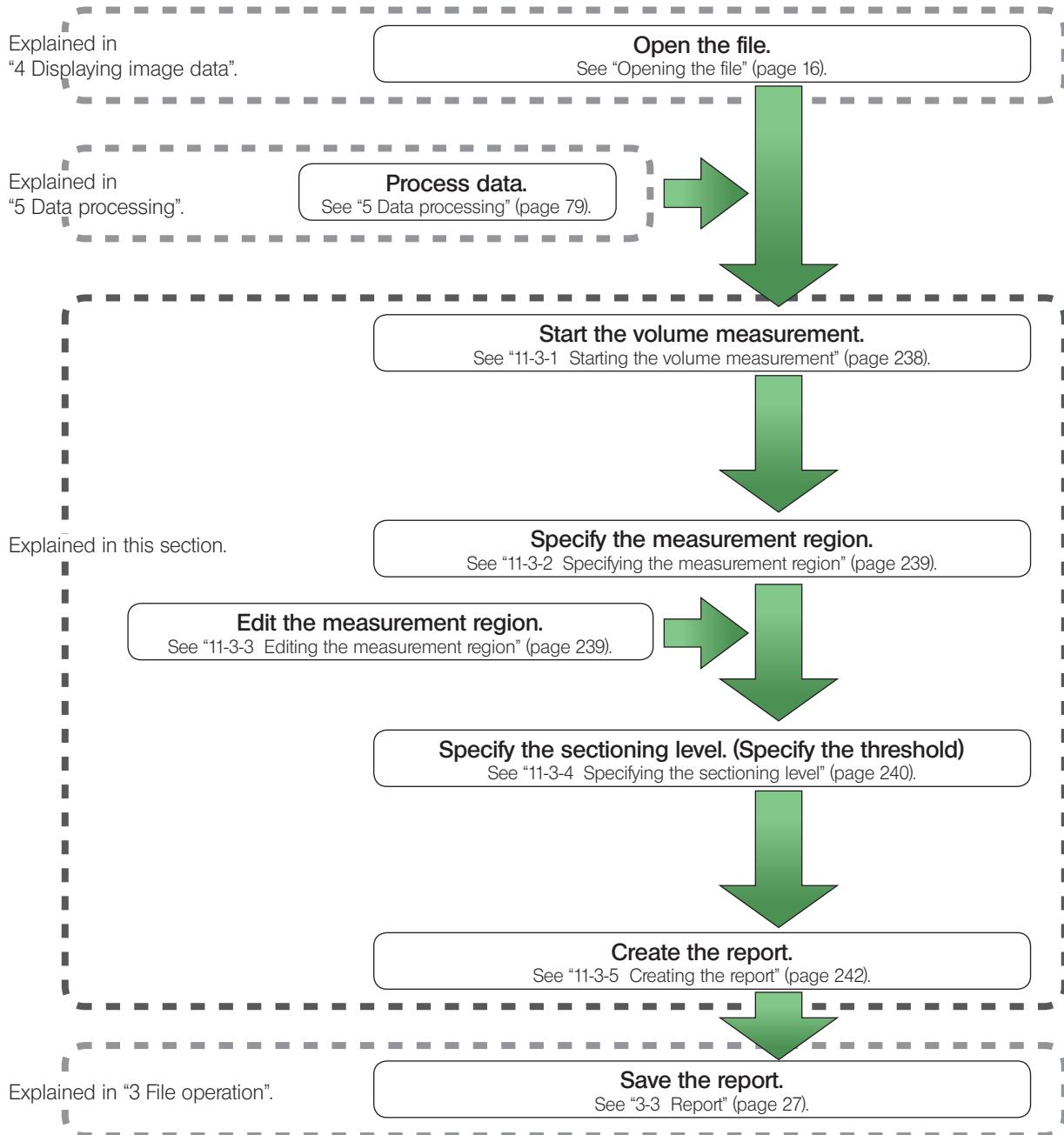
TIP

For details on auxiliary tools, see "Auxiliary tool types" (page 416).

11**Volume measurement**

Measures the area, the volume or the surface area of the region specified on the image.

11-1 Flow of the volume measurement



11-2 Screens used in the volume measurement



a 3D image data selection button

Selects either the laser intensity image, the color image or the height image on the 3D image view area.

b Advanced setting button for 3D image

Displays the screen to define advanced settings for displaying the 3D image. For details on the screen, see "4-2-1 Screens used with the 3D view" (page 51).

c 3D image view area

Displays the 3D image.

Dragging the image allows you to change the angle to display the image.

Rotating the mouse wheel on the image zooms in or out the image.

Dragging the image while holding down the right button of the mouse allows you to move the view position.

d 2D image data selection button

Selects either the laser intensity image, the color image or the height image on the 2D image view area.

e Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

f Loupe button

Zooms in the mouse pointer position on the 2D image view area.

g 2D image view area

Displays the 2D image, the measurement line and the measurement region.

Rotating the mouse wheel on the image zooms in or out the image.

The information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area is displayed on the status bar.

(h) to (o) are described on the next page.)



(a) to (g) are described on the previous page.)

(h) Histogram view area

Displays the height histogram. Dragging the bar on the histogram allows you to specify the sectioning level.

(i) Profile view area

Displays the profile of the measurement line position on the 2D image view area. Dragging the bar on the profile allows you to specify the sectioning level. You can select the direction of the measurement line on the 2D image either horizontal or vertical.

Rotating the mouse wheel on the profile zooms in or out the profile.

(k) Measurement results view area

Displays measurement results obtained from the sectioning level on the histogram or the profile.

(l) Measurement region setting area

Set the measurement region to measure the area and the volume.

(m) Sectioning level setting area

Set the sectioning level.

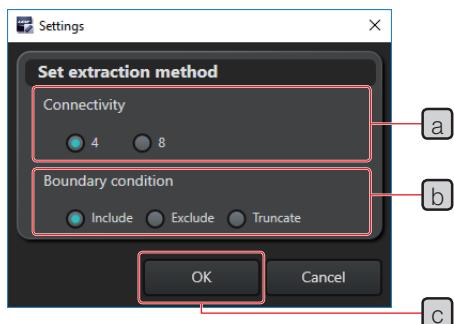
(n) [Create report] button

Creates the report based on measurement results obtained from the sectioning level on the histogram or the profile.

(o) [Cancel] button

Cancels the volume measurement.

Setting the number of particles to connect and particles to extract



[a] **[Connectivity] radio button**

Recognizes the pixels connected according to the specified number of connection as a single particle.

[b] **[Boundary condition] radio button**

Selects the target particles for extraction on the boundary of the ROI.

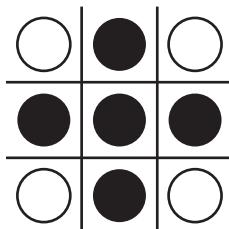
[c] **[OK] button**

Changes ROI settings and closes the [Settings] screen.

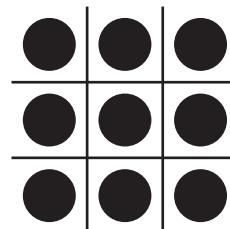
Point

Number of connection:

The number of particles to be recognized or the binarization process operation differs depending on the number of connection.



4-connection



8-connection

mark indicates the pixel of image data 1.

The pixels connected to the center pixel of the 3 X 3 vicinity are illustrated above:

4-connection: Pixels up/down/right/left of the center pixel

8-connection: Diagonal pixels are added to pixels in case of 4-connection.

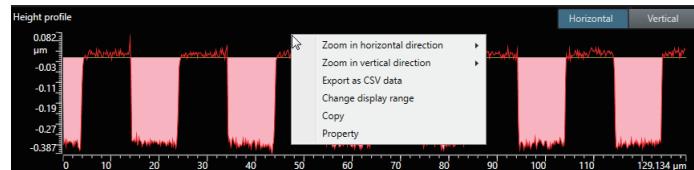
Point

Target particles for extraction on the boundary of the ROI

[Include]: Extracts the particle inside and outside of the boundary of the ROI.

[Exclude]: Excludes the particle on the boundary of the ROI.

[Truncate]: Extracts only the particle inside the boundary of the ROI.

Profile

You can define following settings on the profile. Right-click on the profile to display the menu, and select the menu you desire.

- **[Zoom in horizontal direction]**

Sets the horizontal magnification of the profile.

- **[Zoom in vertical direction]**

Sets the vertical magnification of the profile.

- **[Export as CSV data]**

Outputs the profile in CSV file format.

- **[Change display range]**

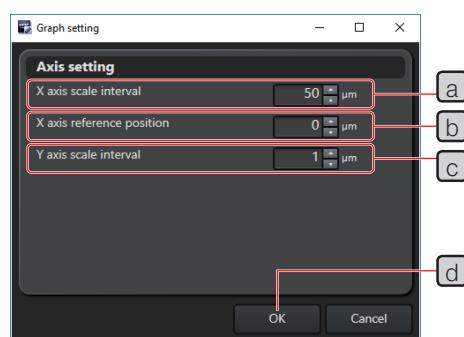
Sets the display range of the image and the profile. For setting the display range, see "4-4 Setting the display range" (page 60) for details.

- **[Copy]**

Copies the profile as an image.

- **[Property]**

Sets the format of the profile. For setting the format, see "Setting the format of the profile" (page 237).

Setting the format of the profile

a [X-axis scale interval]

Sets the scale interval on the X-axis.

b [X-axis reference position]

Sets the value you want to use as a "0" position on the X-axis.

c [Y-axis scale interval]

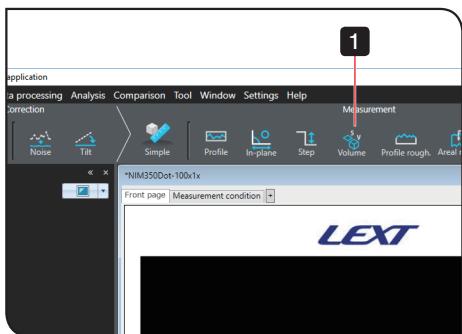
Sets the scale interval on the Y-axis.

d [OK] button

Changes the settings and close the [Graph setting] screen.

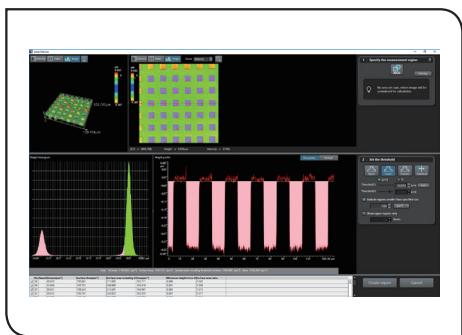
11-3 Operating procedures of the volume measurement

11-3-1 Starting the volume measurement



1 Click the [Volume] button.

TIP You can also display the [Area/Volume] screen by selecting [Area/Volume] from the [Analysis] menu.

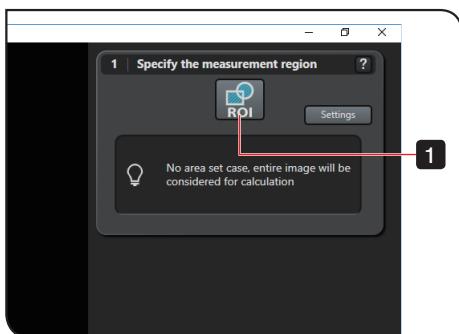


The [Area/Volume] screen appears.

11-3-2 Specifying the measurement region

Specify the measurement region on the 2D image view area, if necessary.

TIP If the measurement region is not specified, all regions are measured.



1 Click the [ROI] button.

The [Set the region] screen appears.

2 Add the measurement region to the position you want to measure.

TIP For adding the measurement region, see "Adding the ROI" (page 399).

11-3-3 Editing the measurement region

Edit the measurement region, if necessary.

TIP For editing the measurement region, see "Editing the ROI" (page 406).

11-3-4 Specifying the sectioning level

Set the sectioning level (threshold) of the region you want to measure on the profile.

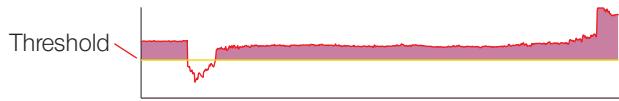
There are two methods to specify the sectioning level as described below.

- Specify the sectioning level (threshold) manually.
- Specify the sectioning level (threshold) automatically.

Specifying the sectioning level (threshold) manually

- 1 Click the [Upper limit], [Lower limit] or [Outside] button.

[Upper limit]: Sets the region higher than the threshold as a measurement region.



[Lower limit]: Sets the region lower than the threshold as a measurement region.



[Outside]: Sets the region outside of the region between the threshold 1 and threshold 2 as a measurement region.



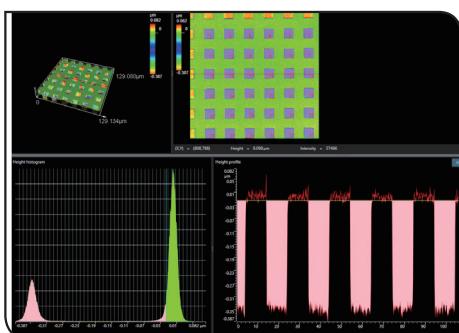
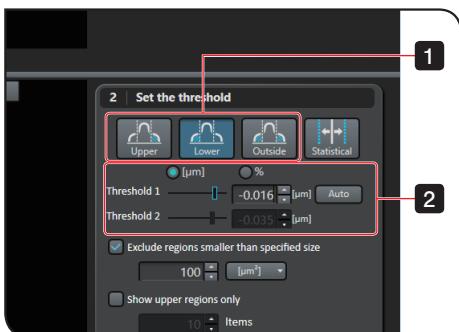
- 2 Set the threshold on the histogram or on the profile.

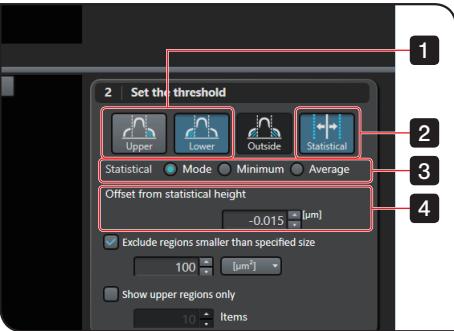
Or set the threshold using the [Threshold 1] or [Threshold 2] slider in the [Set the threshold].

The measurement region on the histogram or the profile is displayed in pink color.

The measurement region you created is masked on the 2D image.

When you move the measurement line position, move it on the 2D image view area while looking at the histogram or the profile.





Specifying the sectioning level (threshold) automatically.

- 1 Click the [Upper limit] button or the [Lower limit] button.

[Upper limit]: Sets the region higher than the threshold as a measurement region.



[Lower limit]: Sets the region lower than the threshold as a measurement region.



- 2 Click the [Statistical] button.

- 3 Click either the [Mode], [Minimum] or [Average] radio button.

[Mode]: Detects the mode of the height of the histogram and sets it as a sectioning level.

[Minimum]: Detects the minimum value of the height of the histogram and sets it as a sectioning level.

[Average]: Detects the average of the height of the histogram and sets it as a sectioning level.

- 4 To offset the sectioning level detected automatically, set the offset value in the [Offset from statistical height] setting field.

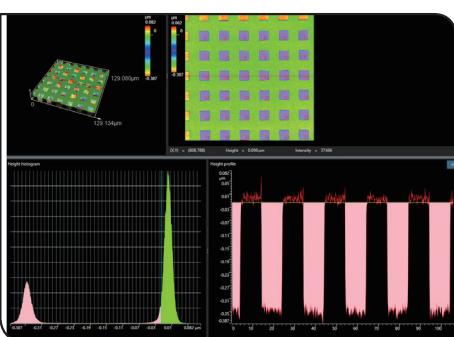
- 5 Set the threshold on the histogram or on the profile.

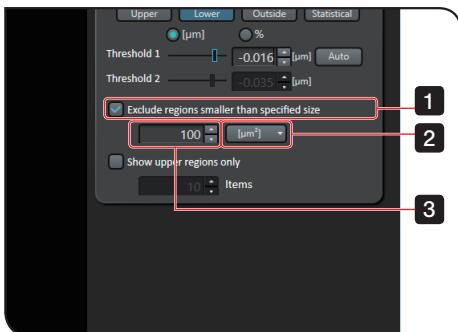
The measurement region on the histogram or the profile is displayed in pink color.

The measurement region you created is masked on the 2D image.

When you move the measurement line position, move it on the 2D image view area while looking at the histogram or the profile.

You can also specify the sectioning level on the 3D image view area.

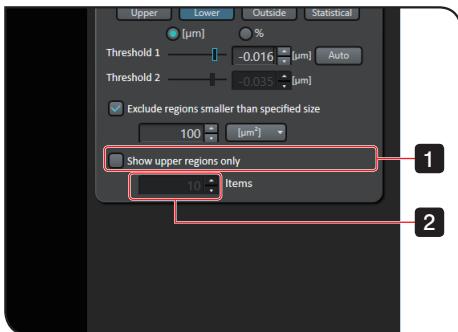




Excluding small regions from measurement

Exclude small regions from the measurement, if necessary.

- 1 Check the [Exclude regions smaller than specified size] checkbox.
- 2 Select either [μm^2] or [Pixel] to specify the region size to exclude from the [Exclude regions smaller than specified size] dropdown list.
- 3 Specify the region size to exclude by selecting the area or the pixel from the [Exclude regions smaller than specified size] setting field.

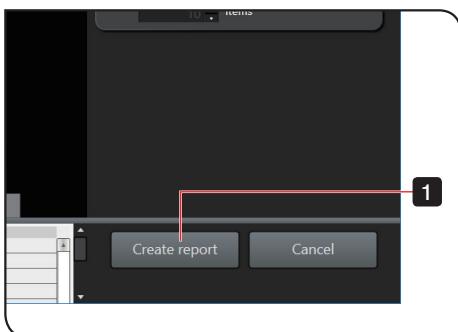


Measuring only measurement regions up to those you specify the number

The measurement regions are numbered in the order of the larger area. Measure the measurement regions up to those you specify the number, if necessary.

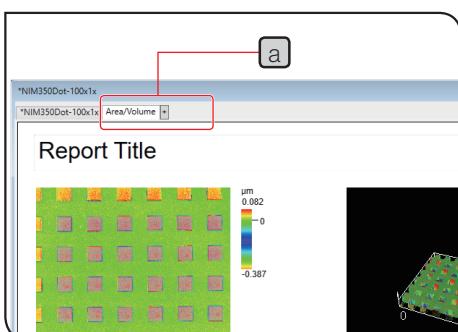
- 1 Check the [Show upper regions only] checkbox.
- 2 Specify the number in the [Show upper regions only] setting field.

11-3-5 Creating the report



When you finish setting the sectioning level, create the report.

- 1 Click the [Create report] button.



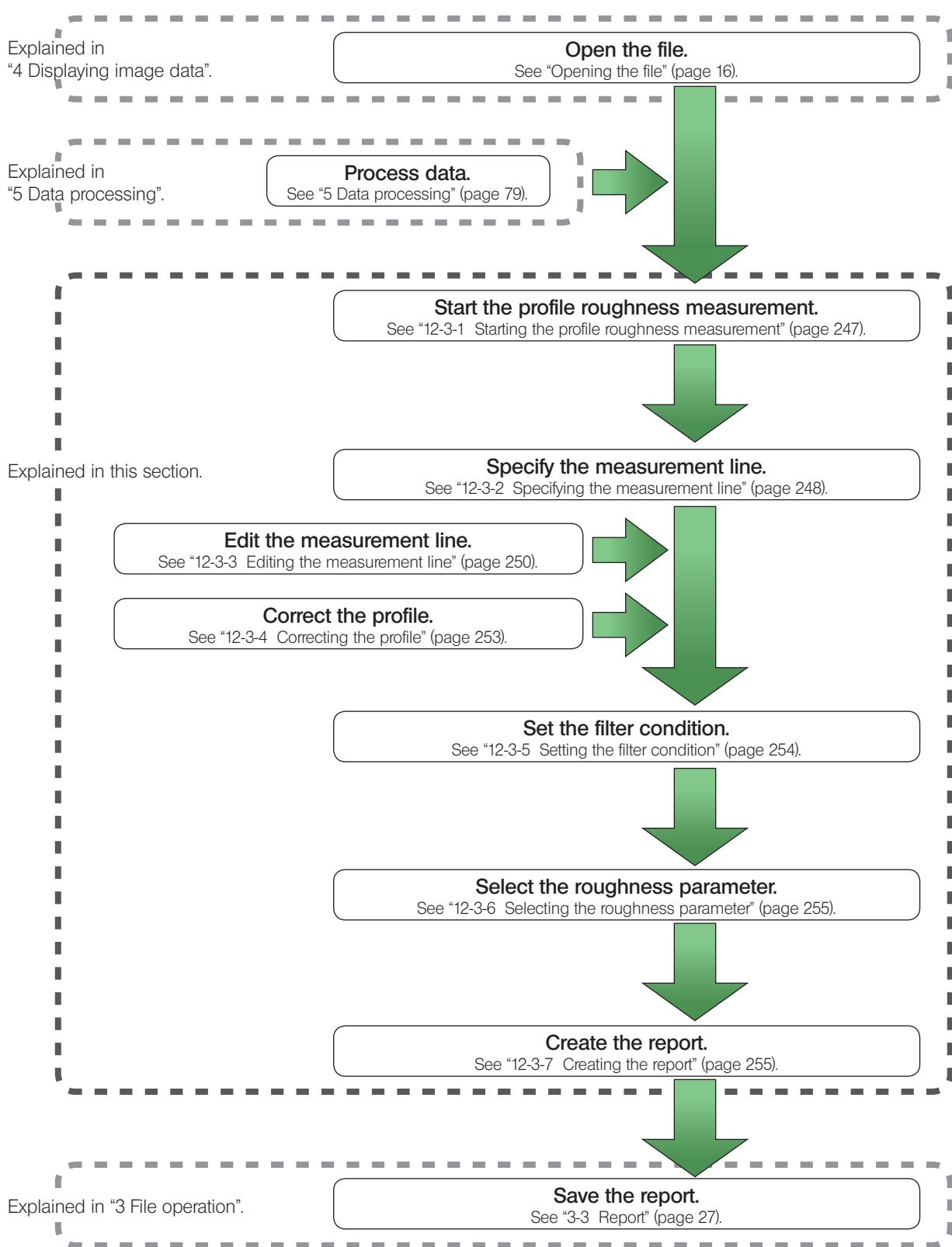
The [Area/Volume] tab **a** is added to the data view window and the report is displayed.

- TIP**
- You can redo the volume measurement by double-clicking on either the 2D image data, the 3D image data, the histogram, the profile or measurement results on the report.
 - For details on redoing the measurement, see “3-3-4 Redoing the measurement analysis” (page 38).
 - For hiding unnecessary measurement results, see “22-10 Measurement analysis options” (page 396).

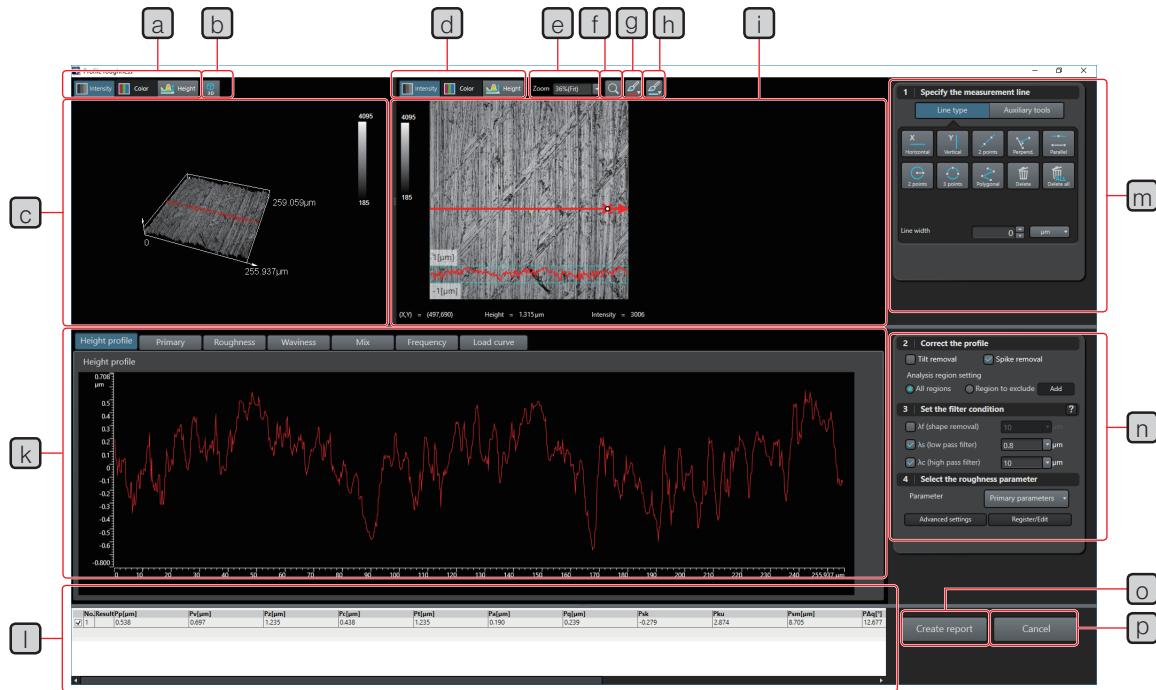
12 Profile roughness measurement

You can measure the cross section, roughness and wave of a single line specified on the height data. The roughness parameters are clearly defined in ISO standards.

12-1 Flow of the profile roughness measurement



12-2 Screens used in the profile roughness measurement



a 3D image data selection button

Selects either the laser intensity image, the color image or the height image on the 3D image view area.

b Advanced setting button for 3D image

Displays the screen to define advanced settings for displaying the 3D image. For details on the screen, see "4-2-1 Screens used with the 3D view" (page 51).

c 3D image view area

Displays the 3D image.

Dragging the image allows you to change the angle to display the image.

Rotating the mouse wheel on the image zooms in or out the image.

Dragging the image while holding down the right button of the mouse allows you to move the view position.

d 2D image data selection button

Selects either the laser intensity image, the color image or the height image on the 2D image view area.

e Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

f Loupe button

Zooms in the mouse pointer position on the 2D image view area.

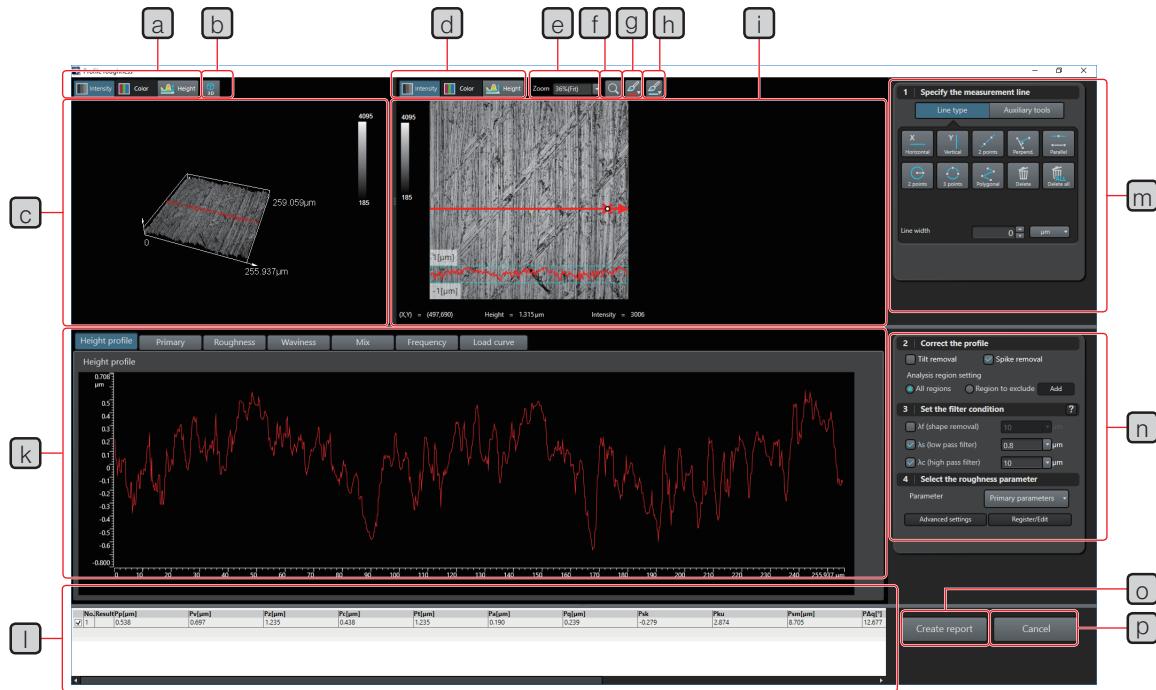
g Measurement line color button

Sets the color of the measurement line selected on the 2D image view area.

h Auxiliary tool color button

Sets the color of the auxiliary tool on the 2D image view area.

(**i** to **p** are described on the next page.)



(a) to (h) are described on the previous page.)

i 2D image view area

Displays the 2D image and the measurement line. Rotating the mouse wheel on the image zooms in or out the image. You can change the color of the measurement line and auxiliary tools. Use the measurement line color button (g) or the auxiliary tool color button (h) to display the color pallet. The information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area is displayed on the status bar.

k Profile roughness measurement information view area

Displays the original profile, cross-sectional profile, roughness profile, wave profile, mixed profile (cross section, roughness and wave), power spectral density and relative material ratio. Rotating the mouse wheel on the profile zooms in or out the profile.

l Measurement results view area

Displays measurement results obtained from the measurement line and the roughness parameter on the 2D image.

m Measurement line setting area

Select the method to specify the measurement line.

n Profile roughness measurement setting area

Set the profile correction method, filter conditions and roughness parameters.

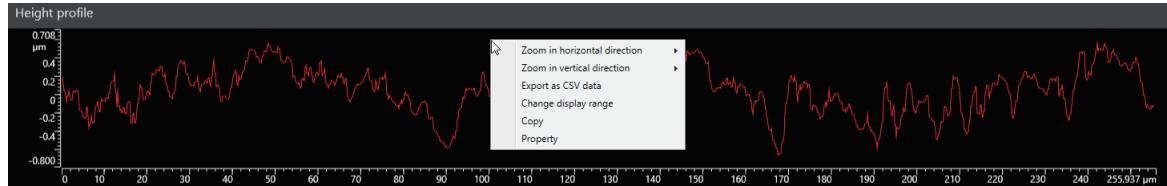
o [Create report] button

Creates the report based on measurement results obtained from the measurement line and roughness parameters on the 2D image.

p [Cancel] button

Cancels the profile roughness measurement.

Profile



You can define following settings on the profile. Right-click on the profile to display the menu, and select the menu you desire.

- **[Zoom in horizontal direction]**

Sets the horizontal magnification of the profile.

- **[Zoom in vertical direction]**

Sets the vertical magnification of the profile.

- **[Export as CSV data]**

Outputs the profile in CSV file format.

- **[Change display range]**

Sets the display range of the image and the profile. For setting the display range, see "4-4 Setting the display range" (page 60) for details.

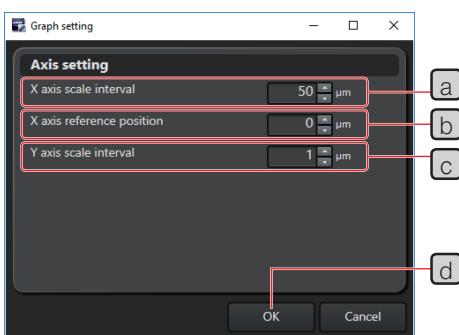
- **[Copy]**

Copies the profile as an image.

- **[Property]**

Sets the format of the profile. For setting the format, see "Setting the format of the profile" (page 246).

Setting the format of the profile



- a **[X-axis scale interval]**

Sets the scale interval on the X-axis.

- b **[X-axis reference position]**

Sets the value you want to use as a "0" position on the X-axis.

- c **[Y-axis scale interval]**

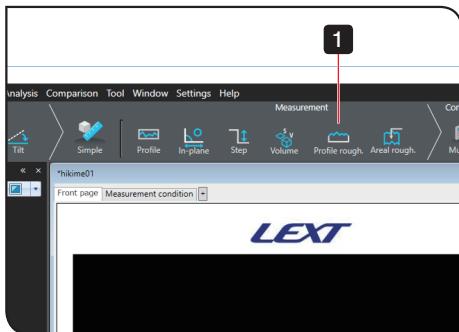
Sets the scale interval on the Y-axis.

- d **[OK] button**

Changes the settings and close the [Graph setting] screen.

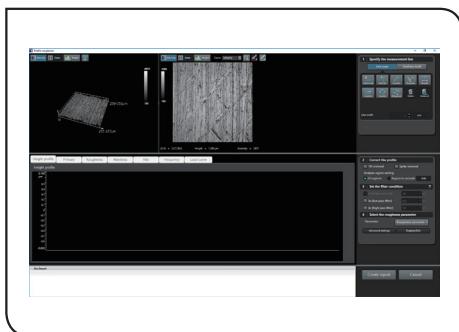
12-3 Operating procedures of the profile roughness measurement

12-3-1 Starting the profile roughness measurement



1 Click the [Profile roughness] button.

TIP You can also display the [Profile roughness] screen by selecting [Profile roughness] from the [Analysis] menu.



The [Profile roughness] screen appears.

12-3-2 Specifying the measurement line

Specify the measurement line at the measurement position on the 2D image view area. When the measurement line is specified, the profile of the measurement line position is displayed on the profile view area.

Point

- If necessary, use the auxiliary tool to draw a point(s) or a line(s) at the position you want to use as a base of the measurement line on the image in advance.
- You can specify the measurement line more efficiently and accurately using auxiliary tools.

TIP

For details on auxiliary tools, see “12-4 Measurement line and auxiliary tools” (page 256).

- 1 If the [Line type] button is not ON, click the [Line type] button.

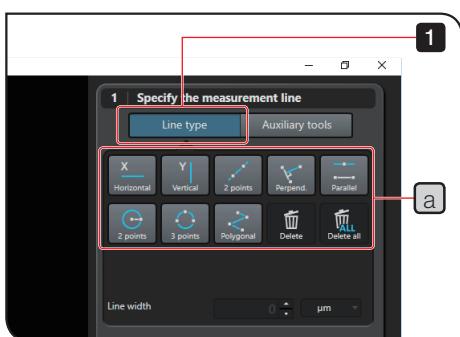
The line types are displayed on the measurement line setting area **a**.

- 2 Click the line type button on the measurement line setting area **a**.

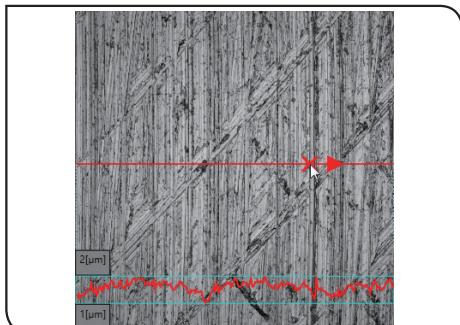
The line type button you selected is pressed (ON).

TIP

For details on the line type, see “12-4 Measurement line and auxiliary tools” (page 256).



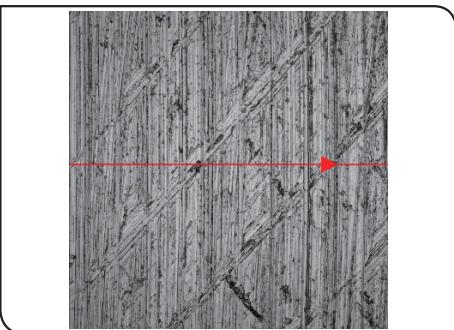
- 3 Click any position on the 2D image view area.



The measurement line is drawn following the movement of the mouse pointer.

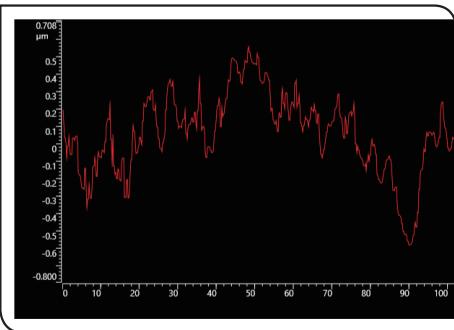
The profile is displayed on the profile view area.

The profile is updated following the movement of the measurement line.



- 4 Move the measurement line position while looking at the profile, and click the mouse at the desired position.

The measurement line is fixed.



The profile is also fixed.

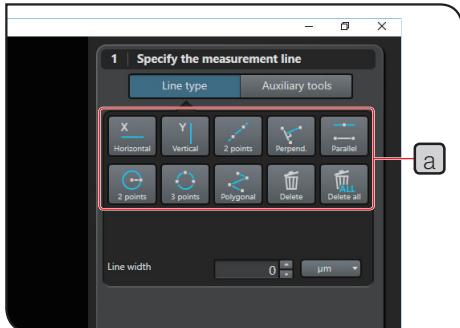
The profile of the target image is displayed in the same color as the measurement line.

- 5 If you want to specify multiple measurement lines, repeat steps from 2 to 4.

TIP The measurement line is added in the order of red, green, blue, pink and yellow.

12-3-3 Editing the measurement line

You can edit or delete the measurement line, if necessary.

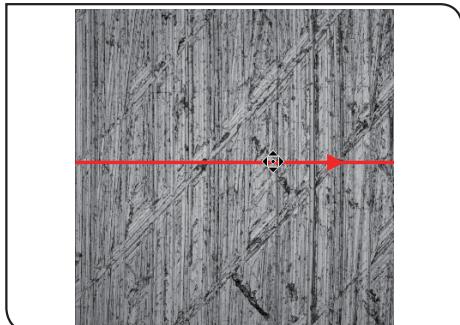


Make sure that all line type buttons on the measurement line setting area **a** are OFF before editing the measurement line.

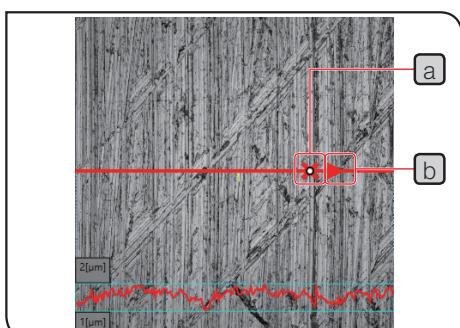
TIP

If the line type button is ON, when you click on the 2D image view area, the measurement line is specified.

Selecting the measurement line



- 1 Click on the measurement line on the 2D image view area.

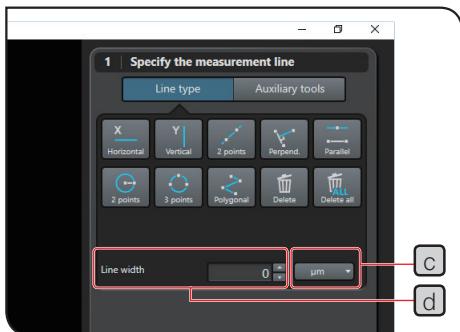


The measurement line is selected and highlighted.

The mouse pointer position when the measurement line is specified is displayed as a “specified point” **a** with a circle and a cross line.

The arrow **b** indicating the profile direction is displayed.

Changing the measurement line width



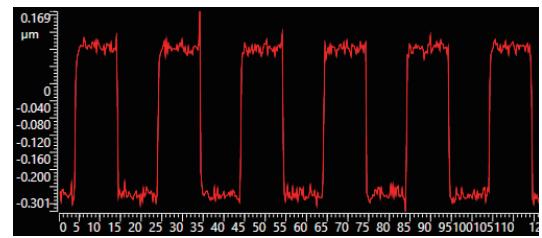
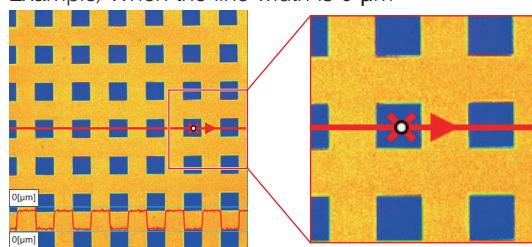
TIP

As the profile is created with the average measurement line width, if you increase the measurement line width, you can make the profile with less noise.

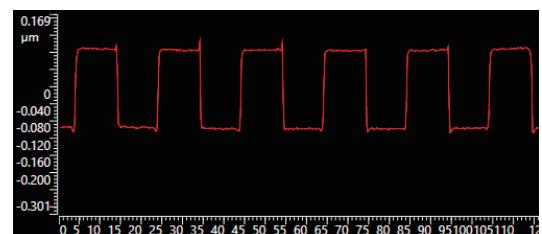
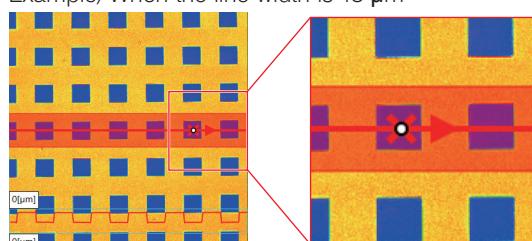
- 1 Select either [μm] or [Pixels] for specifying the line width from the [Line width] dropdown list **c**.
- 2 Specify the line width by either the length or the pixel in the [Line width] setting field **d**.

If you increase the line width, the measurement line width is masked.

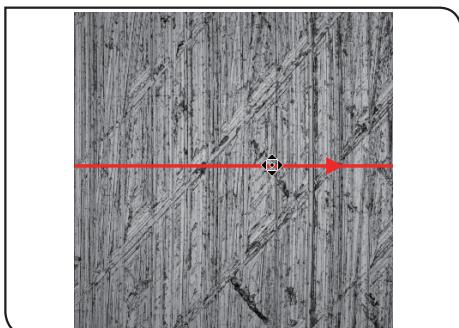
Example) When the line width is 0 μm



Example) When the line width is 18 μm



Deleting the measurement line



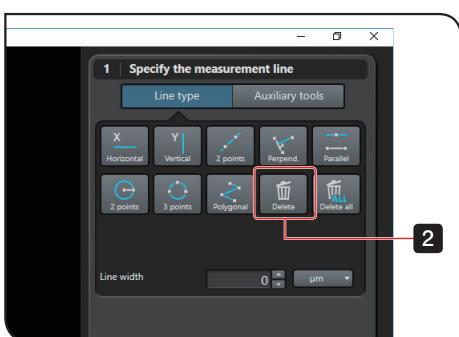
Deleting the selected measurement line

- 1 Click on the measurement line you want to delete on the 2D image view area.

- 2 Click the [Delete] button.

When the message confirming to delete the measurement line appears, click the [Yes] button.

The measurement line is deleted.

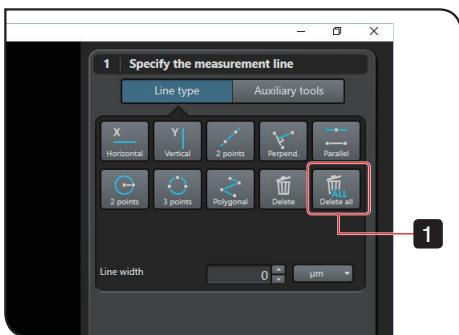


Deleting all measurement lines

- 1 Click the [Delete all] button.

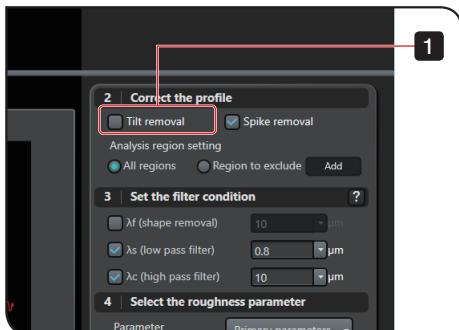
When the message confirming to delete all measurement lines appears, click the [Yes] button.

All measurement lines are deleted.



12-3-4 Correcting the profile

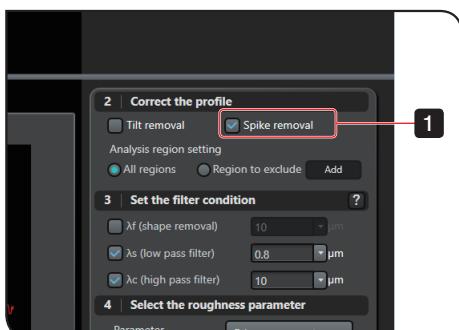
Correct the profile, if necessary.



Removing the tilt of the height

- Check the [Tilt removal] checkbox.

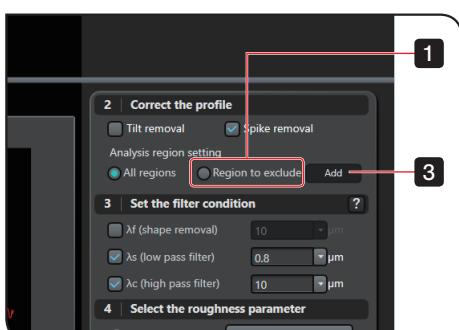
The tilt of the profile is removed.



Removing a sharp waveform noise (spike noise)

- Check the [Spike removal] checkbox.

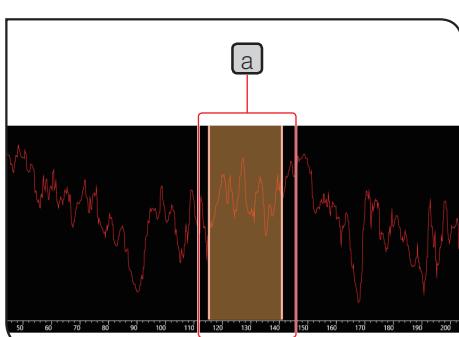
The spike noise is removed from the profile.



Removing the unnecessary region of the profile from measurement

Specify the region of the profile to remove from measurement. If you measure all regions of the profile, this step is not necessary.

- Click the [Region to exclude] radio button.



The region to exclude from measurement **a** is displayed on the profile.

- Drag the right and left lines of the region to exclude from measurement **a**, and specify the region to exclude from measurement.
- To add the region to exclude from measurement, click the [Add] button.
- The another region to exclude from measurement is displayed on the profile. Specify the region to exclude from measurement in the same manner as the step **2**.

12-3-5 Setting the filter condition

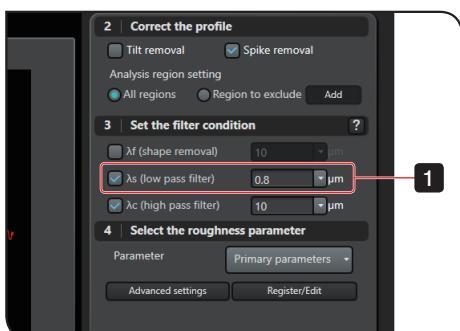
Set the filter condition. Setting the filter condition allows you to remove the structural effect from the roughness contour curve or remove the areal roughness effect from the wave contour curve.



Removing a long wavelength component from the profile

- 1 Check the [λf] checkbox and set the wavelength in the next setting field.

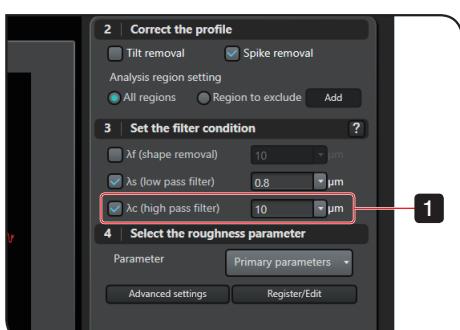
TIP You can use this function for the wave curve.



Removing a short wavelength component from the profile

- 1 Check the [λs] checkbox and set the wavelength in the next setting field.

TIP You can use this function for the roughness curve, cross-sectional curve and wave curve.

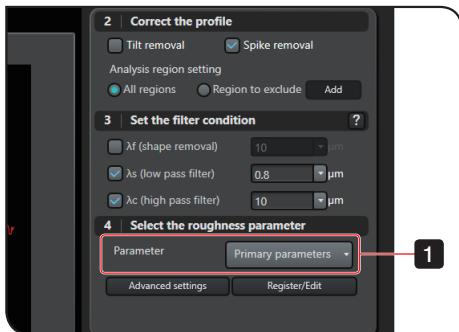


Removing a short wavelength component from the profile

- 1 Check the [λc] checkbox and set the wavelength in the next setting field.

TIP You can use this function for the roughness curve and wave curve.

12-3-6 Selecting the roughness parameter

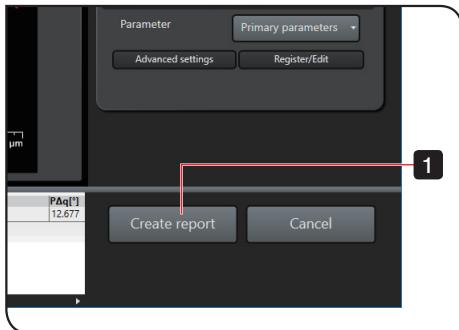


1 Select the roughness parameter from the [Parameter] dropdown list.

TIP

- For registering a new roughness parameter or editing the roughness parameter, see “12-5 Registering and editing the roughness parameter” (page 260)
- For changing the advanced settings of the roughness parameter, see “12-6 Advanced settings of the roughness parameter” (page 261).

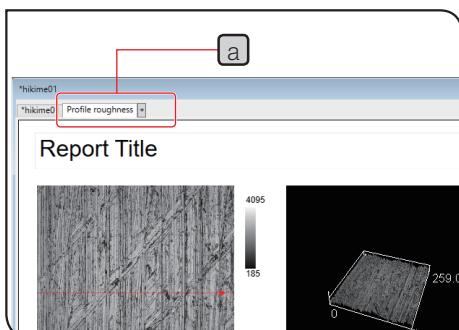
12-3-7 Creating the report



When you select the roughness parameter, create the report.

1 Click the [Create report] button.

12



The [Profile roughness] tab **a** is added to the data view window and the report is displayed.

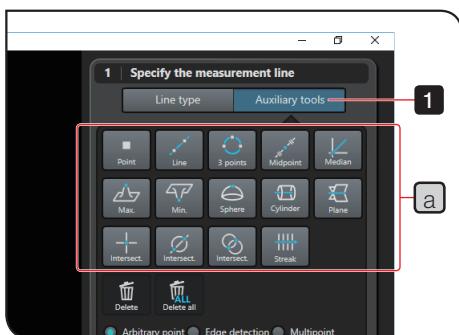
TIP

- You can redo the profile roughness measurement by double-clicking on either the 2D image data, the 3D image data, the histogram, the profile or measurement results on the report.
- For details on redoing the measurement, see “3-3-4 Redoing the measurement analysis” (page 38).

12-4 Measurement line and auxiliary tools

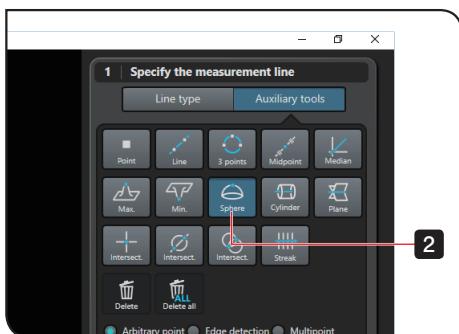
12-4-1 Specifying the measurement line using auxiliary tools

This section describes the procedures to search a sphere center and create a point using auxiliary tools by recognizing the three-dimensional shape in the region specified on the 2D image as a sphere surface, and to specify the measurement line using points created at 2 positions.



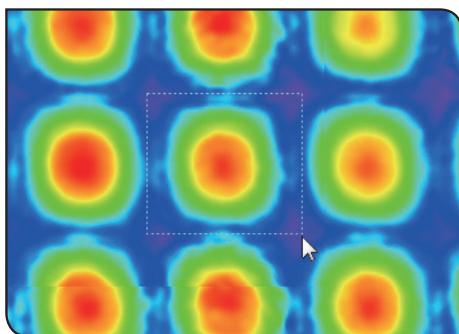
- 1 Click the [Auxiliary tools] button.

The auxiliary tools are displayed on the measurement line setting area a.

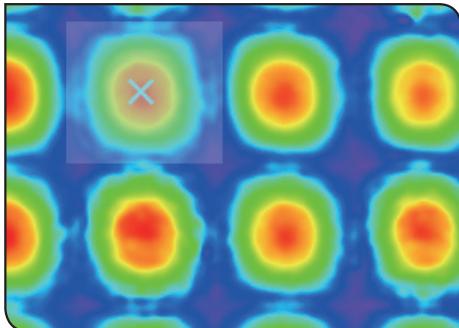


- 2 Click the [Sphere center] button.

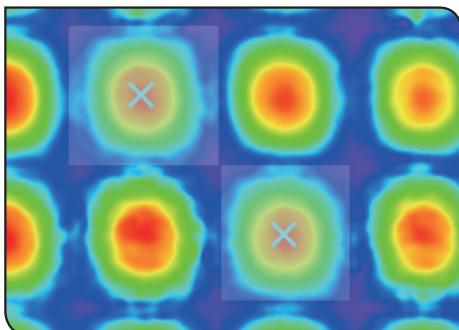
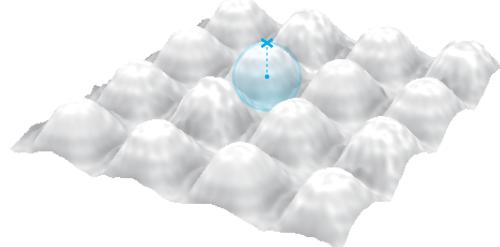
The [Sphere center] button is pressed.



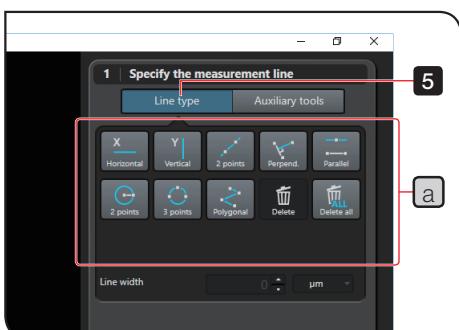
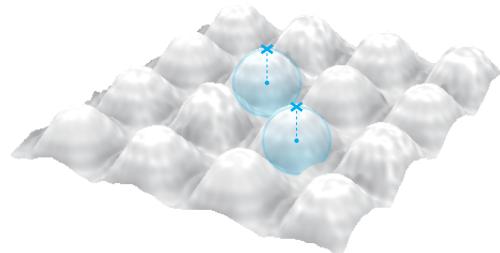
- 3 Drag a position you want to recognize as a sphere surface on the 2D image view area.



The specified region is recognized as a sphere surface, and a “specified point” with a cross line is created at the sphere center position.

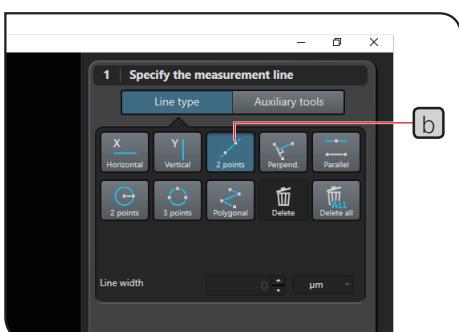


4 Repeat step **3** to specify the second specified point.



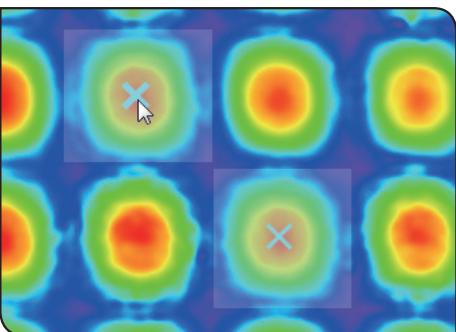
5 Click the [Line type] button.

The line types are displayed on the measurement line setting area **a**.

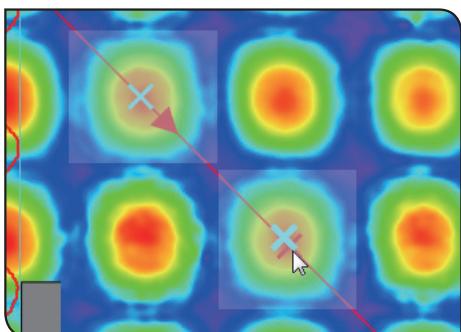


6 Click the [2 points line] button **b**.

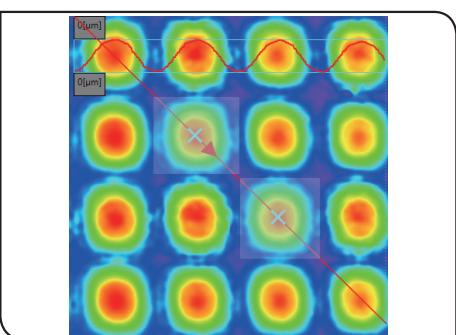
The [2 points line] button is pressed.



- 7 On the 2D image view area, move the mouse pointer closer to the first specified point and click the position where the specified point is highlighted.



- 8 Move the mouse pointer closer to the second specified point and click the position where the specified point is highlighted.



The measurement line passing through two specified points is created.

12-4-2 Measurement line types used in the profile roughness measurement



■[Horizontal]

Draws a horizontal line passing through a single point.



■[2 points line]

Draws a line passing through two points.



■[Parallel line]

Draws a line that is parallel to the line passing through two points and that also passes through a third point.



■[3 points circle]

Draws a circle with three points as a circumference.



■[Vertical]

Draws a vertical line passing through a single point.



■[Perpendicular line]

Draws a line that is perpendicular to the line passing through two points and that also passes through a third point.



■[2 points circle]

Draws a circle with a first point as a center of circle and with a second point as a circumference.



■[Multipoint]

Draws a polygonal line with a first point as a start point and with points after a second point as vertexes.



TIP For details on the measurement line, see "Measurement line types" (page 411).

12-4-3 Auxiliary tool types used in the profile roughness measurement



■[Point]

Draws a point.



■[Line]

Draws a line passing through two points.



■[3 points circle]

Draws a circle with three points as a circumference.



■[Midpoint]

Draws a midpoint of two points.



■[Median line]

Draws a median line of two lines.



■[Maximum height]

Draws the highest position in Z-axis direction in the region as a point.



■[Minimum height]

Draws the lowest position in Z-axis direction in the region as a point.



■[Sphere center]

Recognizing the three-dimensional shape in the region as a sphere, draws a point at the center position of the sphere.



■[Cylinder axis]

Recognizing the three-dimensional shape in the region as a side surface of the cylinder, draws a center axis as a line.



■[Surface intersection line]

Recognizing the three-dimensional shape in the region as a plane, draws its cross line.



■[Intersection line to line]

Draws a point at the intersection of two lines.



■[Intersection circle to line]

Draws a point at the intersection of circle and line.



■[Intersection circle to circle]

Draws a point at the intersection of two circles.



■[Streak]

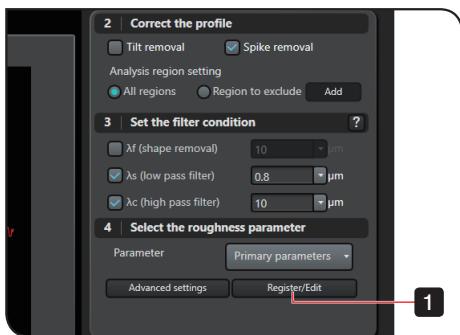
Draw a line orthogonal to the texture of the sample surface in the region.



TIP For details on auxiliary tools, see "Auxiliary tool types" (page 416).

12-5 Registering and editing the roughness parameter

You can register, edit or delete the roughness parameter, if necessary.



- 1 Click the [Register/Edit] button on the [Profile roughness] screen.

The [Analysis parameter] screen appears.

- 2 Set the roughness parameter.

Registering a new roughness parameter

1. Select the [New] radio button **a**.
2. Select the roughness parameter you want to use as a base roughness parameter from the dropdown list **b**.
3. Input the name of the roughness parameter in the [Name] text box **c**.
4. Click a button of [Parameters] **d** to display the parameter checkbox, and check the item you want to measure. The parameter items you will measure are displayed on [Selected parameters] **e**.

Editing the roughness parameter

1. Select the [Edit] radio button **f**.
2. Select the roughness parameter you want to edit from the dropdown list **b**.

TIP You can edit only the roughness parameter registered by the user.

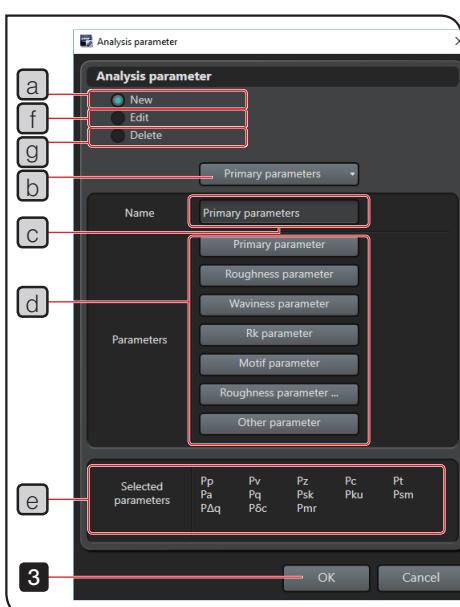
3. If you want to change the name of the roughness parameter, input the name in the [Name] text box **c**.
4. Click a button of [Parameters] **d** to display the parameter checkbox, and check the item you want to measure. The parameter items you will measure are displayed on [Selected parameters] **e**.

Deleting the roughness parameter

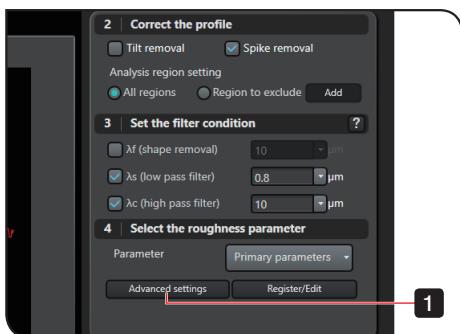
1. Select the [Delete] radio button **g**.
2. Select the roughness parameter you want to delete from the dropdown list **b**.

TIP You can delete only the roughness parameter registered by the user.

- 3 When you finish settings, click the [OK] button to close the [Analysis parameter] screen.



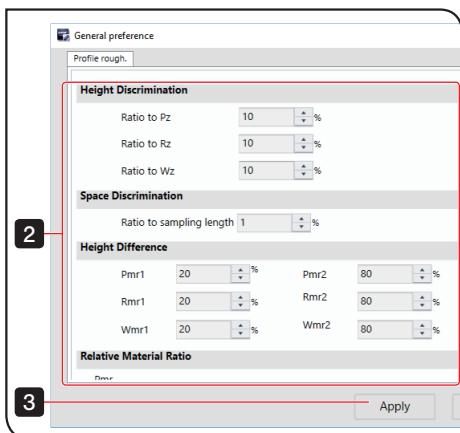
12-6 Advanced settings of the roughness parameter



1 Click the [Advanced settings] button on the [Profile roughness] screen.

TIP

You can also display the [General preference] screen by selecting [General preference] from the [Settings] menu.



The [Profile roughness] tab is displayed on the [General preference] screen.

2 Set the roughness parameters.

3 When you finish setting parameters, click the [Apply] button to close the [General preference] screen.

12-7 Roughness parameter

Profile parameter

Amplitude parameters (peak and valley) (ISO4287:1997)	
Maximum height	Pz, Rz, Wz
Maximum profile peak height	Pp, Rp, Wp
Maximum profile valley depth	Pv, Rv, Wv
Mean height	Pc, Rc, Wc
Total height	Pt, Rt, Wt
Ten-point mean roughness	Rzjis
Amplitude average parameters (ISO4287:1997)	
Arithmetical mean deviation	Pa, Ra, Wa
Root mean square deviation	Pq, Rq, Wa
Skewness	Psk, Rsk, Wsk
Kurutosis	Pku, Rku, Wku
Spacing parameters (ISO4287:1997)	
Mean width	PSm, RSm, WSm
Hybrid parameters (ISO4287:1997)	
Root mean square slope	Pdq, Rdq, Wdq
Parameter from bearing ratio curve and profile height amplitude curve (ISO4287:1997)	
Material ratio	Pmr(c), Rmr(c), Wmr(c)
Profile section height difference	Pdc, Rdc, Wdc
Relative material ratio	Pmr, Rmr, Wmr
Parameters of surface having stratified functional properties (ISO13565-2:1996)	
Core roughness depth	Rk
Material portion	Mr1
Material portion	Mr2
Reduced peak height	Rpk
Reduced valley depth	Rvk
Motif parameters (ISO12085:1996)	
Mean spacing of roughness motifs	AR
Mean depth of roughness motifs	R
Maximum depth of profile irregularity	Rx
Mean spacing of waviness motifs	AW
Mean depth of waviness motifs	W
Maximum depth of waviness	Wx

Amplitude parameters (peak and valley)

■ Maximum height (R_z)

Represents the sum of the maximum peak height Z_p and the maximum valley depth Z_v of a profile within the reference length.

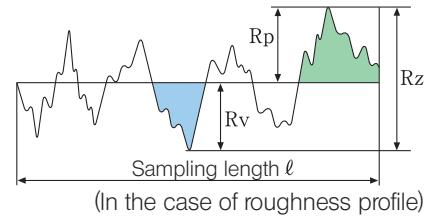
* Indicated as R_y within JIS'94

* Profile peak: Portion above (from the object) the mean profile line (X-axis)

* Profile valley: Portion below (from the surrounding space) the mean profile line (X-axis)

- P_z Maximum height of the primary profile
- W_z Maximum height of the waviness

$$R_z = R_p + R_v$$



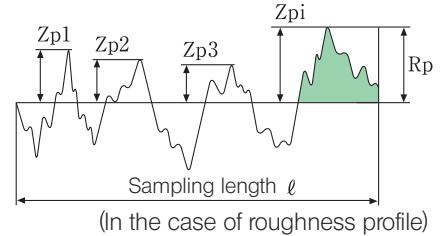
Although frequently used, max height is significantly influenced by scratches, contamination, and measurement noise due to its reliance on peak values.

■ Maximum profile peak height (R_p)

Represents the maximum peak height Z_p of a profile within the sampling length.

- P_p The maximum peak height of the primary profile
- W_p The maximum peak height of the waviness profile

$$R_p = \max (Z(x))$$

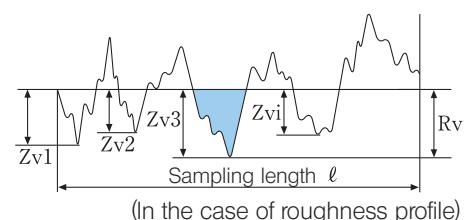


■ Maximum profile valley depth (R_v)

Represents the maximum valley depth Z_v of a profile within the sampling length.

- P_v The maximum valley depth of the primary profile
- W_v The maximum valley depth of the waviness profile

$$R_v = \min (Z(x))$$



■ Mean height (Rc)

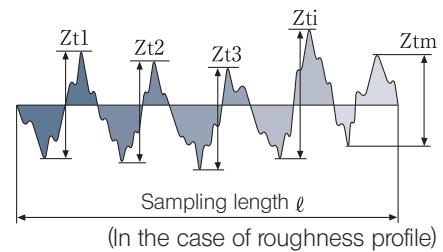
Represents the mean for the height Z_t of profile elements within the sampling length.

- * Profile element: A set of adjacent peaks and valleys
- * Minimum height and minimum length to be discriminated from the peaks (valleys).

Minimum height discrimination: 10 % of the R_z value
Minimum length discrimination: 1 % of the reference length

- P_c The mean height of the primary profile element
- W_c The mean height of the waviness element

$$R_c = \frac{1}{m} \sum_{i=1}^m Z_{ti}$$



■ Total height (Rt)

Represents the sum of the maximum peak height Z_p and the maximum valley depth Z_v of a profile within the evaluation length, not sampling length.

- * Relationship $R_t \geq R_z$ applies for all profiles.

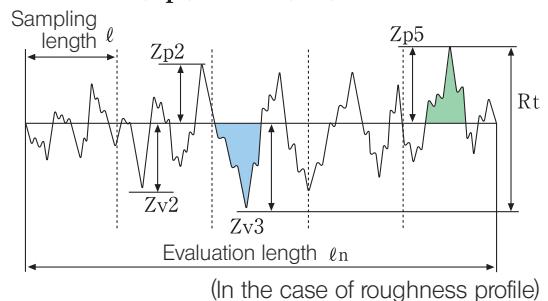
- P_t The maximum total height of the profile (R_{max} in the case of JIS'82)
- W_t The maximum total height of the waviness



R_t is a stricter standard than R_z in that the measurement is conducted against the evaluation length.

It should be noted that the parameter is significantly influenced by scratches, contamination, and measurement noise due to its utilization of peak values.

$$R_t = \max(Z_{pi}) + \max(Z_{vi})$$



■ Ten-point mean roughness (Rzjis)

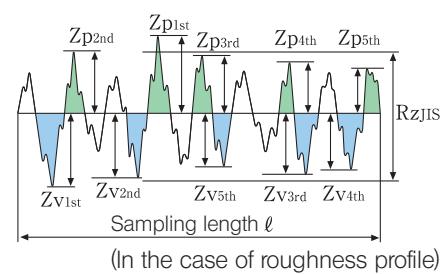
Represents the sum of the mean value for the height of the five highest peaks and the mean of the depth of the five deepest valleys of a profile within the sampling length.

- * Indicated as R_z within JIS'94



$Rzjis$ is equivalent to the parameter R_z of the obsolete JIS standard B0601:1994. Although ten-point mean roughness was deleted from current ISO standards, it was popularly used in Japan and was retained within the JIS standard as parameter $Rzjis$.

$$Rzjis = \frac{1}{5} \sum_{j=1}^5 (Z_{pj} + Z_{vj})$$



Amplitude average parameters

■ Arithmetic mean deviation (R_a)

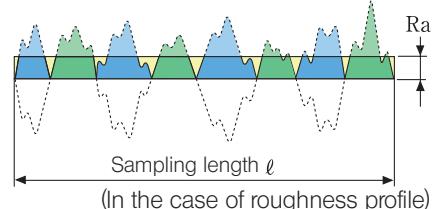
Represents the arithmetic mean of the absolute ordinate $Z(x)$ within the sampling length.

- P_a The arithmetic mean height of the primary profile
- W_a The arithmetic mean waviness



One of the most widely used parameters is the mean of the average height difference for the average surface. It provides for stable results as the parameter is not significantly influenced by scratches, contamination, and measurement noise.

$$R_a = \frac{1}{\ell} \int_0^\ell |Z(x)| dx$$



■ Root mean square deviation (R_q)

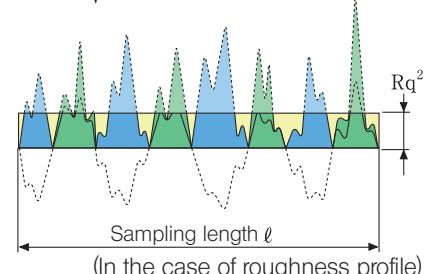
Represents the root mean square for $Z(x)$ within the sampling length.

- P_q The root mean square height for the primary profile
- W_q The root mean square waviness



This is one of the most widely used parameters and is also referred to as the RMS value. The parameter R_q corresponds to the standard deviation of the height distribution. The parameter provides for easy statistical handling and enables stable results as the parameter is not significantly influenced by scratches, contamination, and measurement noise.

$$R_q = \sqrt{\frac{1}{\ell} \int_0^\ell Z^2(x) dx}$$



■ Skewness (R_{sk})

The quotient of the mean cube value of $Z(x)$ and the cube of R_q within a sampling length.

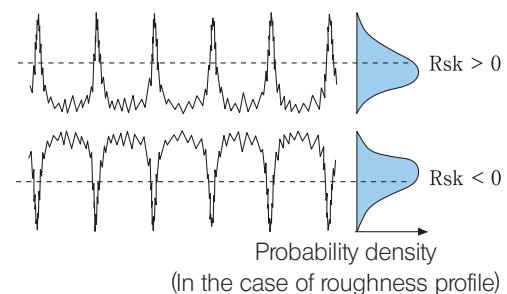
- $R_{sk} = 0$: Symmetric against the mean line (normal distribution)
- $R_{sk} > 0$: Deviation beneath the mean line
- $R_{sk} < 0$: Deviation above the mean line

- P_{sk} The skewness of the primary profile
- W_{sk} The skewness of the waviness profile



This parameter concerns height distribution. It is suitable for evaluating the abrasion and oil sump of lubricants for slide planes.

$$R_{sk} = \frac{1}{R_q^3} \left(\frac{1}{\ell} \int_0^\ell Z^3(x) dx \right)$$



■ Kurtosis (Rku)

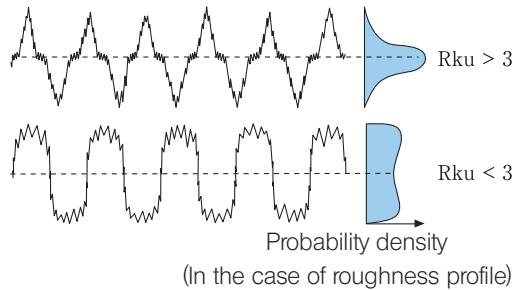
The quotient of the mean quadratic value of $Z(x)$ and the fourth power of Rq within a sampling length.

- $Rku = 3$: Normal distribution
- $Rku > 3$: The height distribution is sharp
- $Rku < 3$: The height distribution is even
- Pku The Kurtosis of the primary profile
- Wku The Kurtosis of the waviness profile



This parameter relates to the tip geometry of peaks and valleys and is suitable for analyzing the degree of contact between two objects.

$$Rku = \frac{1}{Rq^4} \left(\frac{1}{\ell} \int_0^\ell Z^4(x) dx \right)$$



Spacing parameters

■ Mean width (RSm)

Represents the mean for the length Xs of profile elements within the sampling length.

* Indicated as Sm within JIS'94

* Minimum height and minimum length to be discriminated from peaks (valleys).

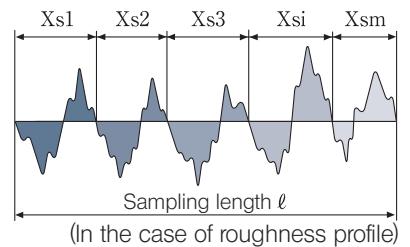
- Minimum height discrimination: 10% of the Rz value
- Minimum length discrimination: 1% of the reference length

- PSm Mean width of the primary profile element
- WSm Mean width of the waviness element



This parameter is used to evaluate the horizontal size of parallel grooves and grains instead of the height parameters.

$$RSm = \frac{1}{m} \sum_{i=1}^m Xsi$$



Hybrid parameters

■ Root mean square slope (Rdq)

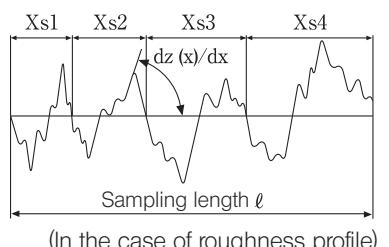
Represents the root mean square for the local slope dz/dx within the sampling length.

- Pdq The root mean square slope for the primary profile
- Wdq The root mean square slope for the waviness



The steepness of the surface can be numerically represented with this parameter.

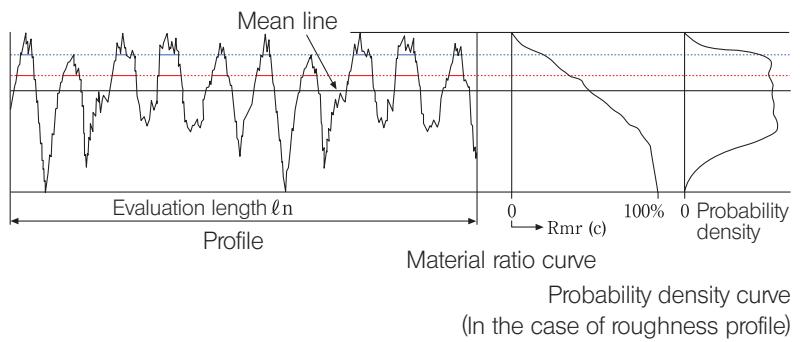
$$Rdq = \sqrt{\frac{1}{\ell} \int_0^\ell \left(\frac{d}{dx} Z(x) \right)^2 dx}$$



Material ratio curves and related parameters

■ Material ratio curve and probability density curves

Material ratio curves signify the ratio of materiality derived as a mathematical function of parameter c , where c represents the height of severance for a specific sample. This is also referred to as the bearing curve (BAC) or Abbott curve. Probability density curves signify the probability of occurrence for height Z_x . The parameter is equivalent to the height distribution histogram.

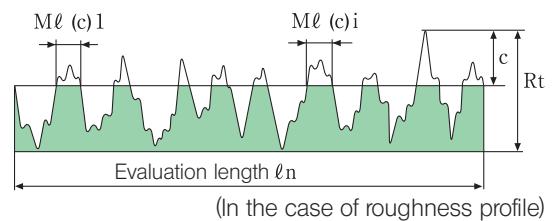


■ Material ratio (Rmr(c))

Indicates the ratio of the material length $Ml(c)$ of the profile element to the evaluation length for the section height level c (% or μm).

- $Pmr(c)$ The material length rate of the primary profile (formerly tp)
- $Wmr(c)$ The material length rate of the waviness

$$Rmr (c) = \frac{1}{\ell_n} \sum_{i=1}^m Ml (c) i$$

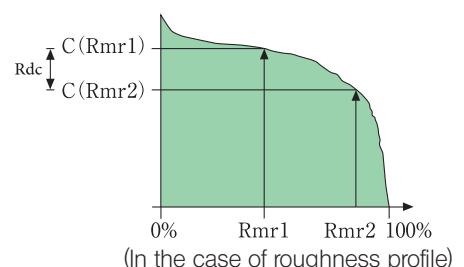


■ Profile section height difference (Rdc)

Rdc signifies the height difference in section height level c , matching the two material ratios.

- Pdc The section height level difference for the primary profile
- Wdc The section height level difference for the waviness profile

$$Rdc = c(Rmr1) - c(Rmr2) : Rmr1 < Rmr2$$



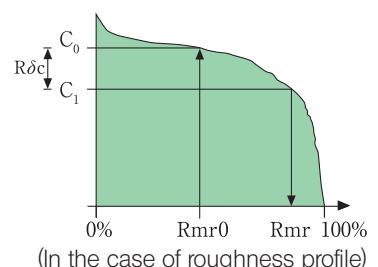
■ Relative material ratio (Rmr)

Rmr indicates the material ratio determined by the difference $R\delta c$ between the referential section height level C_0 and the profile section height level.

- Pmr The relative material length rate of the primary profile
- Wmr The relative material length rate of the waviness profile

$$Rmr = Rmr(c_i)$$

$$\text{Where } C_1 = C_0 - R\delta c, C_0 = C(Rmr0)$$

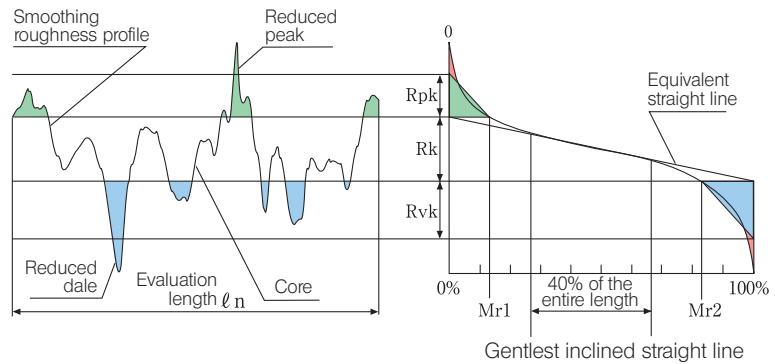


Profile method (linear roughness) parameters

Rk, Mr1, and Mr2 values are calculated from the linear curve (equivalent linear curve) minimizing the sectional inclination corresponding to 40% of the material ratio curve.

Draw a triangle with the area equivalent to the protrusion of the material ratio curve segmented by the breadth of the parameter Rk and calculate parameters Rpk and Rvk.

- Rk Core roughness depth
- Rpk Reduced peak height
- Rvk Reduced valley depth
- Mr1, Mr2 Material portion



This function is used to evaluate friction and abrasion.

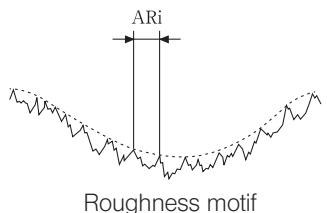
It is also used to evaluate the lubricity of engine cylinder surfaces.

12

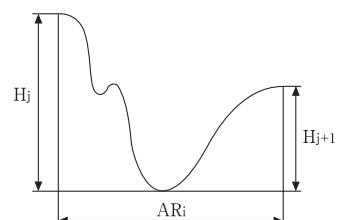
Motif parameters

Motif parameters are used for the evaluation of surface contact status based on the enveloped features of the sample surface.

- AR Mean spacing of roughness motifs, the arithmetic mean of roughness motifs AR, calculated from the evaluation length
- R Mean depth of roughness motifs the arithmetic mean of the roughness motif depth Hj calculated from the evaluation length
- Rx Maximum depth of roughness motifs the maximum value of the Hj calculated from the evaluation length
- AW Mean spacing of waviness motifs the arithmetic mean of the waviness motif AWi calculated from the evaluation length
- W Mean depth of waviness motifs the arithmetic mean of the waviness motif depth HWj calculated from the evaluation length
- Wx Maximum depth of waviness motifs the maximum value of the HWj calculated from the evaluation length



Roughness motif



These parameters are suited to evaluating the slippage of lubrication mechanisms and contact surfaces, such as gaskets.

12-8 Description of technical glossaries

Profile method glossary

- **Primary profile curve**

The curve obtained by applying a low-pass filter with a cutoff value of λ_s to the primary profile measured. The surface texture parameter calculated from the primary profile is referred to as the primary profile parameter (P-parameter).

- **Roughness profile**

The profile derived from the primary profile by suppressing the long wave component using the highpass filter with a cutoff value of λ_c . The surface texture parameter calculated from the roughness profile is referred to as the roughness profile parameter (R-parameter).

- **Waviness profile**

The profile obtained by sequential application of profile filters with cutoff values of λ_f and λ_c to the primary profile. λ_f cuts off the long wave component while the short wave component is cut off with filter λ_c . The surface texture parameter calculated from the waviness profile is referred to as the waviness profile parameter (W-parameter).

- **Profile filter**

The filter for the isolation of the long and short wave components contained in the profile. Three types of filters are defined:

λ_s filter: Filter designating the threshold between the roughness component and shorter wave components

λ_c filter: Filter designating the threshold between the roughness component and waviness components

λ_f filter: Filter designating the threshold between the waviness component and longer wave components

- **Cut-off wavelength**

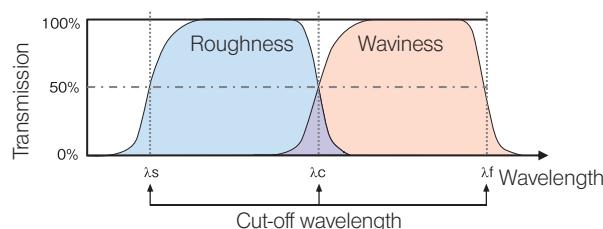
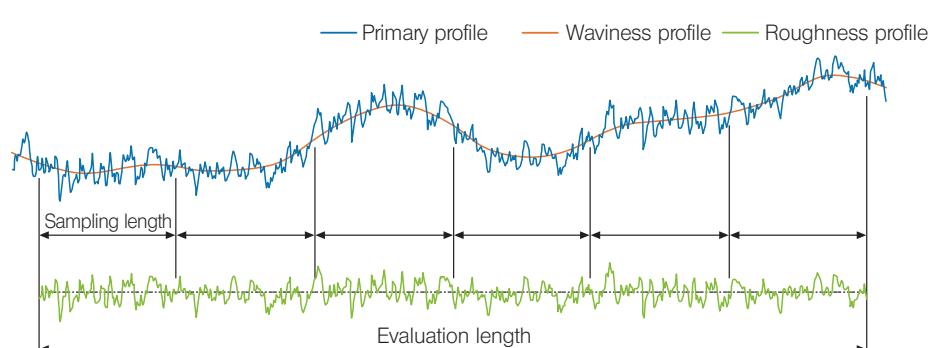
Threshold wavelength for profile filters. Wavelength indicating 50% transmission factor for a given amplitude.

- **Sampling length**

The length in the direction of the X-axis used for the determination of profile characteristics.

- **Evaluation length**

Length in the direction of the X-axis used for assessing the profile under evaluation.

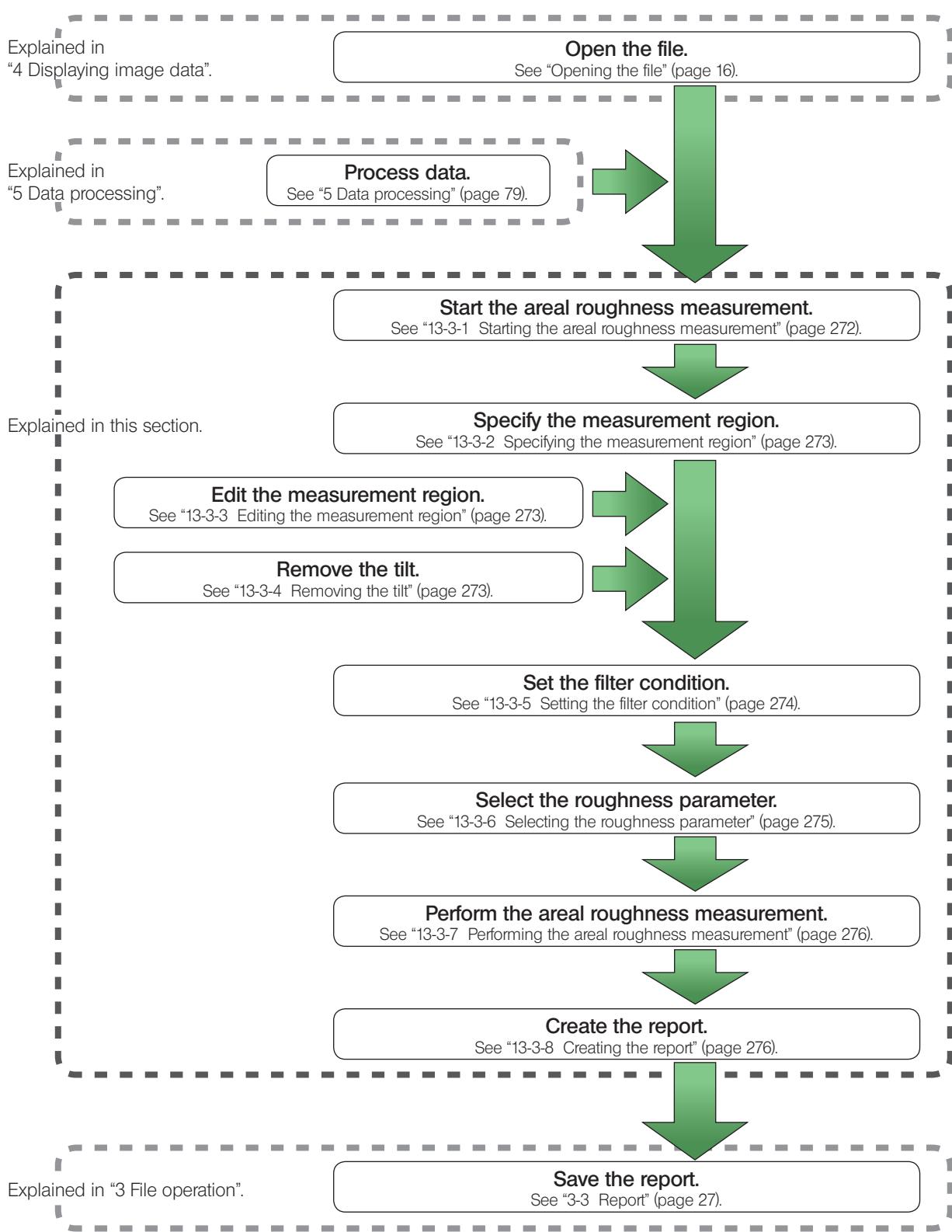


Conceptual drawing of Profile method

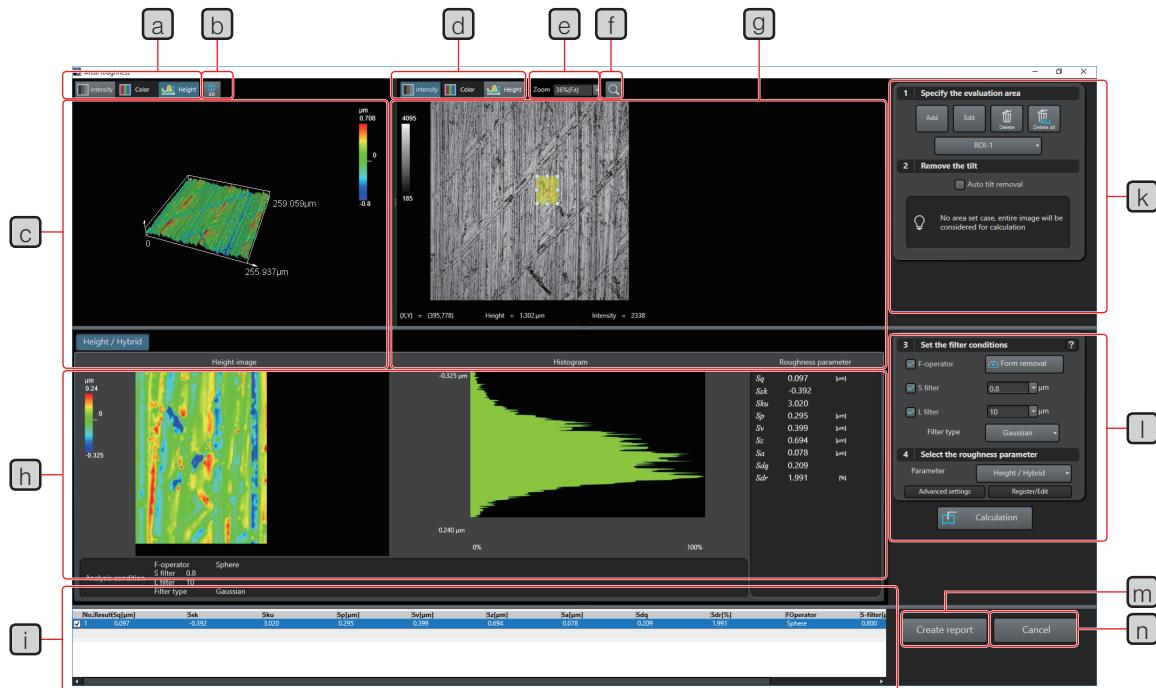
13 Areal roughness measurement

You can measure the roughness or the wave of entire image data or of the specified region.

13-1 Flow of the areal roughness measurement



13-2 Screens used in the areal roughness measurement



[a] 3D image data selection button

Selects either the laser intensity image, the color image or the height image on the 3D image view area.

[b] Advanced setting button for 3D image

Displays the screen to define advanced settings for displaying the 3D image. For details on the screen, see "4-2-1 Screens used with the 3D view" (page 51).

[c] 3D image view area

Displays the 3D image.

Dragging the image allows you to change the angle to display the image.

Rotating the mouse wheel on the image zooms in or out the image.

Dragging the image while holding down the right button of the mouse allows you to move the view position.

[d] 2D image data selection button

Selects either the laser intensity image, the color image or the height image on the 2D image view area.

[e] Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

[f] Loupe button

Zooms in the mouse pointer position on the 2D image view area.

[g] 2D image view area

Displays the 2D image and the measurement region. Rotating the mouse wheel on the image zooms in or out the image.

The information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area is displayed on the status bar.

[h] Areal roughness measurement information view area

Displays the height image, the histogram and the roughness curve parameter.

[i] Measurement results view area

Displays measurement results obtained from the measurement region on the 2D image and the roughness parameter.

[k] Measurement region setting area

Specify the measurement region and select whether to remove the tilt or not.

[l] Areal roughness measurement setting area

Sets the filter condition of the height data and roughness parameters.

[m] [Create report] button

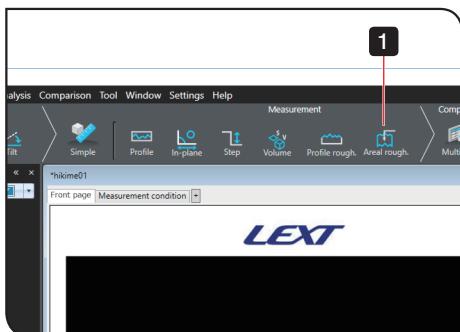
Creates the report based on measurement results obtained from the measurement region on the 2D image and roughness parameters.

[n] [Cancel] button

Cancels the areal roughness measurement.

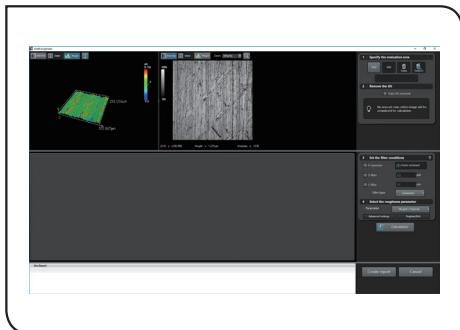
13-3 Operating procedures of the areal roughness measurement

13-3-1 Starting the areal roughness measurement



1 Click the [Areal roughness] button.

TIP You can also display the [Areal roughness] screen by selecting [Areal roughness] from the [Analysis] menu.

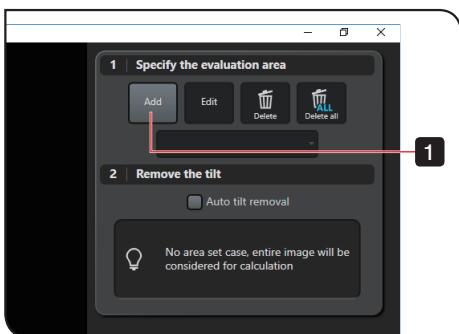


The [Areal roughness] screen appears.

13-3-2 Specifying the measurement region

Specify the measurement region on the 2D image view area, if necessary.

TIP If the measurement region is not specified, all regions are measured.



1 Click the [Add] button.

The [Set the region] screen appears.

2 Add the measurement region to the position you want to measure.

TIP For adding the measurement region, see "Adding the ROI" (page 399).

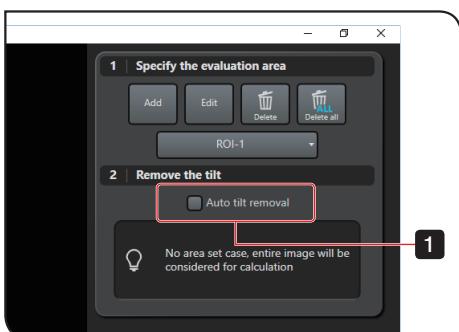
13-3-3 Editing the measurement region

Edit the measurement region, if necessary.

TIP For editing the measurement region, see "Editing the ROI" (page 406).

13-3-4 Removing the tilt

Remove the tilt of the image, if necessary.

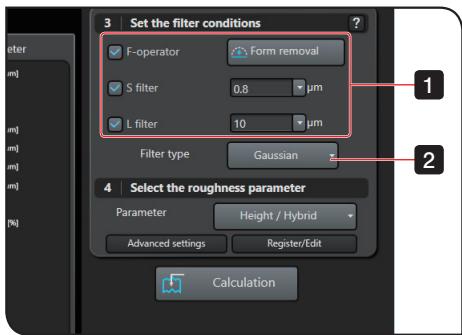


1 Check the [Auto tilt removal] checkbox.

The tilt of the profile is removed.

13-3-5 Setting the filter condition

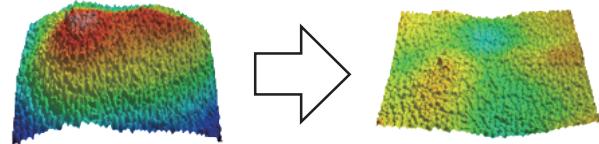
Set the filter condition. Setting the filter condition allows you to remove the structural effect from the roughness contour curve or remove the areal roughness effect from the wave contour curve.



- 1 Check the checkbox of the filter you want to enable and set the wavelength in the next setting field.
- 2 Select the filter type you want to use from the [File type] dropdown list.

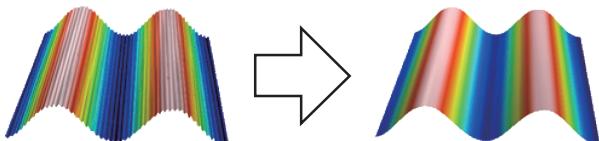
[F operation] (Form removal)

Removes the shape components, e.g. sphere, cylinder, curved surface, etc. from the sample.



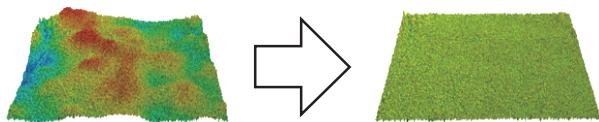
[S filter] (Short-cut filter)

Removes noises or fine shape components.

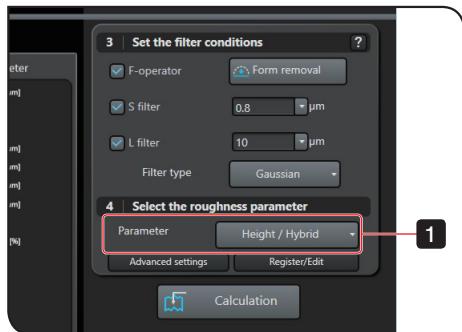


[L filter] (Long-Pass filter)

Removes the wave shape components.



13-3-6 Selecting the roughness parameter



1

Select the roughness parameter from the [Parameter] dropdown list.



Point

- If you know the parameter you use for measurement, select from the following roughness parameters.

- [Height/Hybrid]
- [Spatial]
- [Function]
- [Volume]
- [Direction/Spectrum]
- [Feature]

- If you do not know the parameter you use for measurement, select from the following roughness parameters according to the measurement purpose.

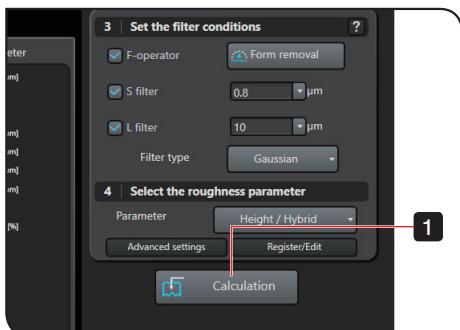
- [Surface unevenness]
- [Height distribution, Histogram]
- [Fineness, Surface area, Gloss]
- [Anisotropy, Periodicity]
- [Density and Curvature of peaks]
- [Change due to Wear]
- [Peak and Valley Volume]



- For registering a new roughness parameter or editing the roughness parameter, see "13-4 Registering and editing the roughness parameter" (page 277)

- For changing the advanced settings of the roughness parameter, see "13-5 Advanced settings of the roughness parameter" (page 278).

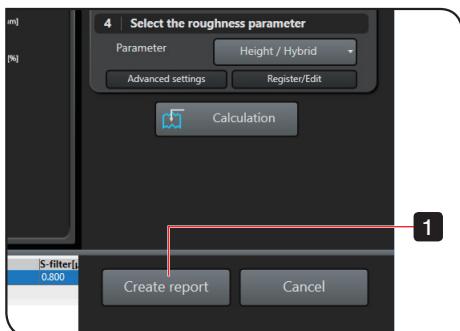
13-3-7 Performing the areal roughness measurement



- 1 When you select the roughness parameter, click the [Calculation] button.

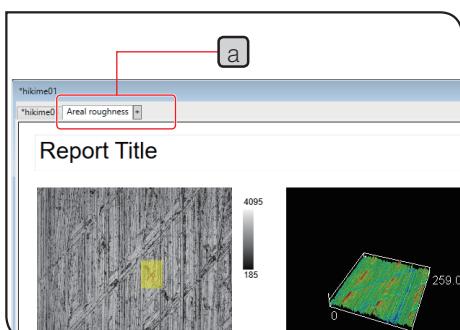
The height image or the histogram is displayed in the lower area of the [Areal roughness] screen.

13-3-8 Creating the report



When you perform the areal roughness measurement, create the report.

- 1 Click the [Create report] button.

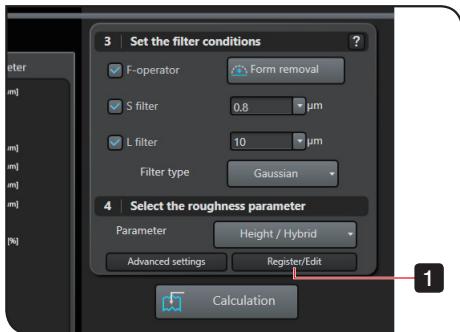


The [Areal roughness] tab **a** is added to the data view window and the report is displayed.

- TIP**
- You can redo the areal roughness measurement by double-clicking on either the 2D image data, the 3D image data, the histogram or measurement results on the report.
 - For details on redoing the measurement, see "3-3-4 Redoing the measurement analysis" (page 38).

13-4 Registering and editing the roughness parameter

You can register, edit or delete the roughness parameter, if necessary.



- 1** Click the [Register/Edit] button on the [Areal roughness] screen.

The [Analysis parameter] screen appears.

- 2** Set the roughness parameter.

Registering a new roughness parameter

1. Select the [New] radio button **a**.
2. Select the roughness parameter you want to use as a base roughness parameter from the dropdown list **b**.
3. Input the name of the roughness parameter in the [Name] text box **c**.
4. Click a button of [Parameters] **d** to display the parameter checkbox, and check the item you want to measure. The parameter items you will measure are displayed on [Selected parameters] **e**.

Editing the roughness parameter

1. Select the [Edit] radio button **f**.
2. Select the roughness parameter you want to edit from the dropdown list **b**.

TIP You can edit only the roughness parameter registered by the user.

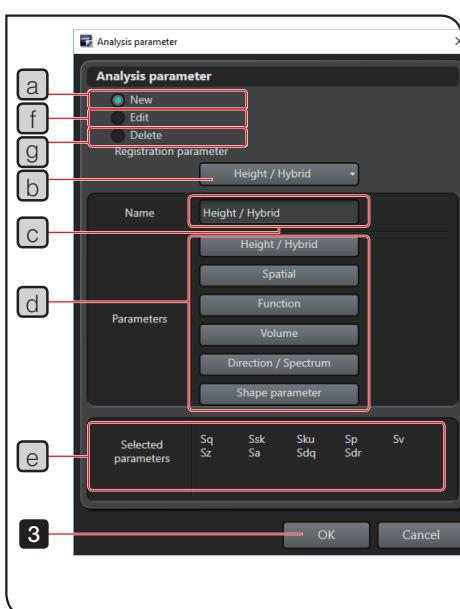
3. If you want to change the name of the roughness parameter, input the name in the [Name] text box **c**.
4. Click a button of [Parameters] **d** to display the parameter checkbox, and check the item you want to measure. The parameter items you will measure are displayed on [Selected parameters] **e**.

Deleting the roughness parameter

1. Select the [Delete] radio button **g**.
2. Select the roughness parameter you want to delete from the dropdown list **b**.

TIP You can delete only the roughness parameter registered by the user.

- 3** When you finish settings, click the [OK] button to close the [Analysis parameter] screen.

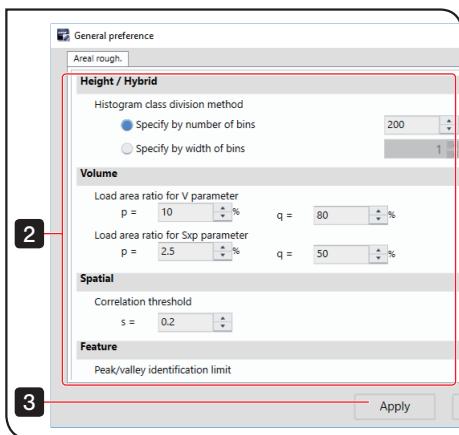


13-5 Advanced settings of the roughness parameter



1 Click the [Advanced settings] button on the [Areal roughness] screen.

TIP You can also display the [General preference] screen by selecting [General preference] from the [Settings] menu.



The [Areal roughness] tab is displayed on the [General preference] screen.

2 Set the roughness parameters.

3 When you finish setting parameters, click the [Apply] button to close the [General preference] screen.

13-6 Roughness parameter

Areal parameter

Height parameters (ISO25178-2: 2012)	Symbol	Default units
Root mean square height	S_q	μm
Skewness	S_{sk}	(unitless)
Kurutosis	S_{ku}	(unitless)
Maximum peak height	S_p	μm
Maximum pit height	S_v	μm
Maximum height	S_z	μm
Arithmetical mean height	S_a	μm
Spatial parameters (ISO25178-2: 2012)		
Autocorrelation length	S_{al}	μm
Texture aspect ratio	S_{tr}	(unitless)
Hybrid parameters (ISO25178-2: 2012)		
Root mean square gradient	S_{dq}	(unitless)
Developed interfacial area ratio	S_{dr}	%
Functions and related parameters (ISO25178-2: 2012)		
Areal material ratio	$S_{mr}(c)$	%
Inverse areal material ratio	$S_{mc}(mr)$	μm
Core height	S_k	μm
Reduced peak height	S_{pk}	μm
Reduced valley height	S_{vk}	μm
Material ratio	S_{mr1}	%
Material ratio	S_{mr2}	%
Void volume	$V_v(p)$	ml/m^2 ($=\mu\text{m}^3/\mu\text{m}^2$)
Dale void volume	V_w	ml/m^2 ($=\mu\text{m}^3/\mu\text{m}^2$)
Core void volume	V_{vc}	ml/m^2 ($=\mu\text{m}^3/\mu\text{m}^2$)
Material volume	$V_m(p)$	ml/m^2 ($=\mu\text{m}^3/\mu\text{m}^2$)
Peak material volume	V_{mp}	ml/m^2 ($=\mu\text{m}^3/\mu\text{m}^2$)
Core material volume	V_{mc}	ml/m^2 ($=\mu\text{m}^3/\mu\text{m}^2$)
Peak extreme height	S_{xp}	μm
Miscellaneous parameter (ISO25178-2: 2012)		
Texture direction	S_{ld}	degrees
Named feature Parameters (ISO25178-2: 2012)		
Density of peaks	S_{pd}	mm^{-2}
Arithmetic mean peak curvature	S_{pc}	mm^{-1}
Ten-point height of surface	S_{10z}	μm
Five point peak height	S_{5p}	μm
Five point pit height	S_{5v}	μm

Height parameters

■ Maximum height (Sz)

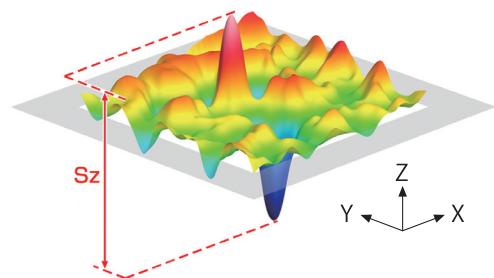
This parameter expands the profile (line roughness) parameter Rz three dimensionally.

The maximum height Sz is equivalent to the sum of the maximum peak height Sp and maximum valley depth Sv.



Although frequently used, this parameter is significantly influenced by scratches, contamination, and measurement noise due to its utilization of peak values.

$$Sz = Sp + Sv$$

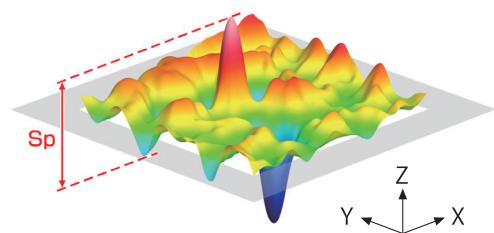


■ Maximum peak height (Sp)

This parameter expands the profile (line roughness) parameter Rp three dimensionally.

It is the maximum value for peak height.

$$Sp = \max (Z(x,y))$$

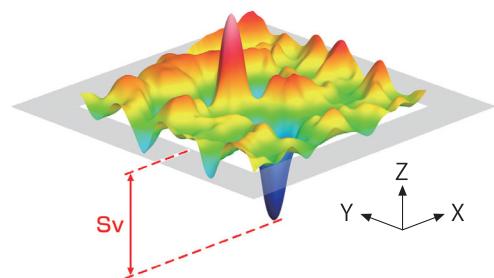


■ Maximum pit depth (Sv)

This parameter expands the profile (line roughness) parameter Rv three dimensionally.

It is the maximum value for the valley's depth.

$$Sv = |\min (Z(x,y))|$$



■ Arithmetical mean height (S_a)

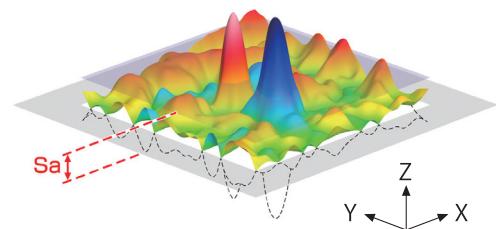
This parameter expands the profile (line roughness) parameter R_a three dimensionally.

It represents the arithmetic mean of the absolute ordinate $Z(x, y)$ within the evaluation area.



This is one of the most widely used parameters and is the mean of the average height difference for the average plane. It provides stable results since the parameter is not significantly influenced by scratches, contamination, and measurement noise.

$$S_a = \frac{1}{A} \iint_A |Z(x,y)| dx dy$$



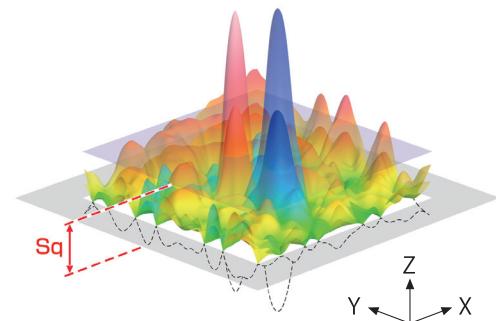
■ Root mean square height (S_q)

This parameter expands the profile (line roughness) parameter R_q three dimensionally. It represents the root mean square for $Z(x, y)$ within the evaluation area.



This is one of the most widely used parameters and is also referred to as the RMS value. The parameter R_q corresponds to the standard deviation of the height distribution. The parameter generates good statistics and enables stable results since the parameter is not significantly influenced by scratches, contamination, and measurement noise.

$$S_q = \sqrt{\frac{1}{A} \iint_A Z^2(x,y) dx dy}$$



■ Skewness (Ssk)

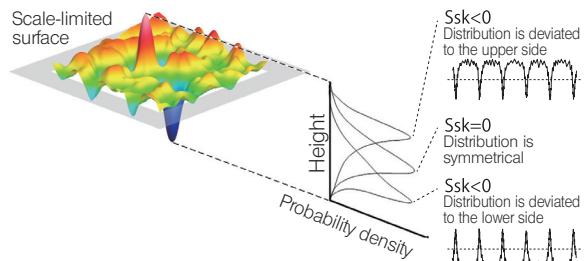
This parameter expands the profile (line roughness) parameter Rsk three dimensionally; parameter Rsk, is used to evaluate deviations in the height distribution.

- Ssk = 0: Symmetric against the mean line
- Ssk > 0: Deviation beneath the mean line
- Ssk < 0: Deviation above the mean line



This parameter concerns the height distribution and is suitable for evaluating the abrasion and oil sump of lubricants for slide planes.

$$Ssk = \frac{1}{Sq^3} \left(\frac{1}{A} \iint_A Z^3(x,y) dx dy \right)$$



■ Kurtosis (Sku)

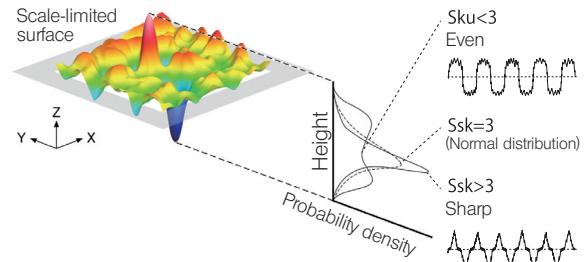
This parameter expands the profile (line roughness) parameter Rku three dimensionally; Rku, is used to evaluate sharpness in the height distribution.

- Sku = 3: Normal distribution
- Sku > 3: Height distribution is sharp
- Sku < 3: Height distribution is even



This parameter relates to the tip geometry of peaks and valleys and is suited to analyzing the contact between two objects.

$$Sku = \frac{1}{Sq^4} \left(\frac{1}{A} \iint_A Z^4(x,y) dx dy \right)$$



Spatial parameters

■ Autocorrelation length (Sal)

The horizontal distance of the autocorrelation function that has the fastest decay to a specified value s ($0 \leq s < 1$). Unless otherwise specified, the parameter is specified as = 0.2.

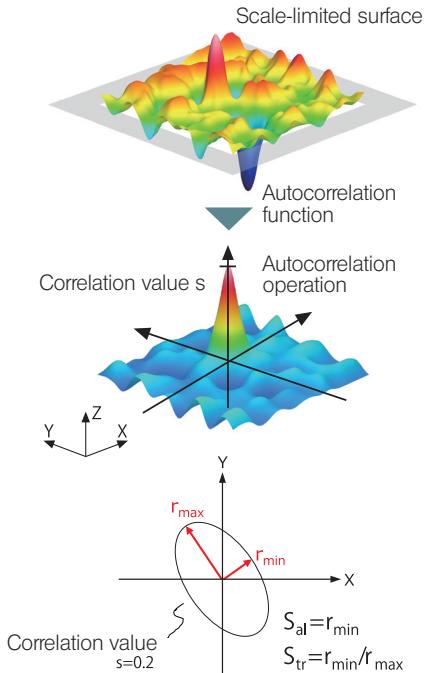
■ Texture aspect ratio (Str)

This parameter is defined as the ratio of the horizontal distance of the autocorrelation function that has the fastest decay to a specified value s to the horizontal distance of the autocorrelation function that has the slowest decay to s ($0 \leq s < 1$) and indicates the isotropic/anisotropic strength of the surface.

The Str value ranges from 0 to 1; normally $\text{Str} > 0.5$ indicates a strong isotropy while $\text{Str} < 0.3$ is strongly anisotropic.



These parameters are used to evaluate the horizontal size and complexity of parallel grooves and grains instead of the height parameters.



Hybrid parameters

■ Root mean square gradient (Sdq)

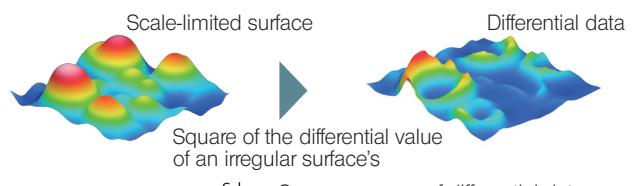
This parameter expands the profile (line roughness) parameter Rdq three dimensionally. It indicates the mean magnitude of the local gradient (slope) of the surface.

The surface is more steeply inclined as the value of the parameter Sdr becomes larger.



The steepness of the surface can be numerically represented in this parameter.

$$Sdq = \sqrt{\frac{1}{A} \iint_A \left[\left(\frac{\partial z(x,y)}{\partial x} \right)^2 + \left(\frac{\partial z(x,y)}{\partial y} \right)^2 \right] dx dy}$$



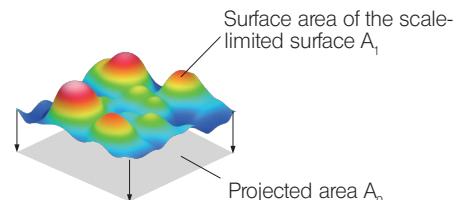
■ Developed interfacial area ratio (Sdr)

This signifies the rate of an increase in the surface area. The increase rate is calculated from the surface area A_1 derived by the projected area A_0 .



Sdr values increase as the surface texture becomes fine and rough.

$$= \frac{1}{A} \left[\iint_A \left(\sqrt{\left[1 + \left(\frac{\partial z(x,y)}{\partial x} \right)^2 + \left(\frac{\partial z(x,y)}{\partial y} \right)^2 \right]} - 1 \right) dx dy \right]$$

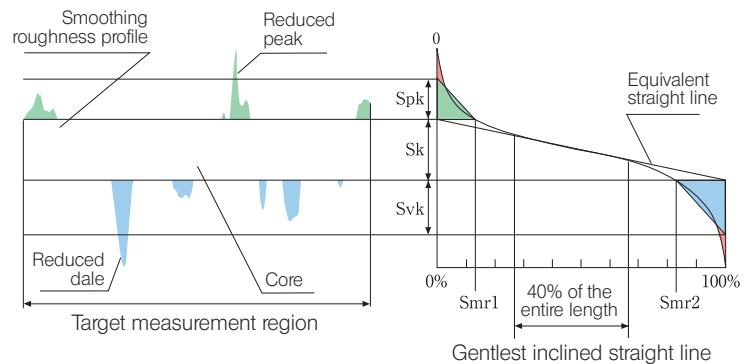
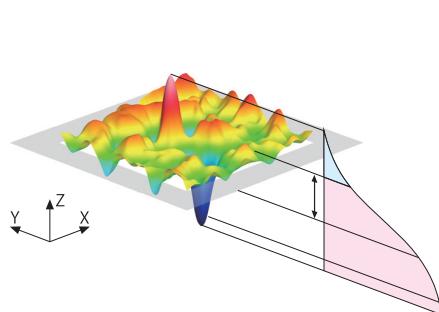


$$Sdr = \{(A_1/A_0) - 1\} \times 100 (\%)$$

Function and related parameters

This parameter expands the material ratio curve parameters (R_k , R_{pk} , R_{vk} , M_{r1} , and M_{r2}) of the profile parameter three dimensionally.

- S_k Core height: the difference between the upper and lower levels of the core
- S_{pk} Reduced peak height: the mean height of the protruding peaks above the core
- S_{vk} Reduced valley depth: the mean depth of the protruding dales beneath the core
- S_{mr1} The areal material ratio segmenting protruding peaks from the core
(indicated as a percentage)
- S_{mr2} Areal material ratio segmenting protruding valleys from the core
(indicated as percentage)



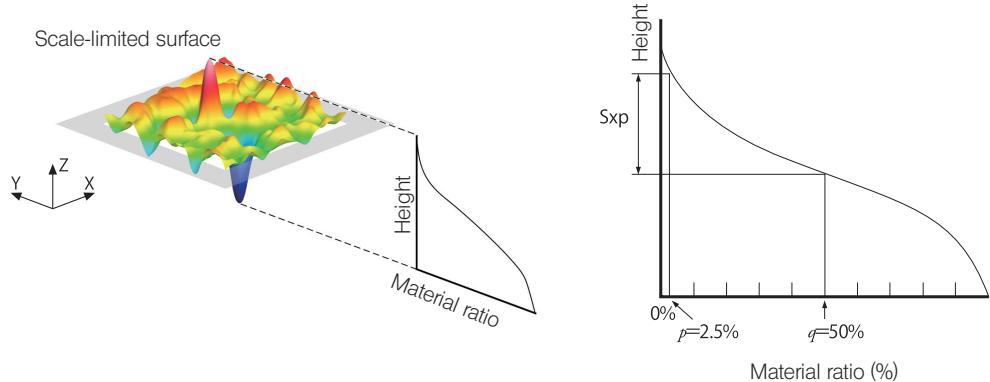
This parameter is suitable for evaluating friction and abrasion.

It is also used to evaluate lubricity for engine cylinder surfaces.

■ Peak extreme height (S_{xp})

The difference in height between the p and q material ratio.

Unless specified otherwise, the values $p = 2.5\%$, $q = 50\%$ shall be applied.

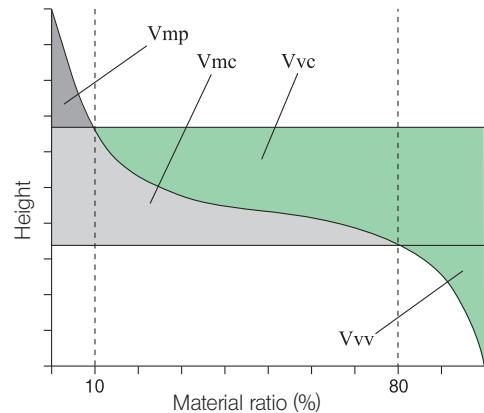


The material volume and void volume are calculated from a material ratio curve as indicated in the diagram. The position that corresponds to a material ratio of 10% and 80% is regarded as the threshold segmenting the peak, core, and dale

- V_{w} Dale void volume
- V_{c} Core void volume
- V_{mp} Peak material volume
- V_{mc} Core material volume



This parameter is often used to evaluate abrasion and lubricant retention.



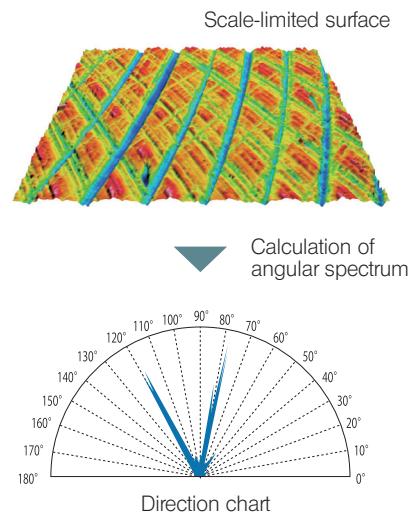
Miscellaneous parameters

■ Texture direction (Std)

This parameter indicates the direction angle of the texture (parallel groove orientation, etc.). It is derived from the angle maximizing the angle spectrum of two-dimensional Fourier transformation images.



Std represents the angle for the strongest orientation, although the second and third strongest angles can also be defined on the directional chart.



Feature parameters

■ Density of peaks (Spd)

This is the number of peaks per unit area. Only peaks that exceed a designated size are counted.

Unless otherwise specified, the designated size is determined to be 5% of the maximum height Sz.

The parameter is calculated from the number of peaks divided by the projected area.

■ Arithmetic mean peak curvature (Spc)

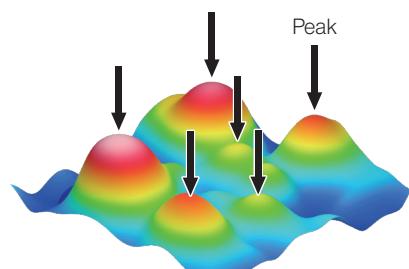
Spc indicates the mean principle curvature (average sharpness) of the peaks. Only peaks that exceed a designated curvature are taken into consideration.

Unless otherwise specified, the designated size is determined to be 5% of the maximum height Sz.

The parameter is derived from the arithmetic mean curvatures of peaks within the evaluation area.



This parameter is suited for analyzing the contact between two objects.



■ Ten-point height of surface (S10z)

The average value of the heights of the five peaks with the largest global peak height added to the average value of the heights of the five pits with the largest global pit height.

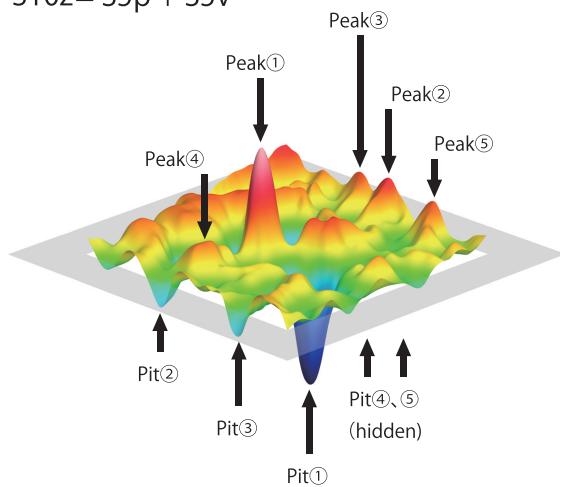
■ Five-point peak height (S5p)

The average value of the heights of the five peaks with the largest global peak height.

■ Five-point pit height (S5v)

The average value of the heights of the five pits with the largest global pit height.

$$S10z = S5p + S5v$$



13-7 Description of technical glossaries

Areal method glossary

· Scale limited surface

The surface data are serving as the basis for the calculation of areal surface texture parameters. S-F surface or S-L surface. Sometimes simply referred to as 'surface.'

· Areal filter

The filter for the separation of the long and short wave components contained in the scale-limited surfaces. Three types of filters are defined according to function:

S filter: Filter eliminates small wavelength components from scale-limited surfaces

L filter: Filter eliminates large wavelength components from scale-limited surfaces

F operation: Association or filter for the elimination of specific forms(spheres, cylinders, etc.)

NOTE) Gaussian filters are generally applied as S and L filters, and the total least square association is applied for the F operation.

· Gaussian filter

A type of areal filter normally used in areal measurement. Filtration is applied by convolution based on weighting functions derived from a Gaussian function. The value of the nesting index is the wavelength of a sinusoidal profile for which 50% of the amplitude is transmitted.

· Spline filter

A type of areal filter with smaller distortion in the peripheral edge when compared to the Gaussian filter.

· Nesting index

The index representing the threshold wavelength for areal filters. The nesting index for the application of areal Gaussian filters are designated in terms of units of length and equivalent to the cutoff value in the profile method.

· S-F surface

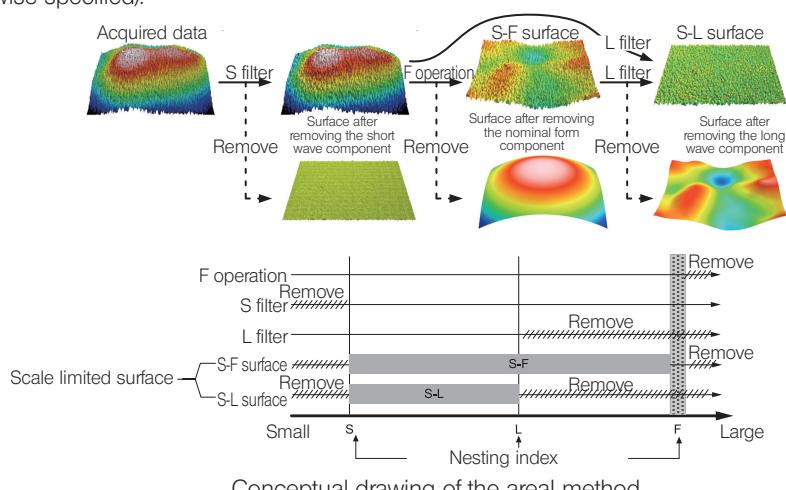
The surface obtained by eliminating small wavelength components using the S filter and then processed by removing certain form components using the F operation.

· S-L surface

The surface obtained by eliminating small wavelength components using the S filter and then eliminating large wavelength components using L filtration.

· Evaluation area

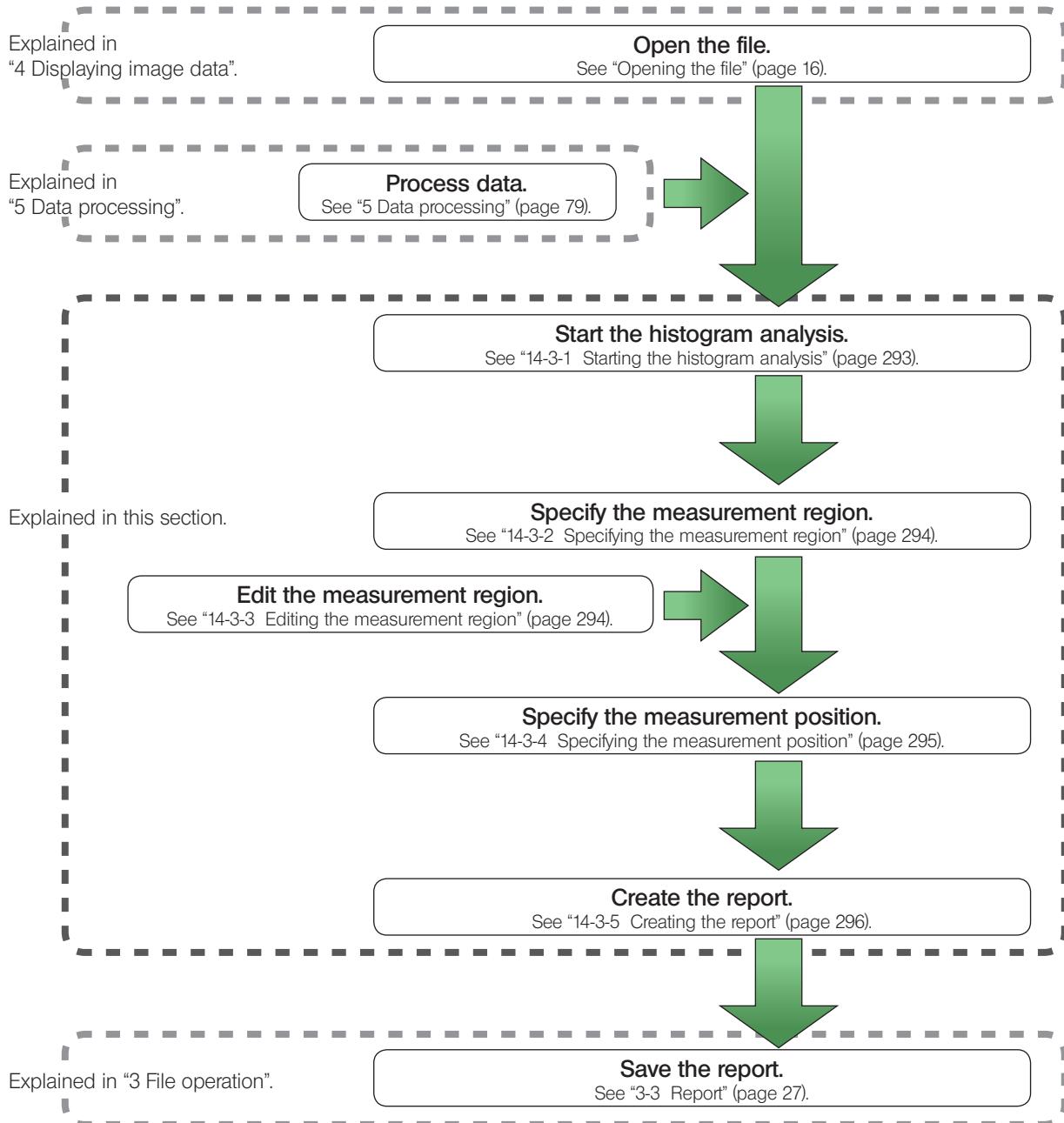
A rectangular portion of the surface designated for characteristic evaluation. The evaluation area shall be a square (if not otherwise specified).



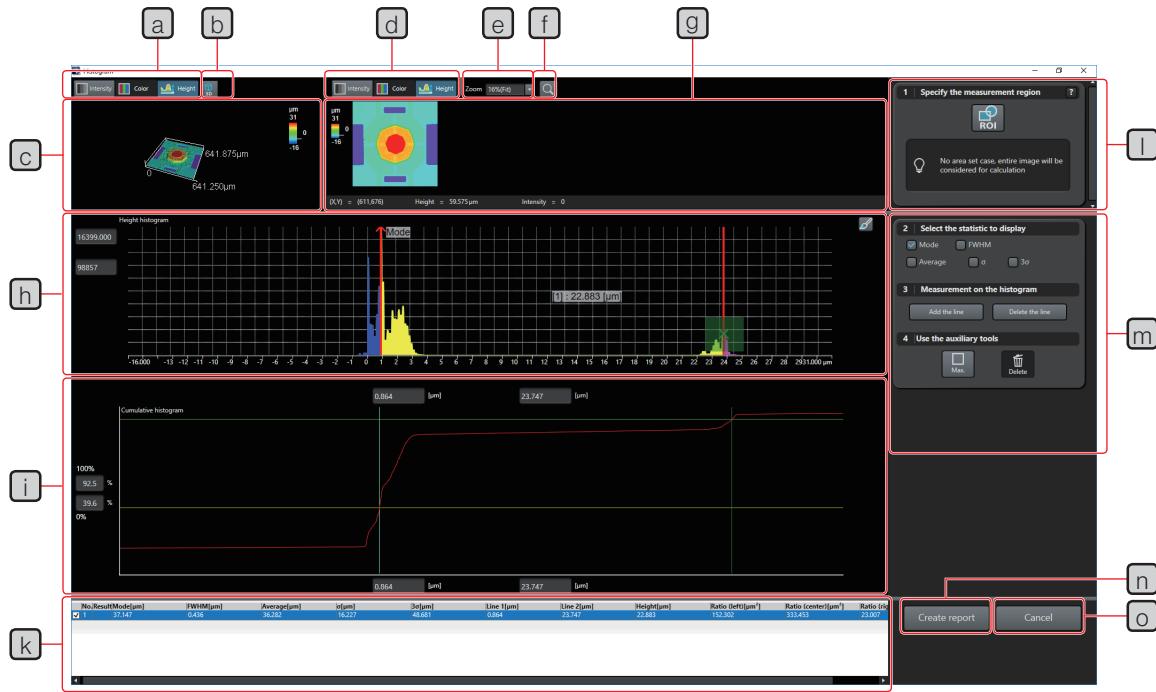
14 Histogram analysis

You can measure the step between two surfaces of image data or the height distribution.

14-1 Flow of the histogram analysis



14-2 Screen used in the histogram analysis



(a) 3D image data selection button

Select either the laser intensity image or the height image on the 3D image view area.

(b) Advanced setting button for 3D image

Displays the screen to define advanced settings for displaying the 3D image. For details on the screen, see "4-2-1 Screens used with the 3D view" (page 51).

(c) 3D image view area

Displays the 3D image.

Dragging the image allows you to change the angle to display the image.

Rotating the mouse wheel on the image zooms in or out the image.

Dragging the image while holding down the right button of the mouse allows you to move the view position.

(d) 2D image data selection button

Select either the laser intensity image or the height image on the 2D image view area.

(e) Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

(f) Loupe button

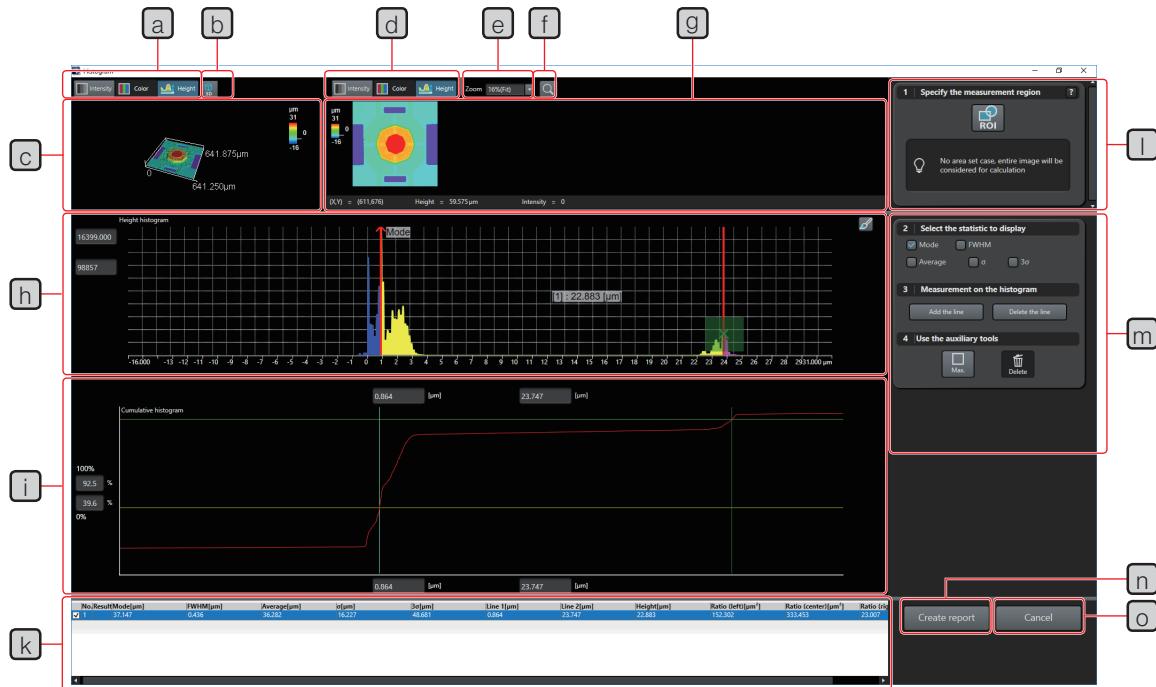
Zooms in the mouse pointer position on the 2D image view area.

(g) 2D image view area

Displays the 2D image and the measurement region. Rotating the mouse wheel on the image zooms in or out the image.

The information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area is displayed on the status bar.

(h) to (o) are described on the next page.)



(a) to (g) are described on the previous page.)

[h] Histogram analysis area

Displays the histogram analysis, the measurement line, analysis results, etc.
You can change the font and the color of analysis results. For the screen to change the color, see “[View setting] screen” (page 292).

[i] Accumulated data view area

Displays the graph of accumulated data. This is used as a guide for adjusting the position of the measurement line. The graph of accumulated data is not output to the report.

[k] Analysis results view area

Displays analysis results obtained from the measurement region on the 2D image and the measurement line in the histogram analysis region.

[l] Measurement region setting area

Specify the measurement region.

[m] Histogram analysis setting area

Displays the statistics or their maximum values on the histogram or adds the measurement line on the histogram.

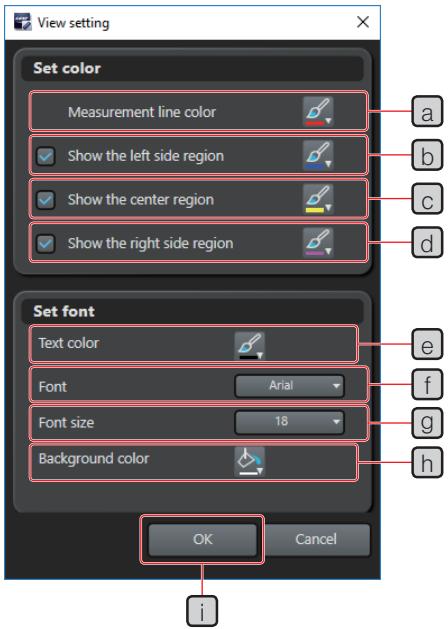
[n] [Create report] button

Creates the report based on measurement results obtained from the measurement region on the 2D image and the measurement line in the histogram analysis region.

[o] [Cancel] button

Cancels the histogram analysis.

[View setting] screen



[a] [Measurement line color] button

Changes the color to display the measurement line.

[b] [Show the left side region] button

Changes the color of the left side measurement region on the histogram.

[c] [Show the center region] button

Changes the color of the center measurement region on the histogram.

[d] [Show the right side region] button

Changes the color of the right side measurement region on the histogram.

[e] [Text color] button

Changes the color of strings of analysis results.

[f] [Font] dropdown list

Changes the font of strings of analysis results.

[g] [Font size] dropdown list

Changes the font size of strings of analysis results.

[h] [Background color] button

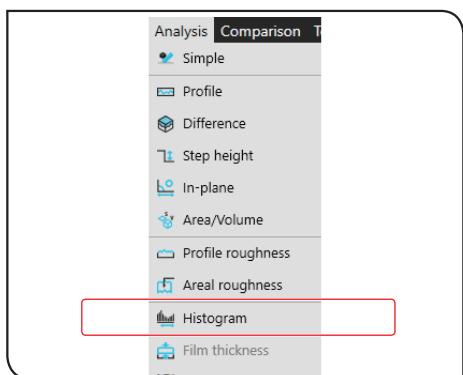
Changes the background color of strings of analysis results.

[i] [OK] button

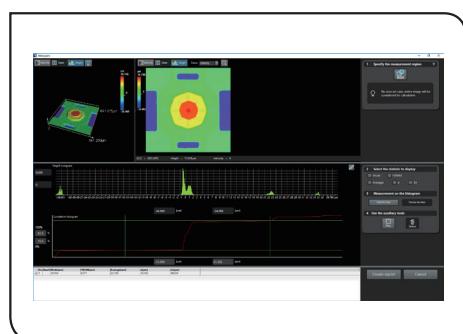
Changes the settings and close the [View setting] screen.

14-3 Operating procedures of the histogram analysis

14-3-1 Starting the histogram analysis



- 1 Select [Histogram] from the [Analysis] menu.

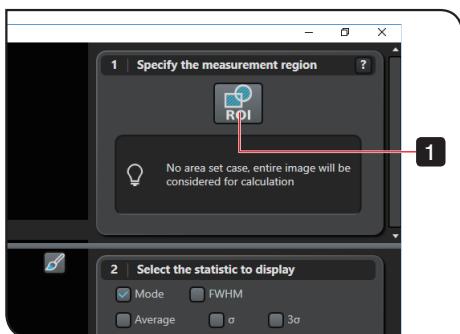


The [Histogram] screen appears.

14-3-2 Specifying the measurement region

Specify the measurement region on the 2D image view area, if necessary.

TIP If the measurement region is not specified, all regions are measured.

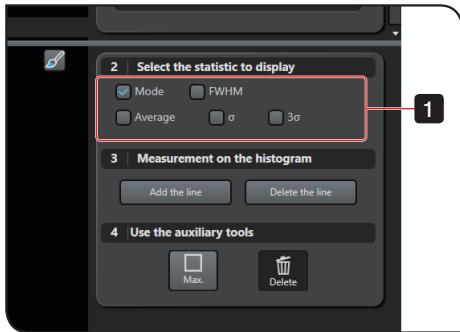


1 Click the [ROI] button.

The [Set the region] screen appears.

2 Add the measurement region to the position you want to measure.

TIP For adding the measurement region, see "Adding the ROI" (page 399).



Displaying the statistics

Select the statistic type you want to display on the histogram.

TIP When the statistics are displayed, if you move the measurement line closer to the statistic, the measurement line comes into contact with the statistic.

1 Check the checkbox of the statistic you want to display.

The statistic is displayed on the histogram.

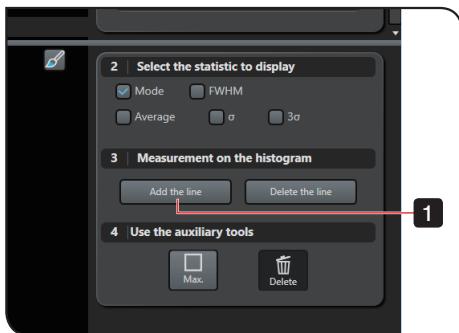
14-3-3 Editing the measurement region

Edit the measurement region, if necessary.

TIP For editing the measurement region, see "Editing the ROI" (page 406).

14-3-4 Specifying the measurement position

Specify the measurement position on the histogram.



- 1** Click the [Add the line] button.



The two measurement lines are added on the histogram.

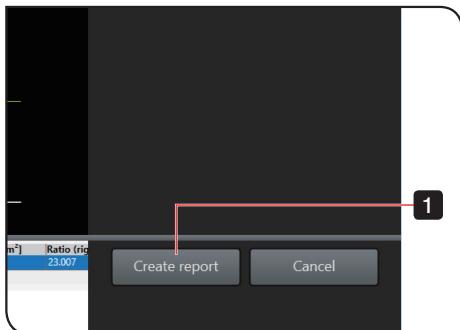
- 2** Drag the measurement line (vertical) to the position you want to measure on the histogram.

Dragging the measurement line (vertical) displays the area of the measurement region with the measurement line (vertical) as a boundary, the step between heights of measurement lines (vertical), etc.

TIP When the statistics are displayed, if you move the measurement line closer to the statistic, the measurement line comes into contact with the statistic.

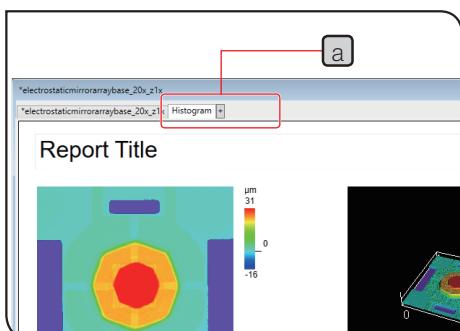
- 3** If you want to measure on multiple positions, repeat steps from **1** to **2**.

14-3-5 Creating the report



When you finish specifying the measurement position, create the report.

- 1 Click the [Create report] button.



The [Histogram] tab **a** is added to the data view window and the report is displayed.

TIP

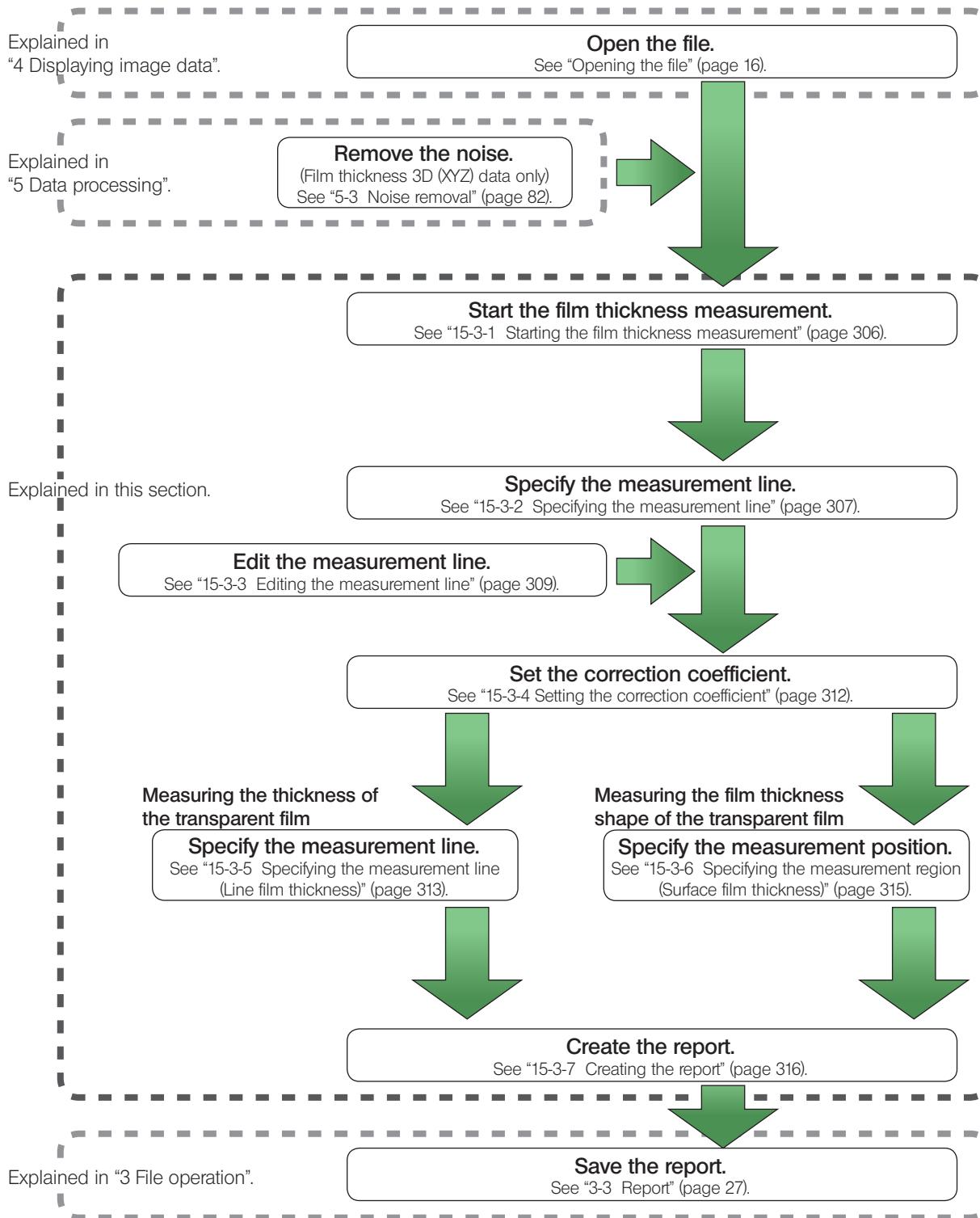
- You can redo the histogram analysis by double-clicking on either the 2D image data, the 3D image data, the histogram or measurement results on the report.
- For details on redoing the measurement, see “3-3-4 Redoing the measurement analysis” (page 38).

15 Film thickness measurement

You can measure the film thickness of the transparent object or the height of the boundary surface.

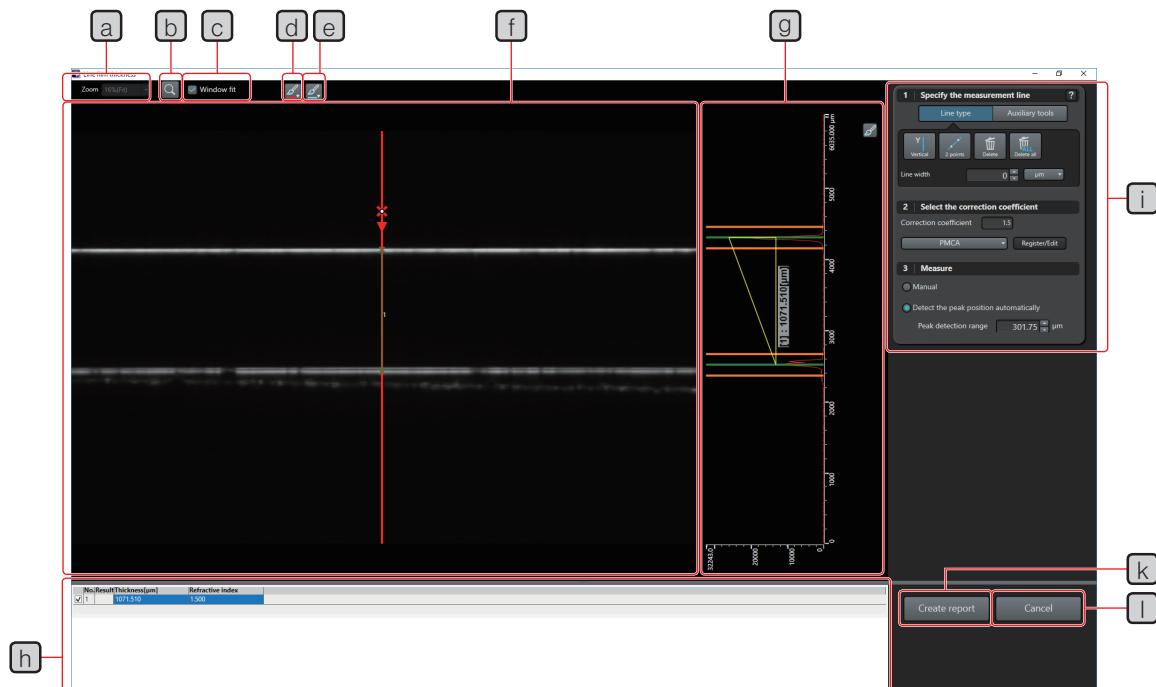
You can measure the data of up to 3 layers.

15-1 Flow of the film thickness measurement



15-2 Screens used in the film thickness measurement

15-2-1 [Line film thickness] screen for the film thickness layer cross-sectional (XZ) data.



a Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

b Loupe button

Zooms in the mouse pointer position on the 2D image view area.

c [Window fit] checkbox

Select whether to fit the horizontal width of the 2D image to the whole 2D image view area or to display it with the same ratio as the vertical width.

d Measurement line color button

Sets the color of the measurement line selected on the 2D image view area.

e Auxiliary tool color button

Sets the color of the auxiliary tool on the 2D image view area.

f 2D image view area

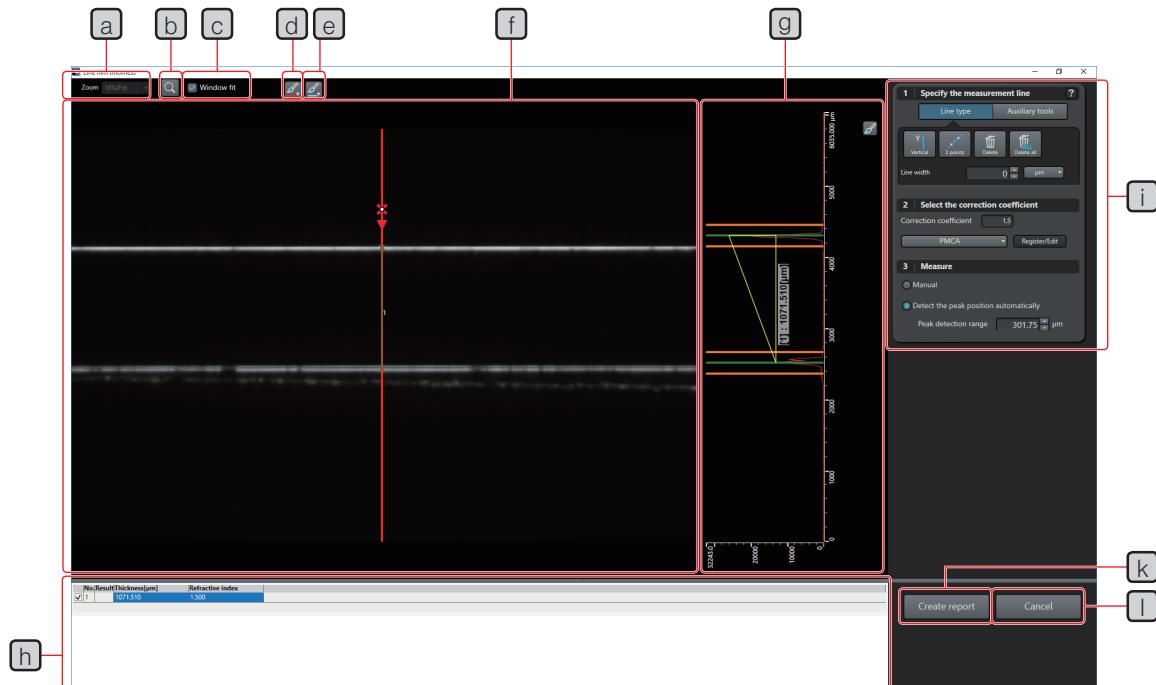
Displays the 2D image and the measurement line. If the [Window fit] checkbox **c** is unchecked, you can zoom in or out the image by rotating the mouse wheel on the image.

You can change the color of the measurement line and auxiliary tools. Use the measurement line color button **d** or the auxiliary tool color button **e** to display the color pallet.

g Profile view area

Displays the profile of the measurement line position on the 2D image view area. If you specify the measurement line on the profile, measurement results are displayed. You can change the font and the color of measurement results. For the screen to change the color, see "View setting] screen" (page 300). Rotating the mouse wheel on the profile zooms in or out the profile.

(**h** to **i** are described on the next page.)



(a) to (g) are described on the previous page.)

[h] Measurement results view area

Displays measurement results obtained from the measurement line on the profile.

[i] Film thickness measurement setting area

Sets the method to specify the measurement line for profile, the correction coefficient and the method to specify the measurement line for height or area.

[k] [Create report] button

Creates the report based on measurement results obtained from the measurement line on the profile.

[l] [Cancel] button

Cancels the film thickness measurement.

[View setting] screen



[a] [Slider color pallette] button

Changes the color to display the measurement line.

[b] [Peak search range lines color] button

Changes the color of the peak search range.

[c] [Text color] button

Changes the color of strings of measurement results.

[d] [Font] dropdown list

Changes the font of strings of measurement results.

[e] [Font size] dropdown list

Changes the font size of strings of measurement results.

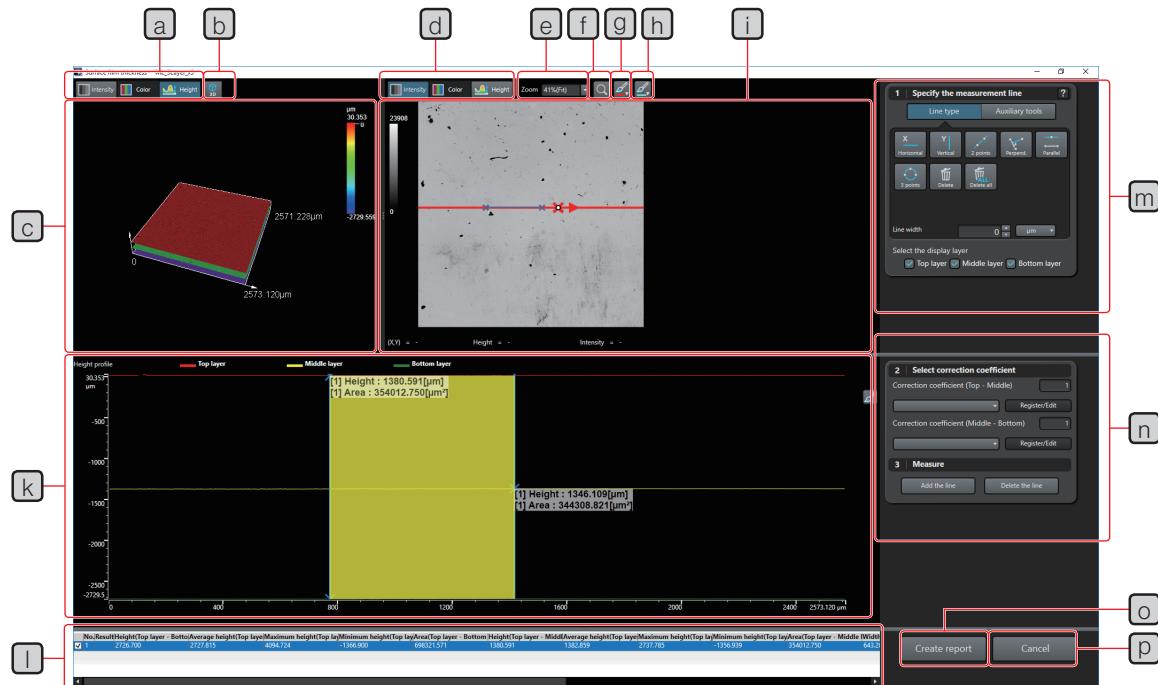
[f] [Background color] button

Changes the background color of strings of measurement results.

[g] [OK] button

Changes the settings and closes the [View setting] screen.

15-2-2 [Surface film thickness] screen for the film thickness 3D (XYZ) data

**a** 3D image data selection button

Select either the laser intensity image or the height image on the 3D image view area.

b Advanced setting button for 3D image

Displays the screen to define advanced settings for displaying the 3D image. For details on the screen, see "4-2-1 Screens used with the 3D view" (page 51).

c 3D image view area

Displays the 3D image.

Dragging the image allows you to change the angle to display the image.

Rotating the mouse wheel on the image zooms in or out the image.

Dragging the image while holding down the right button of the mouse allows you to move the view position.

d 2D image data selection button

Select either the laser intensity image or the height image on the 2D image view area.

e Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

f Loupe button

Zooms in the mouse pointer position on the 2D image view area.

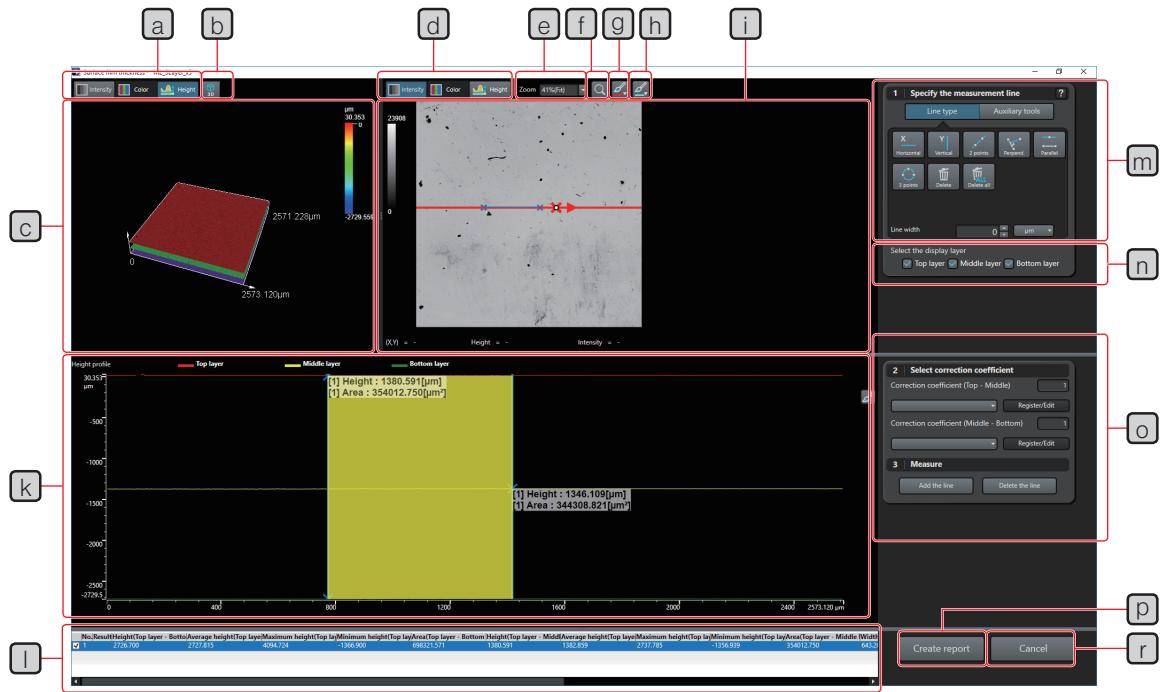
g Measurement line color button

Sets the color of the measurement line selected on the 2D image view area.

h Auxiliary tool color button

Sets the color of the auxiliary tool on the 2D image view area.

(i) to (r) are described on the next page.)



([a] to [h] are described on the previous page.)

[i] 2D image view area

Displays the 2D image and the measurement line. Rotating the mouse wheel on the image zooms in or out the image.

You can change the color of the measurement line and auxiliary tools. Use the measurement line color button [g] or the auxiliary tool color button [h] to display the color pallet.

The information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area is displayed on the status bar.

[k] Profile view area

Displays the profile of the measurement line position on the 2D image view area. Specifying the measurement position on the profile displays measurement results. You can change the font and the color of measurement results. For the screen to change the color, see "View setting" screen" (page 303).

Rotating the mouse wheel on the profile zooms in or out the profile.

[l] Measurement results view area

Displays measurement results obtained from the measurement position on the profile.

[m] Measurement line setting area

Select the method to specify the measurement line.

[n] [Select the display layer] checkbox

Changes between showing and hiding [Top layer], [Middle layer] and [Bottom layer] on the 2D image view area and on the 3D image view area. The checkbox of the layer that is not in the data is grayed out.

[o] Film thickness measurement setting area

Sets the correction coefficient and the measurement position.

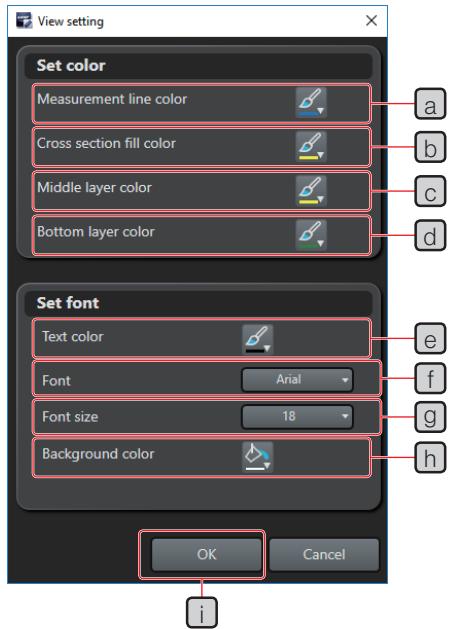
[p] [Create report] button

Creates the report based on measurement results obtained from the measurement position on the profile.

[r] [Cancel] button

Cancels the film thickness measurement.

[View setting] screen

**[a] [Measurement line color] button**

Changes the color to display the measurement line.

[b] [Cross section fill color] button

Changes the color of the measurement position.

[c] [Middle layer Color] button

Changes the color of the profile of the middle layer.

[d] [Bottom layer color] button

Changes the color of the profile of the bottom layer.

[e] [Text color] button

Changes the color of strings of measurement results.

[f] [Font] dropdown list

Changes the font of strings of measurement results.

[g] [Font size] dropdown list

Changes the font size of strings of measurement results.

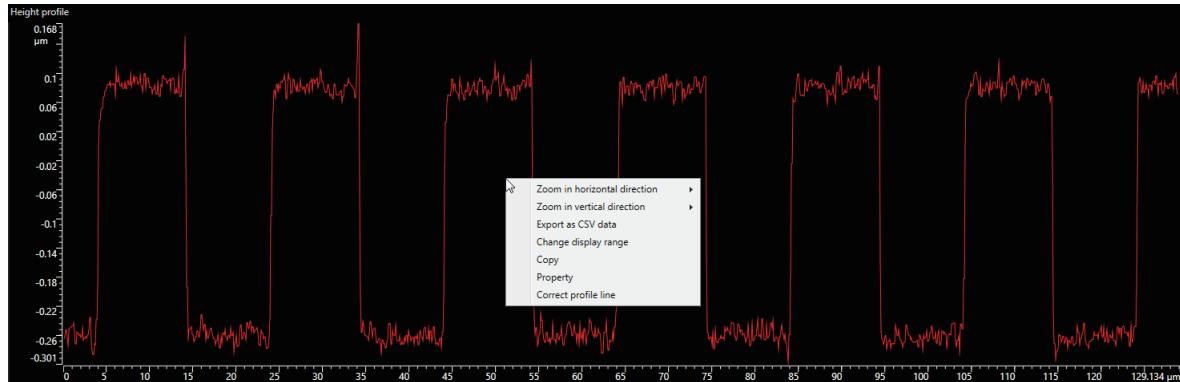
[h] [Background color] button

Changes the background color of strings of measurement results.

[i] [OK] button

Changes the settings and closes the [View setting] screen.

Profile



You can define following settings on the profile. Right-click on the profile to display the menu, and select the menu you desire.

- **[Zoom in horizontal direction]**

Sets the horizontal magnification of the profile.

- **[Zoom in vertical direction]**

Sets the vertical magnification of the profile.

- **[Export as CSV data]**

Outputs the profile in CSV file format.

- **[Change display range]**

Sets the display range of the image and the profile. For setting the display range, see “4-4 Setting the display range” (page 60).

- **[Copy]**

Copies the profile as an image.

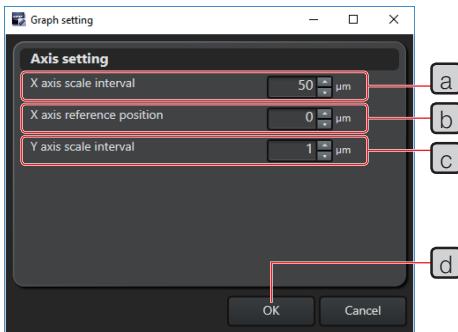
- **[Property]**

Sets the format of the profile. For setting the format, see “Setting the format of the profile” (page 305).

- **[Correct profile line]**

Sets the data processing of the profile. For setting the data processing, see “Correcting the profile” (page 305).

Setting the format of the profile

**[a] [X-axis scale interval]**

Sets the scale interval on the X-axis.

[b] [X-axis reference position]

Sets the value you want to use as a "0" position on the X-axis.

[c] [Y-axis scale interval]

Sets the scale interval on the Y-axis.

[d] [OK] button

Changes the settings and close the [Graph setting] screen.

Correcting the profile

**[a] Profile view area**

Displays the profile before correction and the profile after correction (green).

[b] [Tilt removal] checkbox

Check this checkbox to remove the tilt of the profile.

[c] [Filter] checkbox

Check this checkbox to apply the filter processing to the profile.

[d] [Type] radio button

Select the filter type.

[e] [Correction setting]

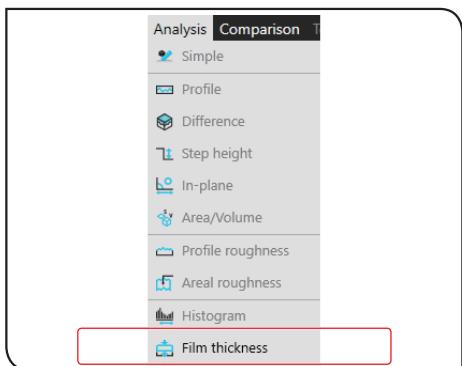
Select either the low pass filter or the high pass filter. If the [Gaussian] or [Spline] radio button is selected in [Type], set the cutoff value.

[f] [OK] button

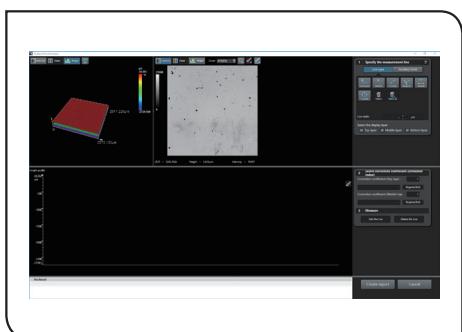
Changes settings and close the [Correct profile line] screen.

15-3 Operating procedures of the film thickness measurement

15-3-1 Starting the film thickness measurement



1 Select [Film thickness] from the [Analysis] menu.



If the film thickness layer cross-sectional (XZ) data file is opened, the [Line film thickness] screen for the film thickness layer cross-sectional data is displayed, and if the film thickness 3D (XYZ) data file is opened, the [Surface film thickness] screen for the film thickness 3D data is displayed.

15-3-2 Specifying the measurement line

Specify the measurement line at the measurement position on the 2D image view area on the [Film thickness] screen. When the measurement line is set, the profile of the measurement line position is displayed on the profile view area.

The appearance of the 2D image view area or the selectable measurement line type differs depending on the data type (film thickness 3D data or film thickness layer cross-sectional data) you measure. This section describes the procedure to specify the measurement line on the film thickness 3D (XYZ) data and screens. The same applies to the procedure to specify the measurement line on the film thickness layer cross-sectional (XZ) data.

Point

- If necessary, use the auxiliary tool to draw a point(s) or a line(s) at the position you want to use as a base of the measurement line on the image in advance.
- You can specify the measurement line more efficiently and accurately by using auxiliary tools.

TIP

For details on auxiliary tools, see "15-4 Measurement line and auxiliary tools" (page 317).

- 1 If the [Line type] button is not ON, click the [Line type] button.

The line types are displayed on the measurement line setting area [a].

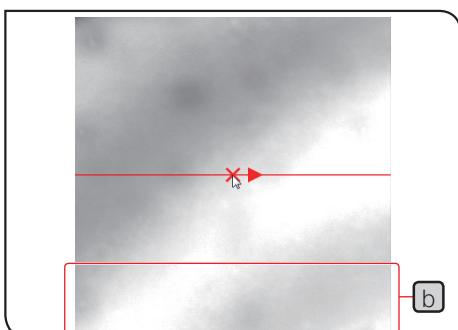
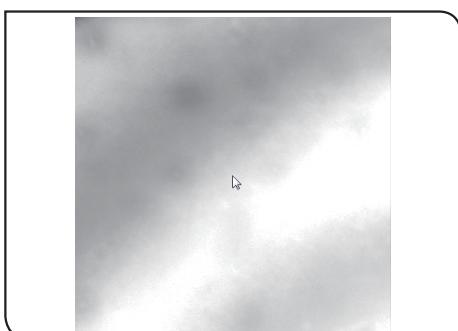
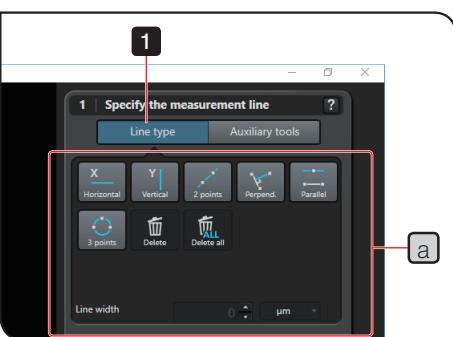
- 2 Click the desired line type button on the measurement line setting area [a].

The line type button you selected is pressed (ON).

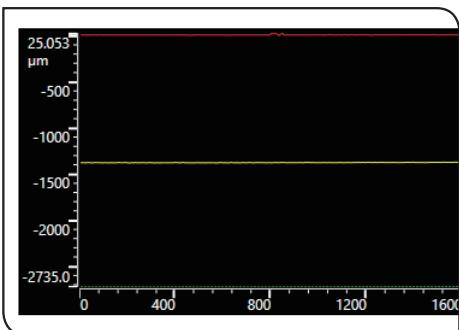
TIP

For details on the line type, see "15-4 Measurement line and auxiliary tools" (page 317).

- 3 Click any position on the 2D image view area.



The measurement line is drawn following the movement of the mouse pointer.

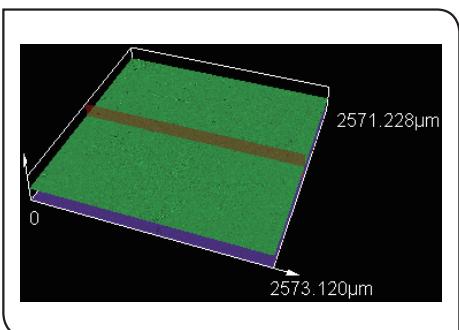


The profile (height data) of the measurement line on the top layer, middle layer and bottom layer of the image data is displayed on the profile view area.

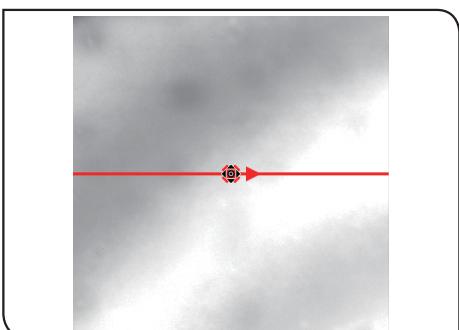
The color of the top layer profile is same as that of the measurement line.

You can change the color of the middle layer profile and the bottom layer profile.

The profile is updated following the movement of the measurement line.

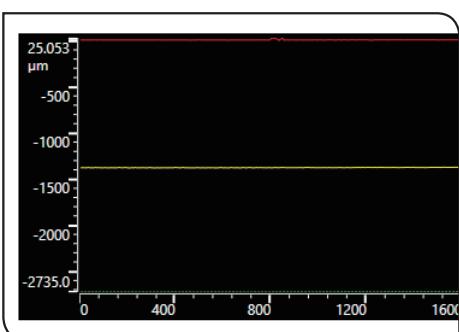


TIP If the measurement line type is set to [Horizontal], [Vertical] or [2 points line], the measurement line (cross-section) position is also displayed on the 3D image view area.



- 4 Move the measurement line position while looking at the profile, and click at the desired position.

The measurement line is fixed.



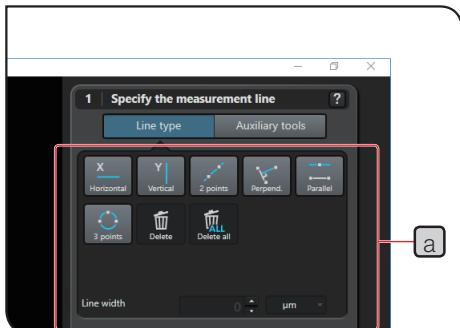
The profile is also fixed.

- 5 If you want to specify multiple measurement lines, repeat steps from **2** to **4**.

TIP The measurement line is added in the order of red, green, blue, pink and yellow.

15-3-3 Editing the measurement line

You can edit or delete the measurement line, if necessary.

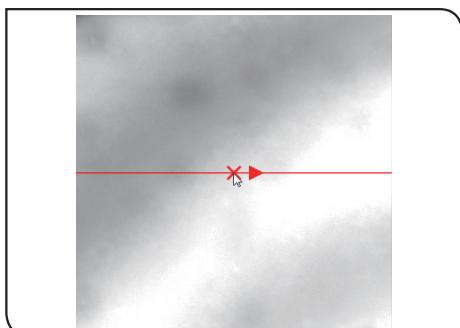


Make sure that all line type buttons on the measurement line setting area **a** are OFF before editing the measurement line.

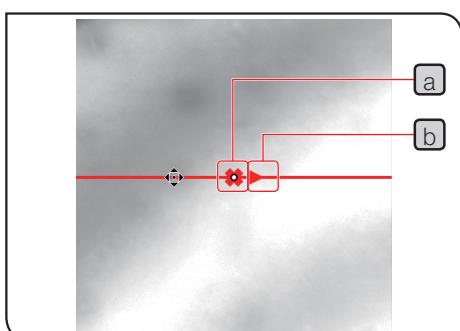
TIP

If the line type button is ON, when you click on the 2D image view area, the measurement line is specified.

Selecting the measurement line



- 1 Click on the measurement line on the 2D image view area.



The measurement line is selected and highlighted.

The mouse pointer position when the measurement line is specified is displayed as a "specified point" **a** with a circle and a cross line.

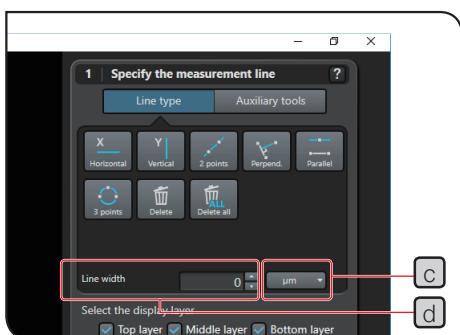
The arrow **b** indicating the profile direction is displayed.

Changing the size or the position of the measurement line

TIP

For changing the size or the position of the measurement line, see "Measurement line types" (page 411).

Changing the measurement line width



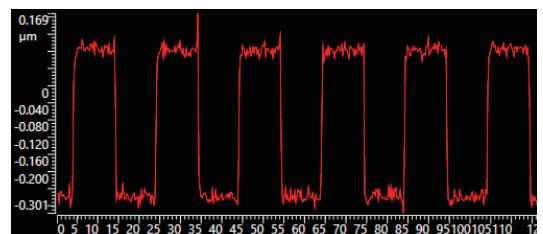
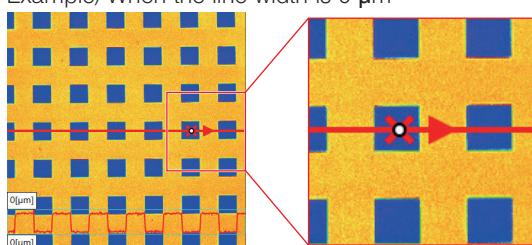
TIP

As the profile is created with the average measurement line width, if you increase the measurement line width, you can make the profile with less noise.

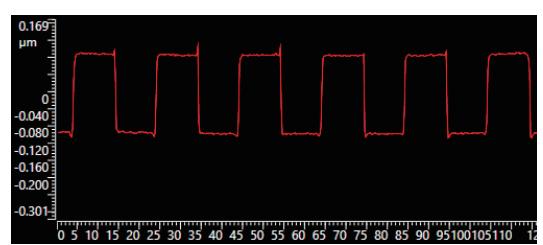
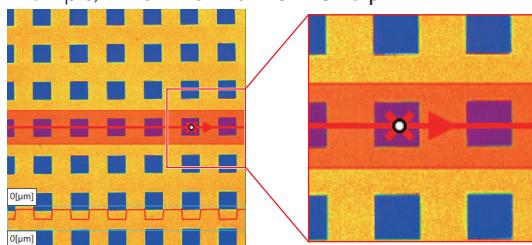
- 1 Select either [μm] or [Pixels] for specifying the line width from the [Line width] dropdown list **c**.
- 2 Specify the line width by either the length or the pixel in the [Line width] setting field **d**.

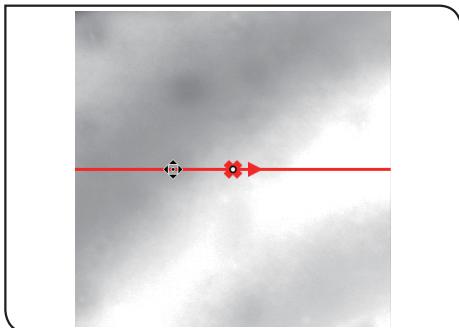
If you increase the line width, the measurement line width is masked.

Example) When the line width is 0 μm



Example) When the line width is 18 μm



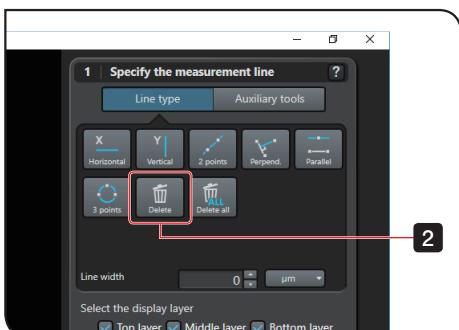
Deleting the measurement line**Deleting the selected measurement line**

- 1 Click on the measurement line you want to delete on the 2D image view area.

- 2 Click the [Delete] button.

When the message confirming to delete the measurement line appears, click the [Yes] button.

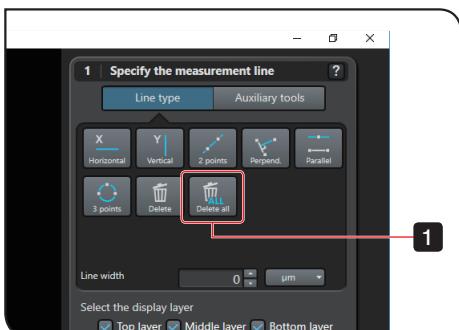
The measurement line is deleted.

**Deleting all measurement lines**

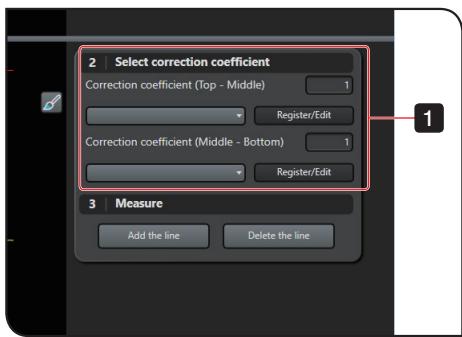
- 1 Click the [Delete all] button.

When the message confirming to delete all measurement lines appears, click the [Yes] button.

All measurement lines are deleted.



15-3-4 Setting the correction coefficient



- 1 Select the correction coefficient from the [Select correction coefficient (refractive index)] dropdown list.

If you want to measure the surface film thickness, select the correction coefficient for each surface.

TIP

- The initial value of the correction coefficient is 1. If you want to change the correction coefficient, register the correction coefficient in advance.
- For procedures to register or edit the correction coefficient, see "15-5 Registering and editing the correction coefficient" (page 321).

15-3-5 Specifying the measurement line (Line film thickness)

There are two methods to specify the measurement line as described below.

- Specify an arbitrary position of the profile as a measurement line.
- Specify a peak detected in the arbitrary range of the profile as a measurement line.

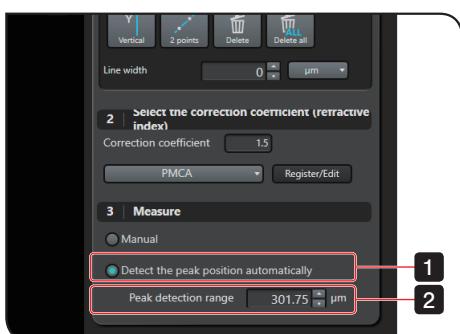
Specifying a peak detected in the arbitrary range of the profile as a measurement position.(Peak search)

You can measure the thickness of the transparent film, etc. by specifying the peak detected in the arbitrary range of the profile (peak search) as a measurement line.

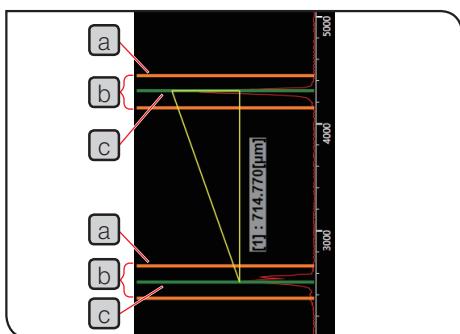
TIP

When measuring the thickness with the peak search function, use the following image data.

- High intensity image data
- Image data of the sample with thick film



- Select the [Detect the peak position automatically] radio button.
- Specify the peak detection range in length in the [Peak detection range] setting field.



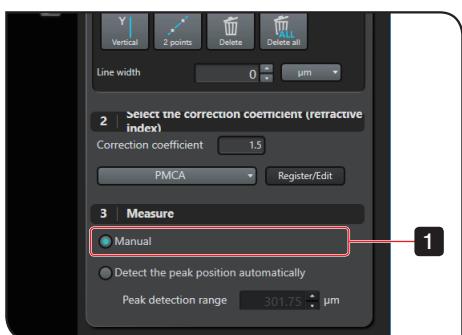
On the profile, the peak detection range **b** placed between peak detection lines (orange color) **a** is displayed at two positions and also the peak measurement line (green color) **c** detected in the peak detection range is displayed.

- Drag each peak detection line **a** to the position you want to search the peak on the profile view area.

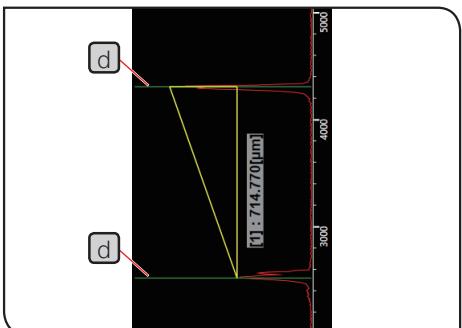
Dragging the peak detection line detects the peak of the profile automatically within that range.

Specifying an arbitrary position of the profile as a measurement line

You can measure the thickness of the transparent film, etc. by specifying the arbitrary position of the profile as a measurement line.



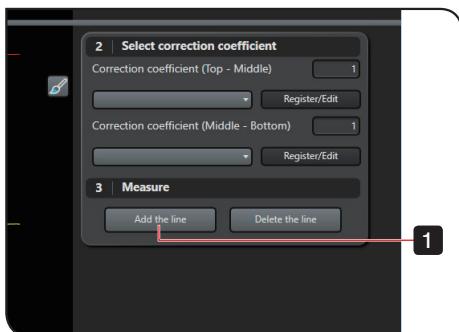
- 1 Select the [Manual] radio button.



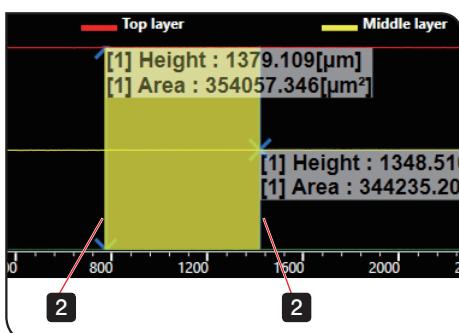
The two measurement lines (green color) **d** are displayed on the profile.

- 2 Drag each measurement line **d** to the position you want to measure on the profile view area.

15-3-6 Specifying the measurement region (Surface film thickness)



- 1 Click the [Add the line] button.



The two measurement lines (light blue color) and the measurement region (yellow color) surrounded by the profile and the measurement lines are displayed on the profile.

- 2 Drag the measurement line to the position you want to measure on the profile view area.

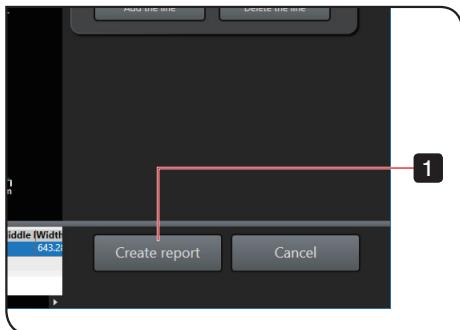
TIP

- Double-clicking on the measurement line displays measurement lines as a single measurement line. Dragging this single measurement line either in right or left direction adjusts the measurement region based on that measurement line.

- Dragging the measurement line to move it closer to the different measurement line displays these two measurement lines as a single measurement line.

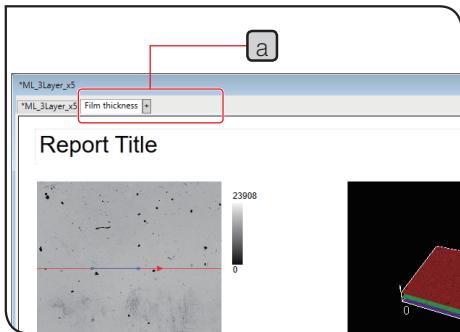
- 3 If you want to measure on multiple positions, repeat steps from 1 to 2.

15-3-7 Creating the report



When you finish specifying the measurement positions, create the report.

- 1 Click the [Create report] button.



The [Film thickness] tab **a** is added to the data view window and the report is displayed.

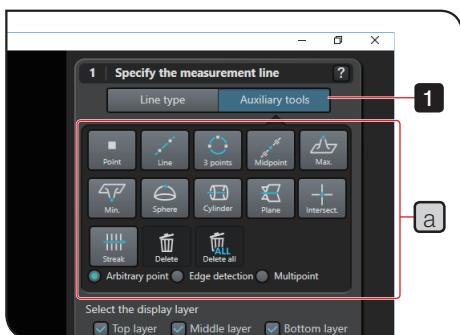
TIP

- You can redo the film thickness measurement by double-clicking on either 2D image data, 3D image data, profile or measurement results on the report.
- For details on redoing the measurement, see “3-3-4 Redoing the measurement analysis” (page 38).

15-4 Measurement line and auxiliary tools

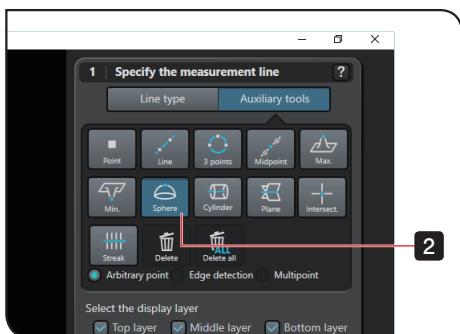
15-4-1 Specifying the measurement line using auxiliary tools

This section describes the procedures to search a sphere center and create a point using auxiliary tools by recognizing the three-dimensional shape in the region specified on the 2D image as a sphere surface, and to specify the measurement line using points created at 2 positions.



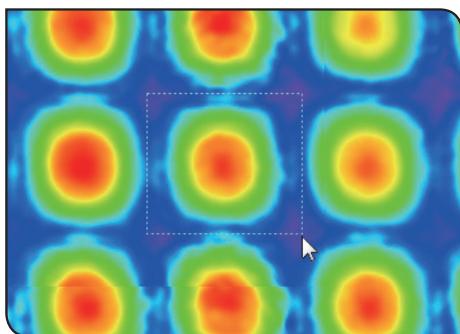
- 1 Click the [Auxiliary tools] button.

The auxiliary tools are displayed on the measurement line setting area a.

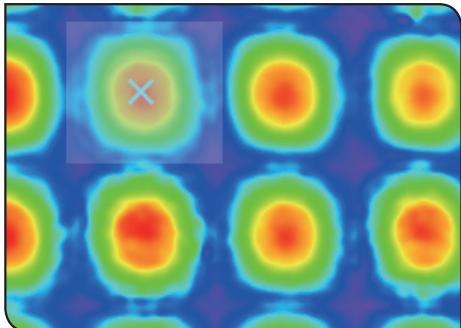


- 2 Click the [Sphere center] button.

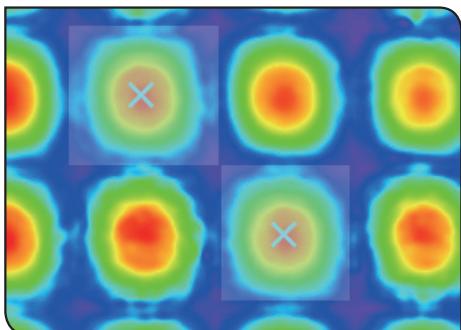
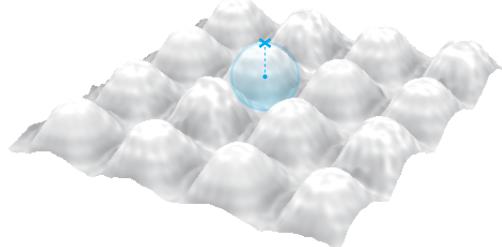
The [Sphere center] button is pushed in.



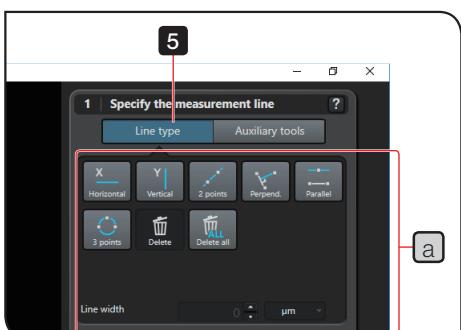
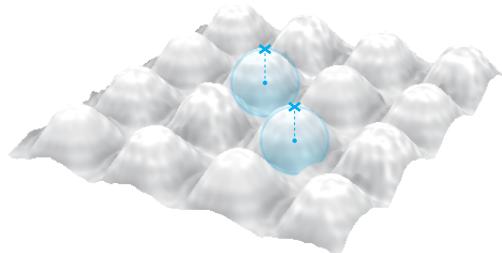
- 3 Drag a position you want to recognize as a sphere surface on the 2D image view area.



The specified region is recognized as a sphere surface, and a “specified point” with a cross line is created at the sphere center position.

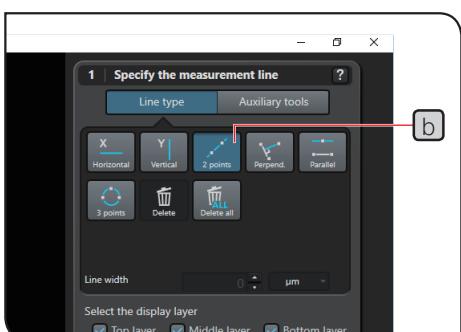


4 Repeat step 3 to specify the second specified point.

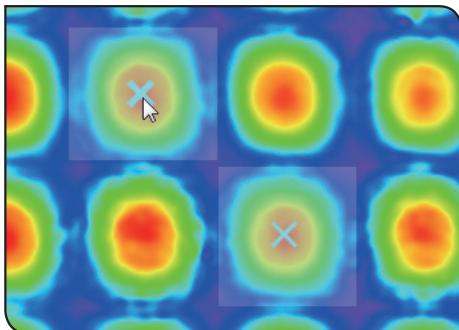


5 Click the [Line type] button.

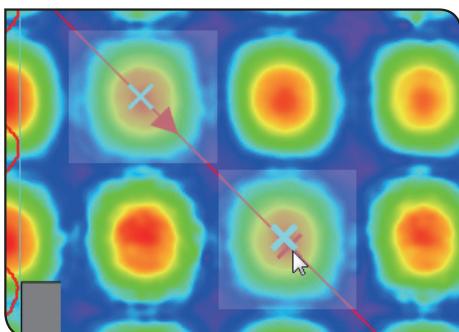
The line types are displayed on the measurement line setting area **a**.



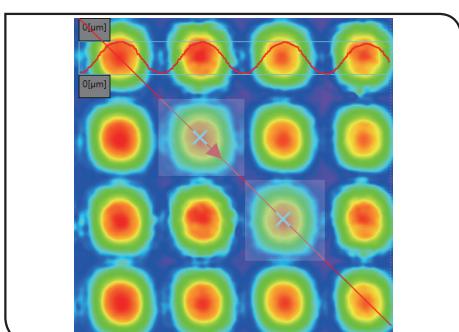
The [2 points line] button is pushed in.



- 7 On the 2D image view area, move the mouse pointer closer to the first specified point and click at the position where the specified point is highlighted.



- 8 Move the mouse pointer closer to the second specified point and click at the position where the specified point is highlighted.



The measurement line passing through two specified points is created.

15-4-2 Measurement line types used in the film thickness measurement

Film thickness layer cross-sectional (XZ) data



■[Vertical]

Draws a vertical line passing through a single point.



■[2 points line]

Draws a line passing through two points.

Film thickness 3D (XYZ) data



■[Horizontal]

Draws a horizontal line passing through a single point.



■[2 points line]

Draws a line passing through two points.



■[Parallel line]

Draws a line that is parallel to the line passing through two points and that also passes through a third point.



TIP For details on the measurement line, see "Measurement line types" (page 411).



■[Vertical]

Draws a vertical line passing through a single point.



■[Perpendicular line]

Draws a line that is perpendicular to the line passing through two points and that also passes through a third point.



■[3 points circle]

Draws a circle with three points as a circumference.

15-4-3 Auxiliary tool types used in the film thickness measurement

Film thickness layer cross-sectional (XZ) data



■[Point]

Draws a point.

Film thickness 3D (XYZ) data



■[Point]

Draws a point.



■[3 points circle]

Draws a circle with three points as a circumference.



■[Maximum height]

Draws the highest position in Z-axis direction in the region as a point.



■[Sphere center]

Recognizing the three-dimensional shape in the region as a sphere, draws a point at the center position of the sphere.



■[Surface intersection line]

Recognizing the three-dimensional shape in the region as a plane, draws its cross line.



■[Streak]

Draw a line orthogonal to the texture of the sample surface in the region.



■[Line]

Draws a line passing through two points.



■[Midpoint]

Draws a midpoint of two points.



■[Minimum height]

Draws the lowest position in Z-axis direction in the region as a point.



■[Cylinder axis]

Recognizing the three-dimensional shape in the region as a side surface of the cylinder, draws a center axis as a line.



■[Intersection line to line]

Draws a point at the intersection of two lines.



TIP For details on auxiliary tools, see "Auxiliary tool types" (page 416).

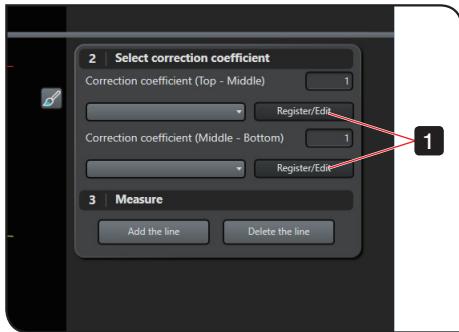
15-5 Registering and editing the correction coefficient

You can register, edit or delete the correction coefficient, if necessary.

TIP The approximate refractive indexes of typical materials are as follows (Wavelength: 405 nm):

Material	Refractive index
Silicon dioxide SiO ₂	1.47
Water	1.34
Optical glass (BK7)	1.53
Acrylic resin (PMMA)	1.50
Air	1

- 1** Click the [Register/Edit] button on the [Film thickness] screen.



The [Edit the correction coefficient] screen appears.

- 2** Set the correction coefficient.

Registering a new correction coefficient

- Select the [New] radio button **a**.
- Input the name of the correction coefficient in the [Name] text box **b**.
- Input the correction coefficient in the [Refractive index] textbox **c**.

TIP The setting range is from 0.001 to 3.

Editing the correction coefficient

- Select the [Edit] radio button **d**.
- Select the correction coefficient you want to edit from the [Name] dropdown list **e**.
- If you want to change the name of the correction coefficient, input the name in the [Name] text box **b**.
- Input the correction coefficient in the [Refractive index] textbox **c**.

TIP The setting range is from 0.001 to 3.

Deleting the correction coefficient

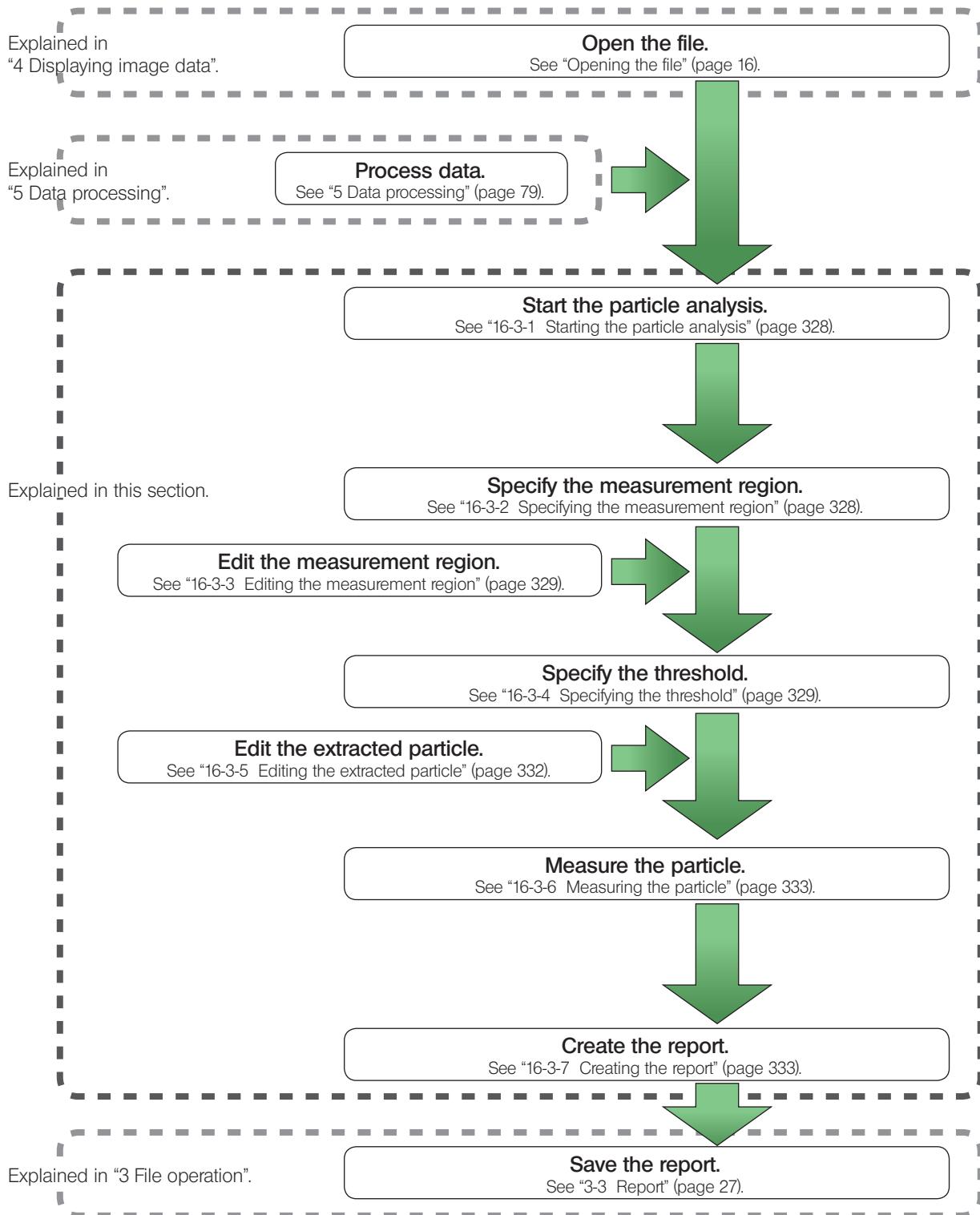
- Select the [Delete] radio button **f**.
- Select the correction coefficient you want to delete from the [Name] dropdown list **e**.

- 3** When you finish settings, click the [OK] button to close the [Edit the correction coefficient] screen.

16 Particle analysis

You can measure the region extracted from the image by binarizing the image data.

16-1 Flow of the particle analysis



16-2 Screen used in the particle analysis



a 2D image data selection button

Selects either the laser intensity image, the color image or the height image on the 2D image view area.

b Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

c Loupe button

Zooms in the mouse pointer position on the 2D image view area.

d 2D image view area

Displays the 2D image and the measurement line. Before clicking the [Calculate] button **k**, the area shown in purple on the 2D image is recognized as a particle.

After the [Calculate] button **k** is clicked, the binarized image where the area recognized as a particle is turned to white is displayed.

Rotating the mouse wheel on the image zooms in or out the image.

The information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area is displayed on the status bar.

e Histogram view area

Displays the histogram of the intensity or the color of the target image. Dragging the bar on the histogram allows you to specify the sectioning level.

f Profile view area

Displays the histogram of the intensity or the color of the measurement line position on the 2D image view area. Dragging the bar on the profile allows you to specify the sectioning level. You can select the direction of the measurement line on the 2D image either horizontal or vertical.

Rotating the mouse wheel on the profile zooms in or out the profile.

g Analysis results view area

Displays analysis results obtained from the sectioning level on the histogram or the profile.

(**h** to **m** are described on the next page.)



(a) to (g) are described on the previous page.)

[h] Analysis range setting area

Sets the analysis range for the particle analysis.

[i] Particle analysis setting area

Sets the method to extract the sectioning level and the particle.

You can check the distribution of particles on the histogram. For details on the screen, see "Checking the distribution of particles on the histogram" (page 326).

You can edit the particle. For details on the screen, see "Editing the extracted particle" (page 327).

[k] [Calculate] button

Binarizes the image data based on the conditions obtained from the sectioning level on the histogram or the profile, and detects the particle.

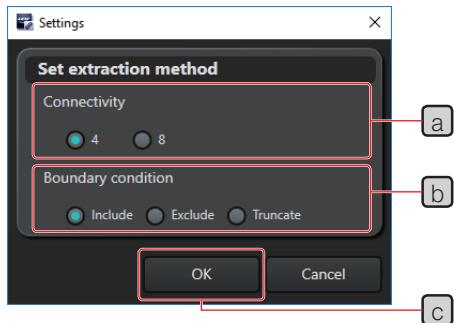
[l] [Create report] button

Creates the report based on analysis results obtained from the sectioning level on the histogram or the profile.

[m] [Cancel] button

Cancels the particle analysis.

Setting the number of particles to connect and particles to extract



[a] [Connectivity] radio button

Recognizes the pixels connected according to the specified number of connection as a single particle.

[b] [Boundary condition] radio button

Selects the target particles for extraction on the boundary of the ROI.

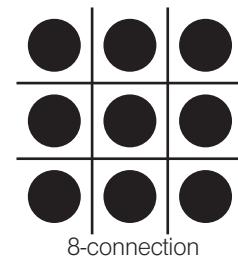
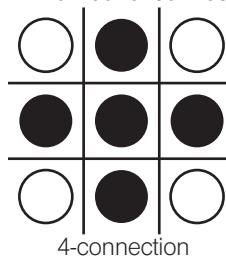
[c] [OK]button

Changes ROI settings and closes the [Settings] screen.

Point

Number of connection:

The number of particles to be recognized or the binarization process operation differs depending on the number of connection.



mark indicates the pixel of image data "1".

The pixels connected to the center pixel of the 3 X 3 vicinity are illustrated above:

4-connection: Pixels up/down/right/left of the center pixel

8-connection: Diagonal pixels are added to pixels in case of 4-connection.

Point

Target particles for extraction on the boundary of the ROI

[Include]: Extracts particles contacting the boundary of the ROI including those outside of the ROI.

[Exclude]: Extracts particles excluding those contacting the boundary of the ROI.

[Truncate]: Extracts only particles inside the boundary of the ROI.

Checking the distribution of particles on the histogram



The histogram of each item of analysis results is shown on this screen.

[a] Calculation method dropdown list

Select the histogram type from the following.

[Area](μm^2), [Center of gravity X](μm), [Center of gravity Y](μm), [Perimeter](μm), [Area ratio factor](%), [Maximum diameter](μm), [Feret diameter X](μm), [Feret diameter Y](μm), [Degree of roundness]

[b] [Particle count]

Displays the number of particles included in the threshold range.

[c] Lower limit threshold setting field

Sets the lower limit threshold (light blue line).

[d] Upper limit threshold setting field

Sets the upper limit threshold (orange line).

TIP If you change the upper limit or the lower limit threshold, items within the threshold range are highlighted among analysis results in the analysis results view area.

[e] [Close] button

Closes the [Histogram] screen.



Editing the extracted particle



[a] 2D image data selection button

Selects either the laser intensity image, the color image or the height image on the 2D image view area. Or input the numerical value.

[b] Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

[c] Preview image magnification dropdown list

Select the magnification to display the preview image. Or input the numerical value.

[d] 2D image view area

Displays the 2D image. Rotating the mouse wheel on the image zooms in or out the image.

[e] Preview image view area

Displays the extracted particles in white. Rotating the mouse wheel on the image zooms in or out the image.

[f] Status bar

Displays the information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area.

[g] Particle editing area

Sets the method to extract the particles and the detection level.

[h] [OK] button

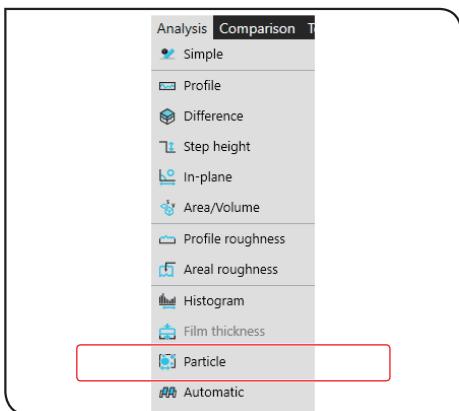
Determines the particle extraction.

[i] [Cancel] button

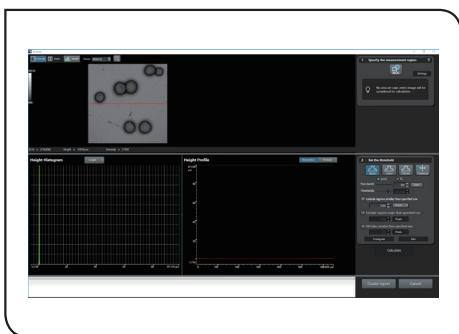
Cancels the particle extraction.

16-3 Operating procedures of the particle analysis

16-3-1 Starting the particle analysis



- 1 Select [Particle] from the [Analysis] menu.



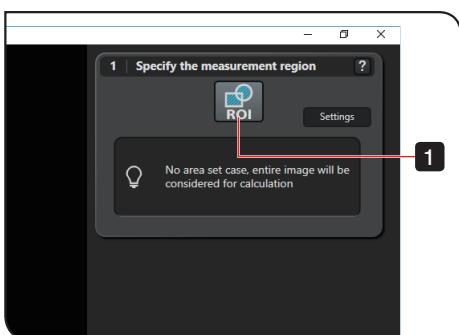
The [Particle] screen appears.

16-3-2 Specifying the measurement region

16

You can specify the measurement region on the 2D image view area, if necessary.

TIP If the measurement region is not specified, all regions are measured.



- 1 Click the [ROI] button.

The [Set the region] screen appears.

- 2 Add the measurement region to the position you want to measure.

TIP For adding the measurement region, see "Adding the ROI" (page 399).

16-3-3 Editing the measurement region

You can edit the measurement region, if necessary.



For editing the measurement region, see "Editing the ROI" (page 406).

16-3-4 Specifying the threshold

You can specify the threshold for binarizing the image.

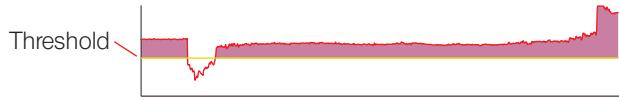
There are two methods to specify the threshold as described below.

- Specify the threshold manually.
- Specifying the threshold automatically

Specifying the threshold manually

- 1 Click the [Upper limit], [Lower limit] or [Outside] button.

[Upper limit]: Sets the region higher than the threshold as a measurement region.



[Lower limit]: Sets the region lower than the threshold as a measurement region.



[Outside]: Sets the region outside of the region between the threshold 1 and threshold 2 as a measurement region.



You can check the rough threshold by displaying the distribution of particles on the histogram.



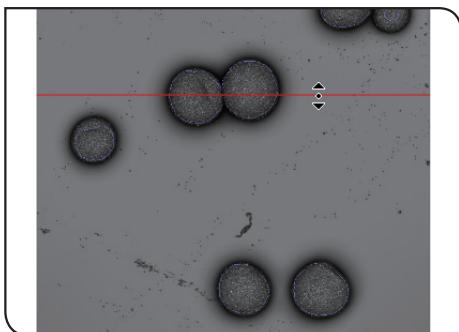
Click the [Histogram] button to display the [Histogram] screen and check the distribution of particles.

- 2 Set the threshold on the histogram or on the profile.

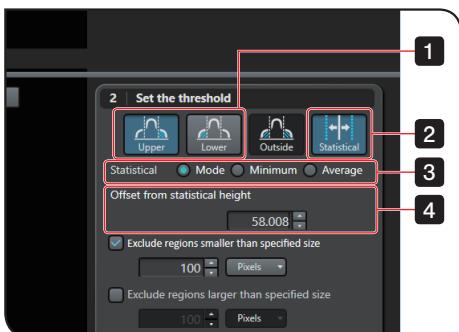
Or set the threshold using the [Threshold 1] or [Threshold 2] slider in [Set the threshold].

The measurement region on the histogram or the profile is displayed in pink color.

The measurement region you created is masked on the 2D image.



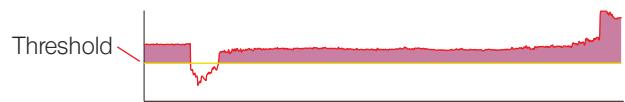
If you want to move the measurement line position, move it on the 2D image view area while looking at the histogram or the profile.



Specifying the threshold automatically

- 1 Click the [Upper] button or the [Lower] button.

[Upper]: Sets the region higher than the threshold as a measurement region.



[Lower]: Sets the region lower than the threshold as a measurement region.



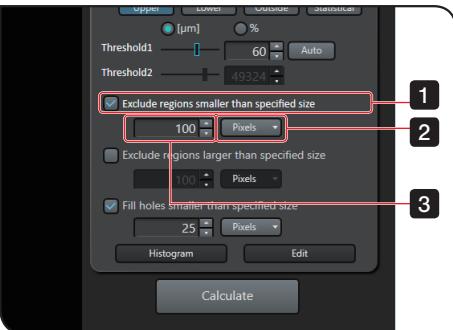
- 2 Click the [Statistical] button.

- 3 Click either the [Mode], [Minimum] or [Average] radio button.

[Mode]: Detects the mode of the height of the histogram and sets it as a sectioning level.

[Minimum]: Detects the minimum value of the height of the histogram and sets it as a sectioning level.

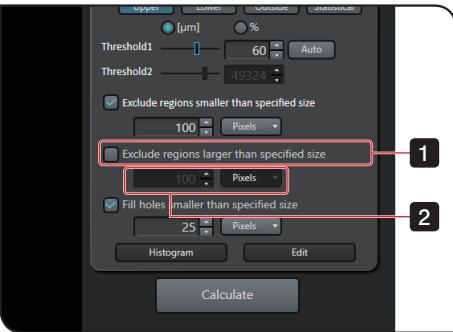
[Average]: Detects the average of the height of the histogram and sets it as a sectioning level.



Excluding small particles from measurement

You can exclude the particle too small to be recognized as a particle from the measurement, if necessary.

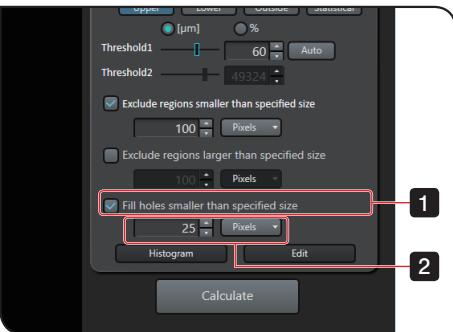
- 1 Check the [Exclude regions smaller than specified size] checkbox.
- 2 Select either [μm^2] or [Pixel] for specifying the particle size to be excluded in the [Exclude regions smaller than specified size] dropdown list.
- 3 Select either the area or the pixel for specifying the particle size to be excluded in the [Exclude regions smaller than specified size] setting field.



Excluding large particles from measurement

You can exclude the particle that is too large to be recognized as a particle from the measurement, if necessary.

- 1 Check the [Exclude regions larger than specified size] checkbox.
- 2 Select either [μm^2] or [Pixel] for specifying the particle size to be excluded in the [Exclude regions larger than specified size] dropdown list.
- 3 Select either the area or the pixel for specifying the particle size to be excluded in the [Exclude regions larger than specified size] setting field.



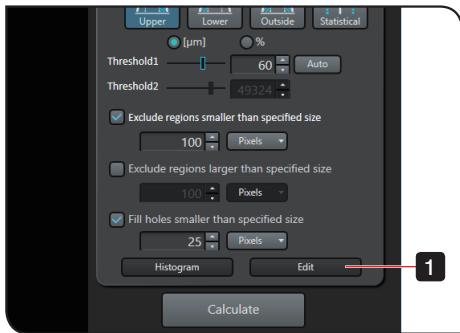
Filling holes in the measurement region

If there are holes in the measurement region, you can fill the holes and extract as a single particle.

- 1 Check the [Fill holes smaller than specified size] checkbox.
- 2 Select either [μm^2] or [Pixel] for specifying the hole size to be recognized as a particle from the [Fill holes smaller than specified size] dropdown list.
- 3 Select either the area or the pixel for specifying the hole size to be recognized as a particle from the [Fill holes smaller than specified size] setting field.

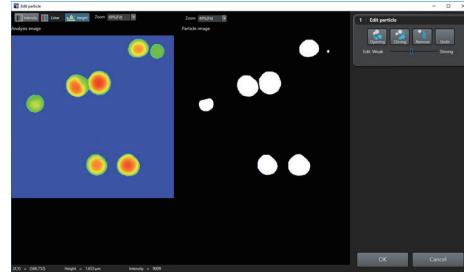
16-3-5 Editing the extracted particle

You can edit the extracted particle, if necessary.



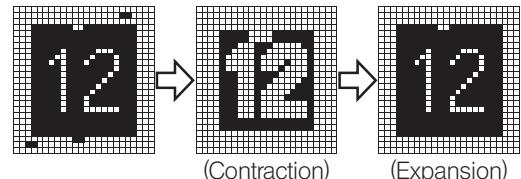
1 Click the [Edit] button.

The [Edit particle] screen appears.

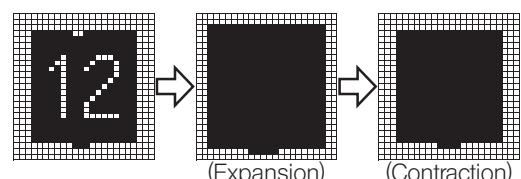


2 Edit the target particle for measurement in the particle editing area.

[Opening]: Disconnects a particle or removes its protrusion. Set the degree of disconnection by moving the [Edit] slider and click the [Opening] button.



[Closing]: Connects a particle or fills the chipped part. Set the degree of connection by moving the [Edit] slider and click the [Closing] button.



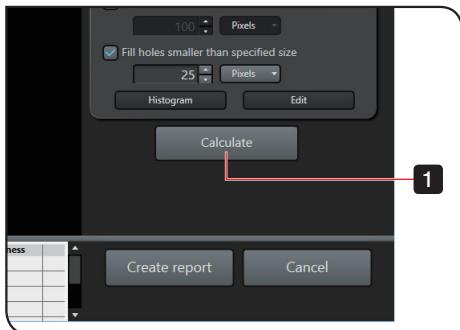
[Remove]: Removes the particles from measurement.

Click the [Remove] button and then, click the white area on the preview image view area.

TIP Clicking the [Undo] button cancels the last operation you performed.

3 Click the [OK] button to close the [Edit particle] screen.

16-3-6 Measuring the particle



- 1 Click the [Calculate] button.

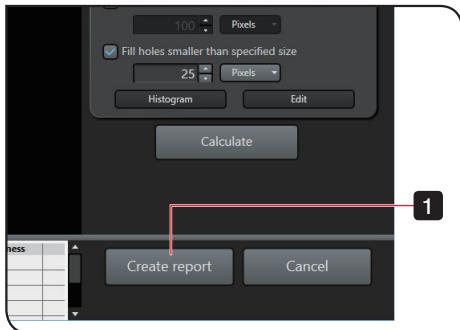
The particles are displayed on the 2D image view area and measurement results are displayed on the measurement results view area.

Measurement results

[Area (μm^2)], [Center of gravity X (μm)], [Center of gravity Y (μm)], [Perimeter (μm)], [Area ratio factor (%)], [Maximum diameter (μm)], [Feret diameter X (μm)], [Feret diameter Y (μm)], [Degree of roundness]

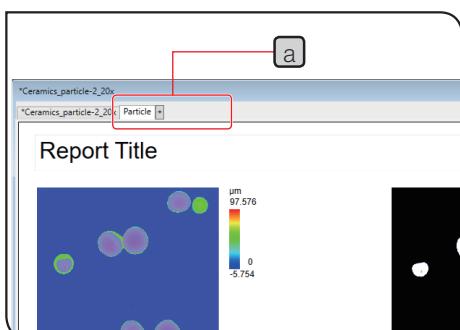
TIP The maximum number of particles you can extract is 5000.

16-3-7 Creating the report



When you finish measuring the particles, you can create the report.

- 1 Click the [Create report] button.



The [Particle] tab **a** is added to the data view window and the report is displayed.

- TIP**
- You can redo the particle analysis by double-clicking on either 2D image data, histogram, profile or measurement results on the report.
 - For details on redoing the measurement, see "3-3-4 Redoing the measurement analysis" (page 38).

16-4 Definition of analysis items in the particle analysis

■[Area (μm^2)]

Area of particle



■[Center of gravity X (μm)]

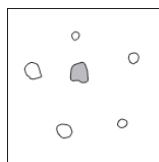
Center of gravity of a particle in X direction (Assume the origin at the top left corner of the image)



■[Area ratio factor (%)]

Area ratio is defined as the proportion of the particle area (all identified particles) to the whole image.

$$\text{Area ratio factor} = \frac{\text{All identified particles}}{\text{Total image}}$$



■[Center of gravity Y (μm)]

Center of gravity of a particle in Y direction (Assume the origin at the top left corner of the image)



■[Perimeter (μm)]

Perimeter of a particle (A hole perimeter is not included)

Perimeter is defined as the total length that connects adjacent center points of boundary pixels.



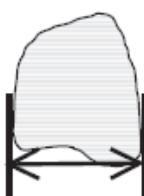
■[Maximum diameter (μm)]

Maximum outer distance of a particle



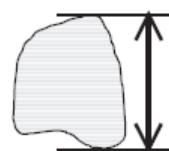
■[Feret diameter X (μm)]

Distance between two vertical lines that contact an image



■[Feret diameter Y (μm)]

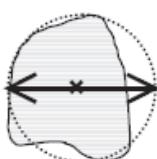
Distance between two horizontal lines that contact an image



■[Equivalent circle diameter (μm)]

Diameter of the circle having the same area as a particle

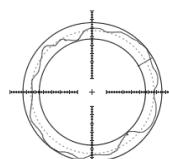
The equivalent circle diameter is defined as 2 times of the radius calculated from the area of a particle assuming that the particle is the perfect circle.



■[Degree of roundness]

Deviation from the circumference of a geometrically perfect circle.

This is defined as the difference between radii of 2 circles which are the circumscribed concentric circle and the inscribed concentric circle to the circle that sum of squares of the deviation is minimum.



■[Volume (μm^3)]

Volume of the peak area or the valley area defined based on a certain height (threshold)



■[Surface area (μm^2)]

Surface area of the peak area or the valley area defined based on a certain height (threshold)



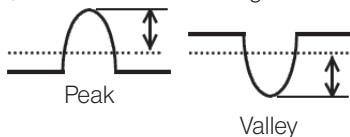
■[Surface area ratio]

Ratio of the surface area of the particle to the whole area of the particle

$$\text{Surface area ratio} = \frac{\text{Surface area of particle}}{\text{Whole area of particle}}$$

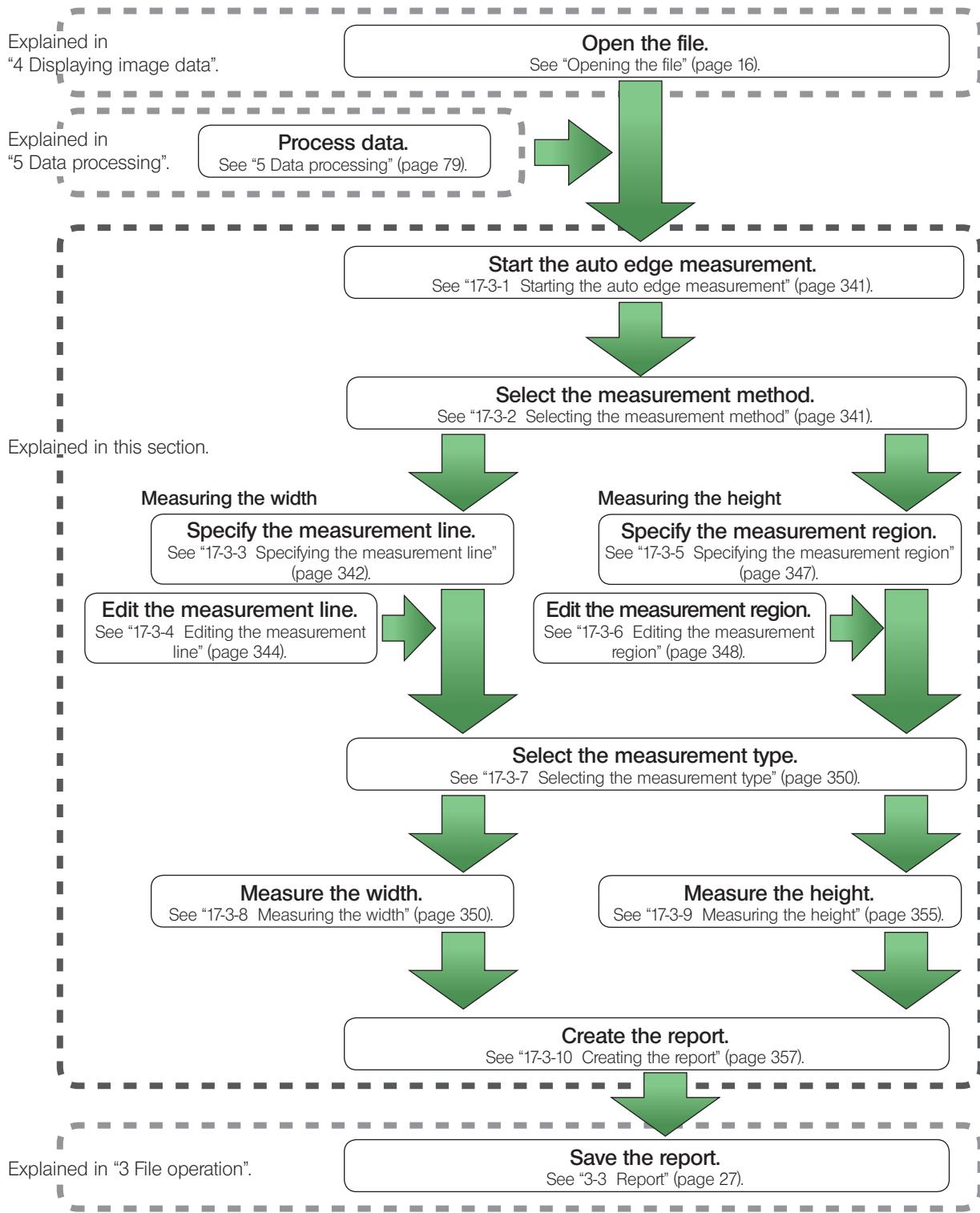
■[Maximum height from threshold (μm)]

Difference between the threshold of the peak area or valley area defined based on a certain height (threshold) and the maximum height



17**Auto edge measurement**

You can measure the pattern width or the height having regularity, e.g. semiconductor, etc. automatically according to the conditions specified in advance. You can set various conditions for the color image, laser image and 3D shape data according to the characteristics of the sample. This function is useful for measuring the same shape samples repetitively.

17-1 Flow of the auto edge measurement

17-2 Screens used in the auto edge measurement



[a] 3D image data selection button

Selects either the laser intensity image, the color image or the height image on the 3D image view area.

[b] Advanced setting button for 3D image

Displays the screen to define advanced settings for displaying the 3D image. For details on the screen, see "4-2-1 Screens used with the 3D view" (page 51).

[c] 3D image view area

Displays the 3D image.

Dragging the image allows you to change the angle to display the image.

Rotating the mouse wheel on the image zooms in or out the image.

Dragging the image while holding down the right button of the mouse allows you to move the view position.

[d] 2D image data selection button

Selects either the laser intensity image, the color image or the height image on the 2D image view area.

[e] Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

[f] Loupe button

Zooms in the mouse pointer position on the 2D image view area.

[g] Measurement line color button

Sets the color of the measurement line selected on the 2D image view area.

[h] Auxiliary tool color button

Sets the color of the auxiliary tool on the 2D image view area.

([i] to [p] are described on the next page.)



(a) to (h) are described on the previous page.)

i 2D image view area

Displays the 2D image with the measurement line or the 2D image with the measurement region.

Rotating the mouse wheel on the image zooms in or out the image.

You can change the color of the measurement line and auxiliary tools. Use the measurement line color button (g) or the auxiliary tool color button (h) to display the color pallet.

The information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area is displayed on the status bar.

k Profile view area

Displays the measurement line on the 2D image view area or the profile of measurement region position. Specifying the measurement position on the profile displays measurement results. You can change the font and the color of measurement results. For the screen to change the color, see “[View setting] screen” (page 338).

Rotating the mouse wheel on the profile zooms in or out the profile.

Measurement results view area

Displays measurement results obtained from the measurement position on the profile.

m Measurement line / Measurement region setting area

Select the method to specify the measurement line or the measurement region.

n Auto edge measurement setting area

Specify the measurement position on the profile.

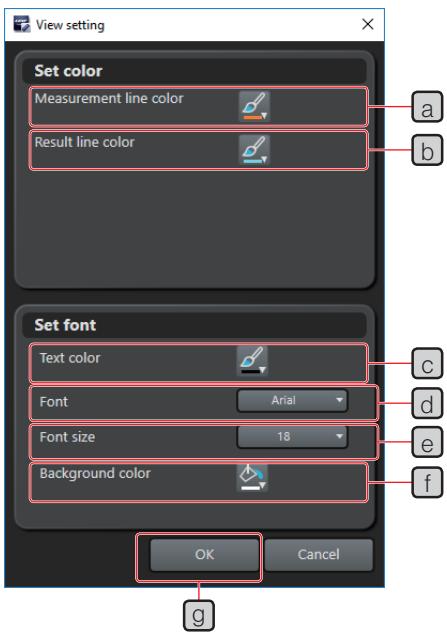
o [Create report] button

Creates the report based on measurement results obtained from the measurement position on the profile.

p [Cancel] button

Cancels the auto edge measurement.

[View setting] screen



[a] [Measurement line color] button

Changes the color to display the line used in measurement.

[b] [Result line color] button

Changes the color of the line that connects the measurement position with measurement results.

[c] [Text color] button

Changes the color of strings of measurement results.

[d] [Font] dropdown list

Changes the font of strings of measurement results.

[e] [Font size] dropdown list

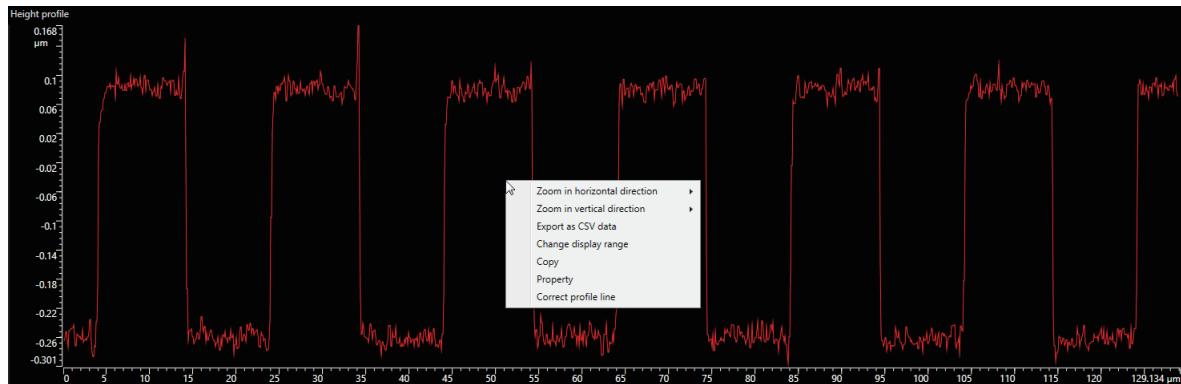
Changes the font size of strings of measurement results.

[f] [Background color] button

Changes the background color of strings of measurement results.

[g] [OK] button

Changes the settings and closes the [View setting] screen.

Profile

You can define following settings on the profile. Right-click on the profile to display the menu, and select the menu you desire.

- **[Zoom in horizontal direction]**

Sets the horizontal magnification of the profile.

- **[Zoom in vertical direction]**

Sets the vertical magnification of the profile.

- **[Export as CSV data]**

Outputs the profile in CSV file format.

- **[Change display range]**

Sets the display range of the image and the profile. For setting the display range, see “4-4 Setting the display range” (page 60).

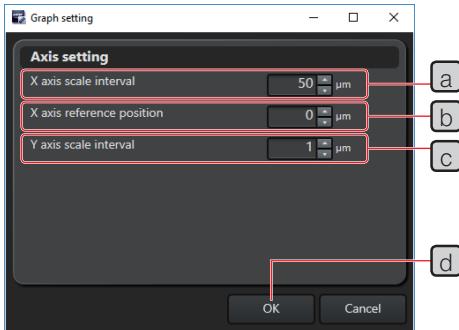
- **[Copy]**

Copies the profile as an image.

- **[Property]**

Sets the format of the profile. For setting the format, see “Setting the format of the profile” (page 340).

Setting the format of the profile



[a] [X-axis scale interval]

Sets the scale interval on the X-axis.

[b] [X-axis reference position]

Sets the value you want to use as a "0" position on the X-axis.

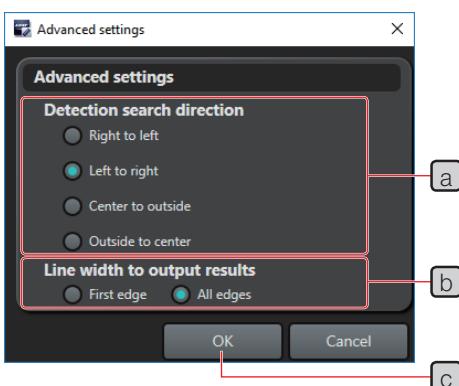
[c] [Y-axis scale interval]

Sets the scale interval on the Y-axis.

[d] [OK] button

Changes the settings and close the [Graph setting] screen.

Setting the direction to detect the edge and the number of edges to be detected



[a] [Detection search direction]

Sets the direction to detect the edge.

[b] [Line width to output results]

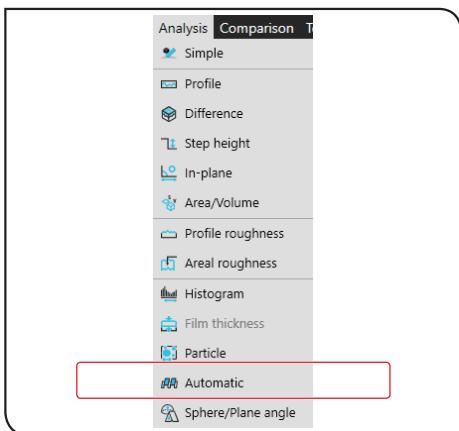
If there are multiple edges to be detected in the profile, select whether to measure the first edge only or measure all edges.

[c] [OK] button

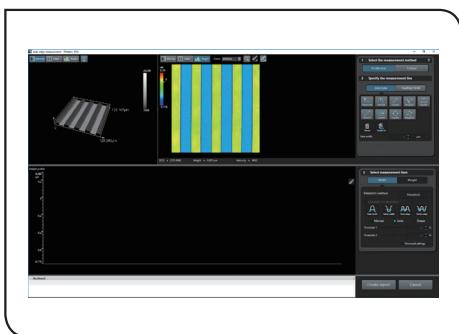
Changes settings and close the [Advanced settings] screen.

17-3 Operating procedures of the auto edge measurement

17-3-1 Starting the auto edge measurement

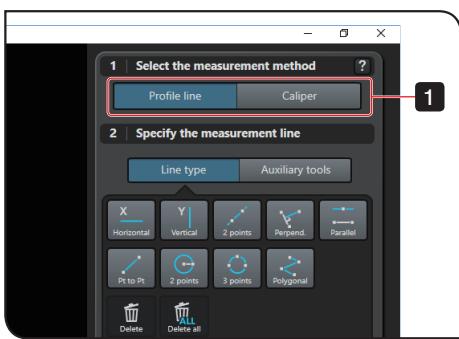


- Select [Automatic] from the [Analysis] menu.



The [Auto Edge measurement] screen appears.

17-3-2 Selecting the measurement method



- Select the measurement method from [Profile line] or [Caliper].

[Profile line]: Measures the difference in width or height on the profile of the measurement line specified on the image.

[Caliper]: Measures the difference in width or height on the profile of the measurement region specified on the image. You can set the measurement region automatically for the sample pattern much easier than [Profile line].

- TIP**
- If you select [Profile line], go to the next section "17-3-3 Specifying the measurement line" (page 342).
 - If you select [Caliper], go to the section "17-3-5 Specifying the measurement region" (page 347).

17-3-3 Specifying the measurement line

You can specify the measurement line at the measurement position on the 2D image view area. When the measurement line is specified, the profile of the measurement line position is displayed on the profile view area.

Point

- If necessary, use the auxiliary tool to draw a point(s) or a line(s) at the position you want to use as a base of the measurement line on the image in advance.
- You can specify the measurement line more efficiently and accurately using auxiliary tools.

TIP

For details on auxiliary tools, see “17-4 Measurement line and auxiliary tools” (page 358).

- 1 If the [Line type] button is not ON, click the [Line type] button.

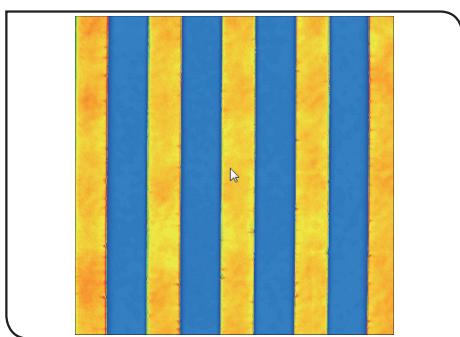
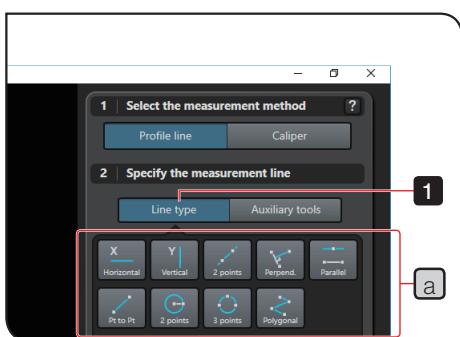
The line types are displayed on the measurement line setting area **a**.

- 2 Click the line type button on the measurement line setting area **a**.

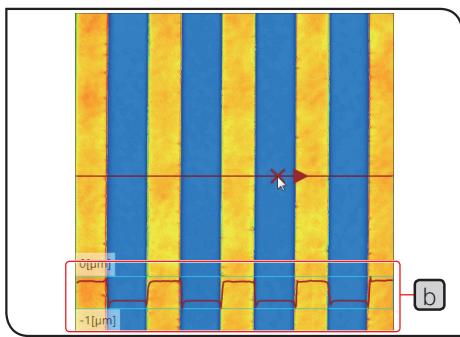
The line type button you selected is pressed (ON).

TIP

For details on the line type, see “17-4 Measurement line and auxiliary tools” (page 358).



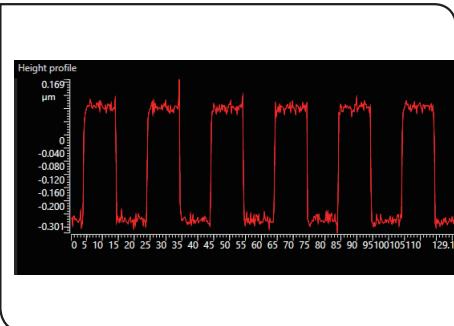
- 3 Click any position on the 2D image view area.



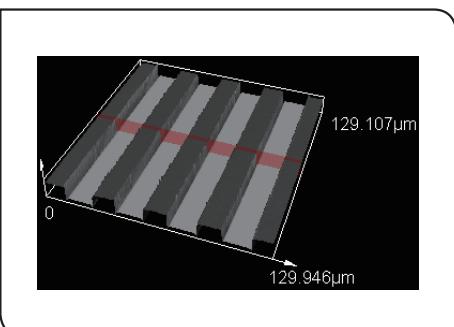
The measurement line is drawn following the movement of the mouse pointer.

The profile (height data) **b** of the measurement line is displayed on the 2D image view area.

The profile is updated following the movement of the measurement line.

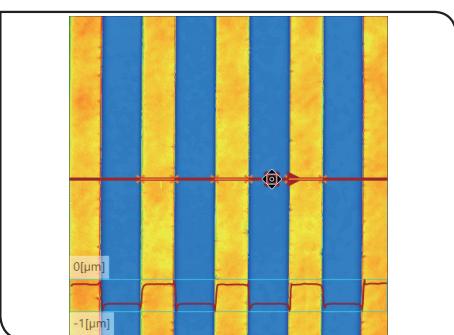


The profile is also displayed on the profile view area.



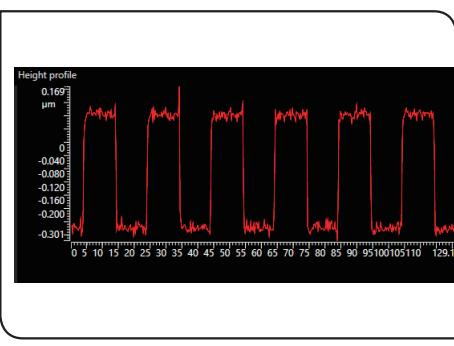
TIP

If the measurement line type is set to [Horizontal], [Vertical], or [2 points line], the measurement line (cross-section) position is also displayed on the 3D image view area.



- 4** Move the measurement line position while looking at the profile, and click the mouse at the desired position.

The measurement line is fixed.



The profile is also fixed.

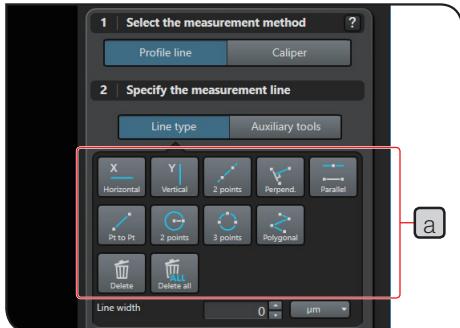
- 5** If you want to specify multiple measurement lines, repeat steps from **2** to **4**.

TIP

The measurement line is added in the order of red, green, blue, pink and yellow.

17-3-4 Editing the measurement line

You can edit or delete the measurement line, if necessary.

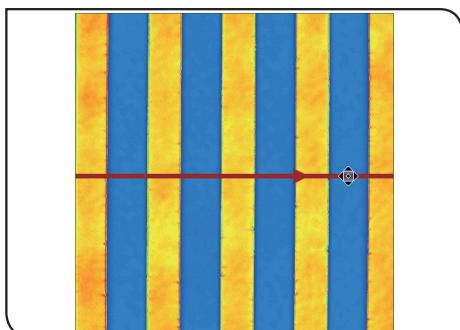


Make sure that all line type buttons on the measurement line setting area **a** are OFF before editing the measurement line.

TIP

If the line type button is ON, when you click on the 2D image view area, the measurement line is specified.

Selecting the measurement line

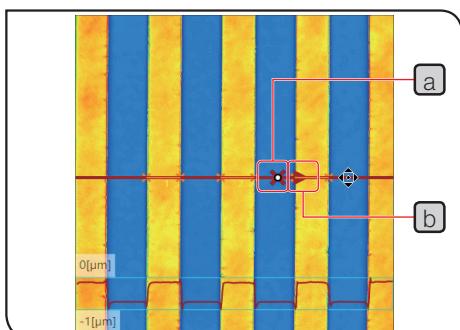


- 1 Click on the measurement line on the 2D image view area.

The measurement line is selected and highlighted.

The mouse pointer position when the measurement line is specified is displayed as a "specified point" **a** with a circle and a cross line.

The arrow **b** indicating the profile direction is displayed.

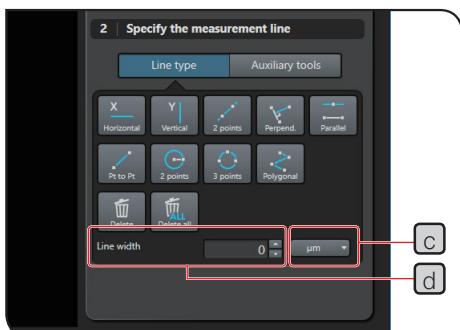


Changing the size or the position of the measurement line

TIP

For changing the size or the position of the measurement line, see "Measurement line types" (page 411).

Changing the measurement line width



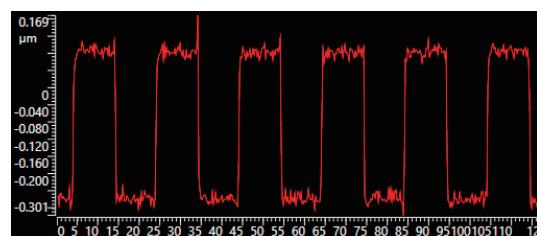
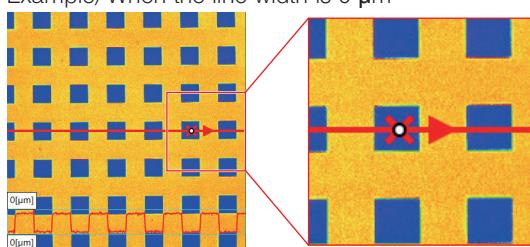
TIP

As the profile is created with the average measurement line width, if you increase the measurement line width, you can make the profile with less noise.

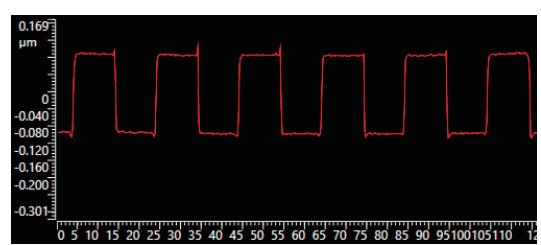
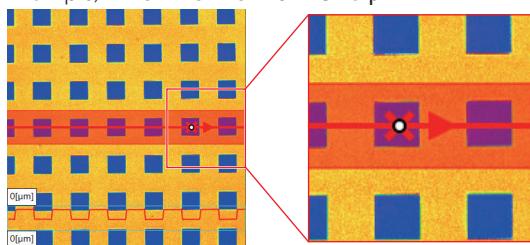
- 1 Select either [μm] or [Pixel] for specifying the line width from the [Line width] dropdown list **c**.
- 2 Select either the length or the pixel for specifying the line width in the [Line width] setting field **d**.

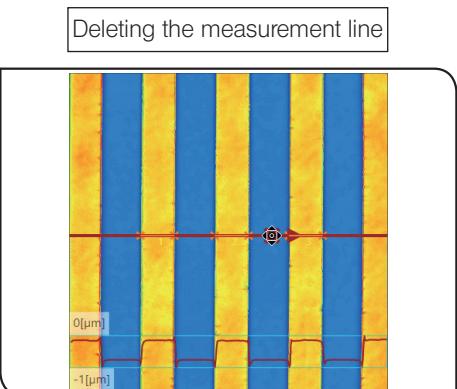
If you increase the line width, the measurement line width is masked.

Example) When the line width is 0 μm



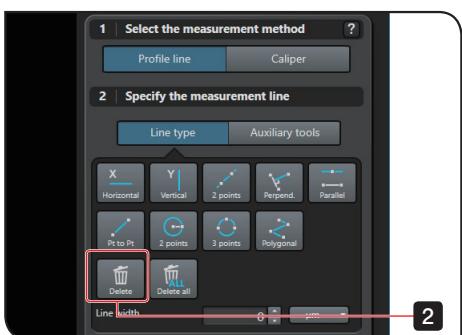
Example) When the line width is 18 μm





Deleting the selected measurement line

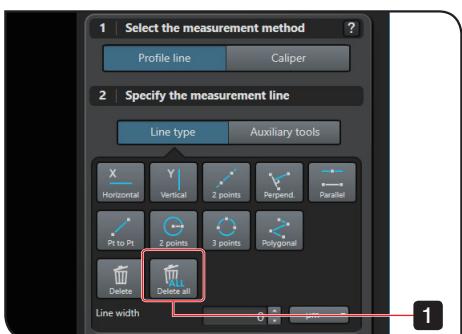
- 1 Click on the measurement line you want to delete on the 2D image view area.



- 2 Click the [Delete] button.

When the message confirming to delete the measurement line appears, click the [Yes] button.

The measurement line is deleted.



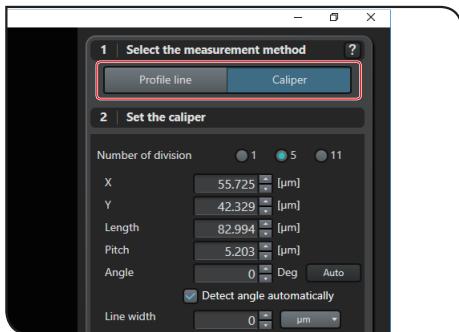
Deleting all measurement lines

- 1 Click the [Delete all] button.

When the message confirming to delete all measurement lines appears, click the [Yes] button.

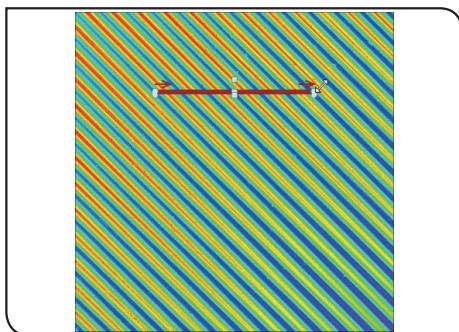
All measurement lines are deleted.

17-3-5 Specifying the measurement region

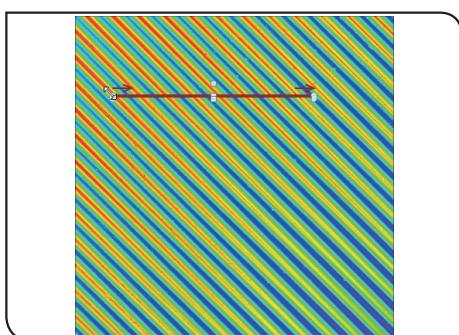


If you select [Caliper] for the measurement method, specify measurement region according to procedures described in this section.

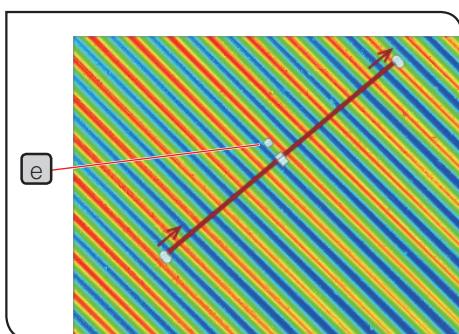
TIP For selecting the measurement method, see "17-3-2 Selecting the measurement method" (page 341).



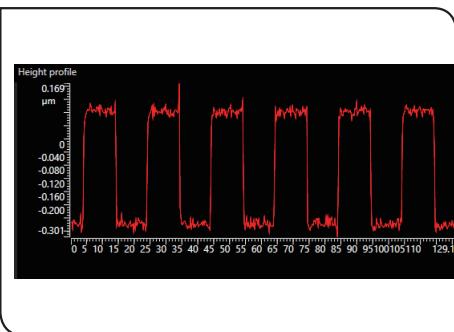
- 1 Drag the one end of the measurement region to move the measurement region to the position you want to measure.



- 2 Drag the other end of the measurement region to move the measurement region to the position you want to measure.



- 3 Rotate the measurement region, if necessary, by clicking the rotation handle **e** above the measurement region to drag it in arbitrary direction.



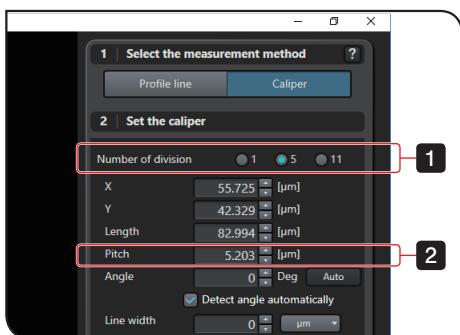
The profile of the measurement region is displayed on the profile view area.

The profile is updated following the movement of the measurement line.

17-3-6 Editing the measurement region

You can edit the measurement region, if necessary.

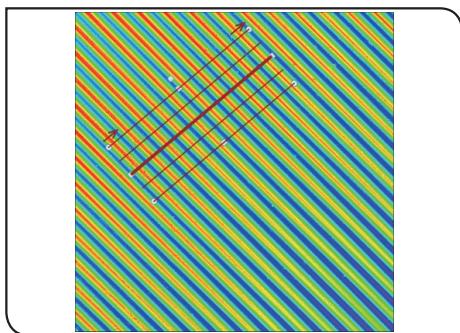
Dividing the measurement region



If you divide the measurement region, you can acquire the analysis results for the number of divisions.

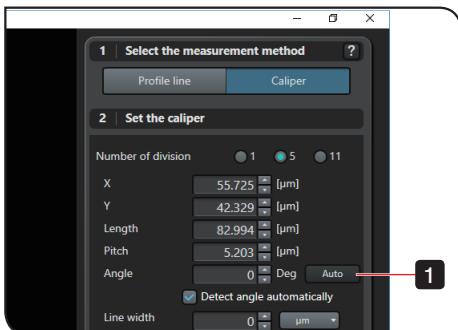
If the measurement region is divided, the profile of the measurement region selected on the 2D image view area is displayed on the profile view area.

- 1** Use the [Number of division] radio button to select [5] or [11].
- 2** Specify the interval to divide the measurement region in the [Pitch] setting field.



Or drag the handle of the measurement region on the 2D image view area to change the size of the measurement region.

Rotating the measurement region automatically



You can rotate the measurement region automatically according to the linear pattern of the sample.

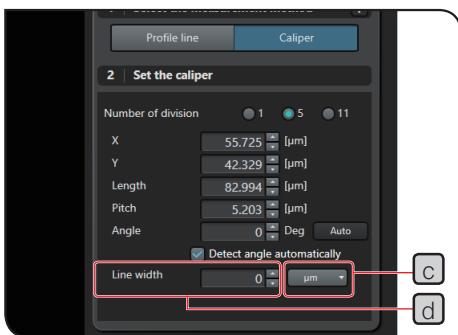
- Click the [Auto] button.

The measurement region is rotated.

TIP

The measurement region may not be rotated to the appropriate angle depending on the image data. If using the sample that does not contain the linear pattern with contrast, the measurement region may not be rotated to the appropriate angle.

Changing the line width of the measurement region



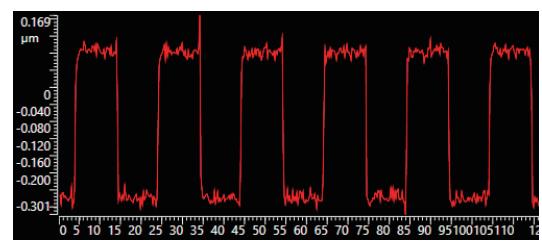
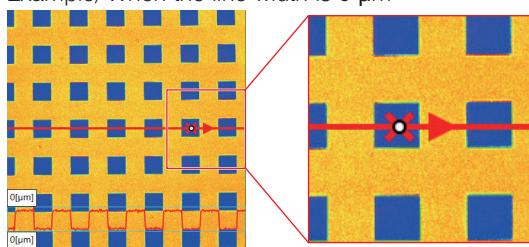
TIP

As the profile is created with the average line width of the measurement region, if you increase the line width of the measurement region, you can make the profile with less noise.

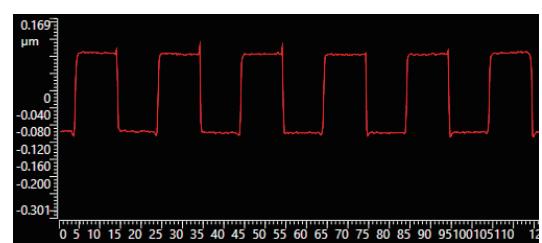
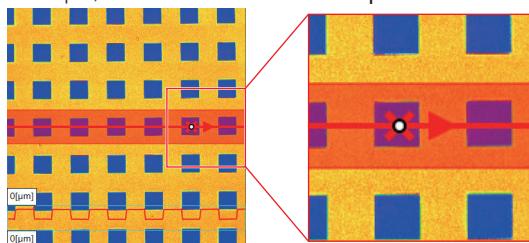
- Select either [μm] or [Pixel] for specifying the line width from the [Line width] dropdown list **c**.
- Select either the length or the pixel for specifying the line width in the [Line width] setting field **d**.

If you increase the line width, the line width of the measurement region is masked.

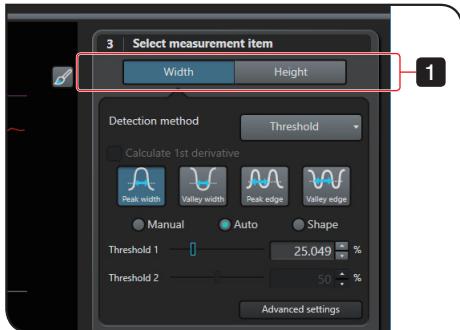
Example) When the line width is 0 μm



Example) When the line width is 18 μm



17-3-7 Selecting the measurement type



1 Select the measurement type either from [Width] or [Height].

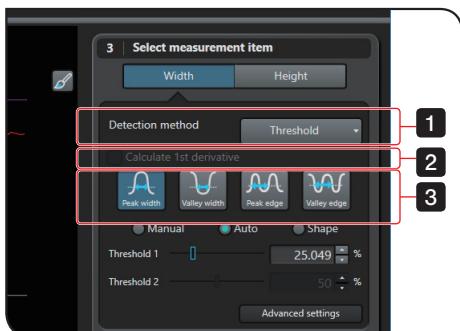
[Width]: Measures each width of multiple measurement positions specified on the profile.

[Height]: Measures each height difference of multiple measurement positions specified on the profile.

TIP

- If you select [Width], go to the next section “17-3-8 Measuring the width” (page 350).
- If you select [Height], go to the section “17-3-9 Measuring the height” (page 355).

17-3-8 Measuring the width



1 Select the detection method from [Detection method].

TIP

[Profile center] is displayed only when the height data is displayed on the 2D image view area.

2 If you want to calculate the 1st derivative of the profile, check the [Calculate 1st derivative] checkbox.

TIP

When the 1st derivative of the profile is calculated, the edge part is highlighted.

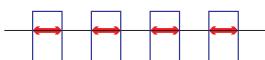
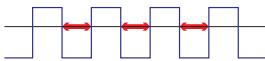
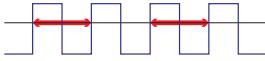
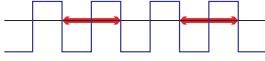
3 Select the method to specify the measurement position.

TIP

Select the detection method (Step 1) and the method to specify the measurement position (Step 3) according to the sample characteristics or the position you want to measure.

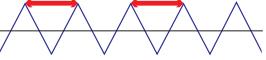
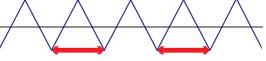
■[Threshold]

Suitable for measuring the width of the sample where the upper edge or the lower edge of the profile is flat.

Method to specify the measurement position	Description
Peak width	Measures the width at the intersections of the threshold and the profile upper than the threshold. 
Valley width	Measures the width at the intersections of the threshold and the profile lower than the threshold. 
Peak edge	Measures the width at the intersections of the threshold and the profile upper than the threshold and the profile lower than threshold. 
Valley edge	Measures the width at the intersections of the threshold and the profile lower than the threshold and the profile upper than the threshold. 

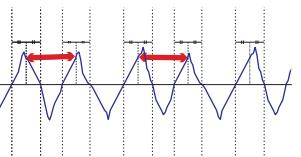
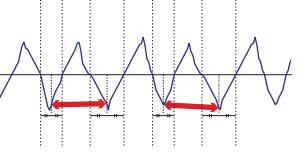
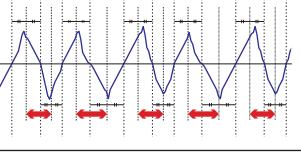
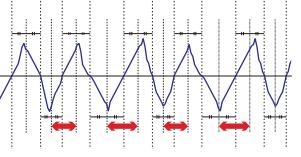
■[Profile peak]

Suitable for measuring the width of the sample where the upper edge or the lower edge of the profile is sharply pointed.

Method to specify the measurement position	Description
Peak-Peak	Measures the width between maximum values of the profile upper than the threshold. 
Valley-Valley	Measures the width between minimum values of the profile lower than the threshold. 
Peak-Valley	Measures the width between the maximum value of the profile upper than the threshold and the minimum value of the profile lower than the threshold. 
Valley-Peak	Measures the width between the minimum value of the profile lower than the threshold and the maximum value of the profile upper than the threshold. 

■[Profile center]

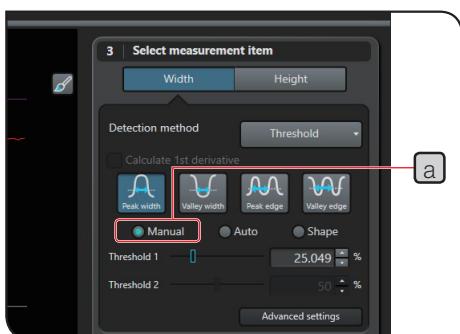
Suitable for measuring the periodic width of the sample where the height profile has regularity.

Method to specify the measurement position	Description
Peak-Peak	
Valley-Valley	
Peak-Valley	
Valley-Peak	

- 4** Select the method to set the settable range of the threshold of the profile.

There are three types of setting methods as described below.

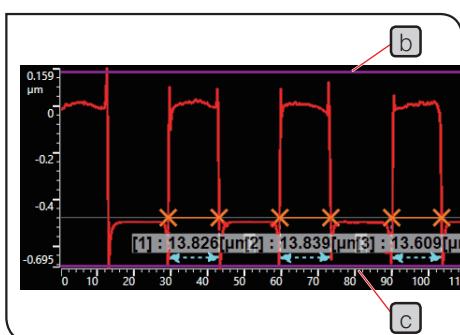
- [Manual]
- [Auto]
- [Shape]



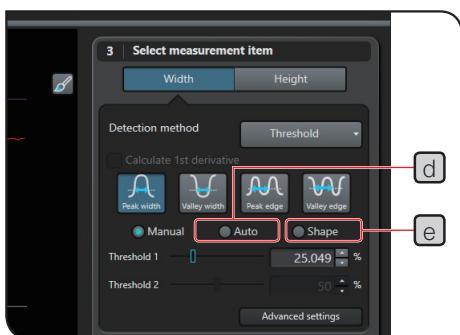
Setting the settable range of the threshold manually

Set the upper limit and the lower limit of the settable range of the threshold.

1. Select [Manual] **a**.



2. Drag the purple line (upper limit) **b** on the profile view area.
3. Drag the purple line (lower limit) **c** on the profile view area.



Setting the settable range of the threshold automatically

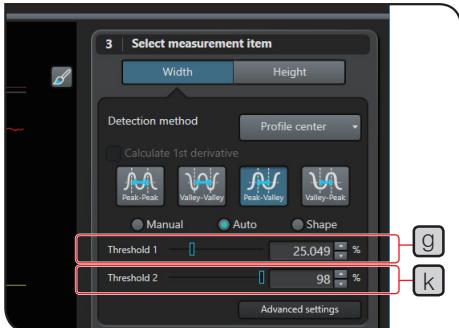
The settable range of the threshold is set automatically so that the upper edge and the lower edge of the profile fit the settable range.

1. Select [Auto] **d**.

Setting the settable range of the threshold from the histogram of the shape

On the histogram obtained from the data on the measurement line or in the caliper frame, the leftmost (minimum value) peak is the lower limit and the highest (high distribution) peak is the upper limit. If both peaks are same, the second highest (high distribution) peak is the upper limit.

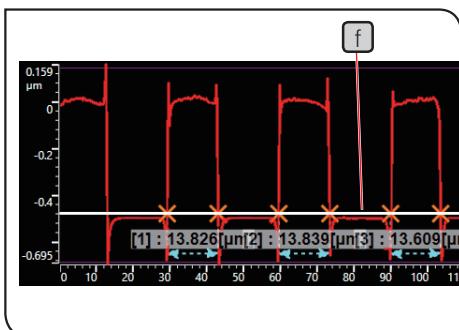
1. Select [Shape] **e**.



5 Set the threshold.

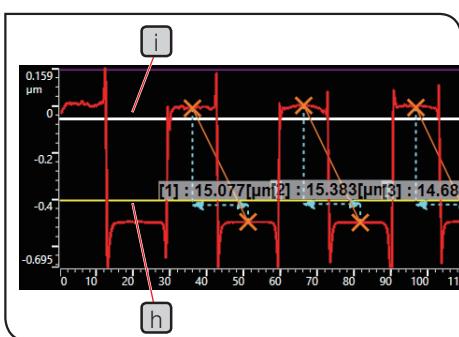
When setting the threshold 1 only

- When [Threshold] is selected for the detection method (Step **1**).
 - When [Profile peak] or [Profile center] is selected for the detection method (Step **1**) and also [Peak width] or [Valley width] is selected for the method to specify the measurement position (Step **3**)
- Set the threshold 1 by dragging the threshold line (white color) **f** or using the [Threshold 1] slider or its setting field **g**.

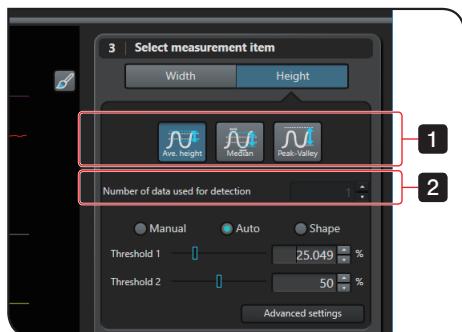


When setting the threshold 1 and the threshold 2

- When [Profile peak] or [Profile center] is selected for the detection method (Step **1**) and also [Peak edge] or [Valley edge] is selected for the method to specify the measurement position (Step **3**)
- Set the threshold 1 by dragging the threshold 1 line (yellow color) **h** or using the [Threshold 1] slider or its setting field **g**.
 - Set the threshold 2 by dragging the threshold 2 line (white color) **i** or using the [Threshold 2] slider or its setting field **k**.



17-3-9 Measuring the height

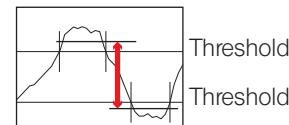


- 1** Select the detection method.

■Ave. height

Suitable for the data containing noises at the flat area of the profile upper and/or lower than the threshold.

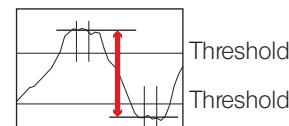
Description: Measures the height difference between the average height of the profile upper than the threshold and the average height of the profile lower than the threshold.



■[Median]

Suitable for the data containing noises at the edge and also the profile upper and/or lower than the threshold is flat. Also suitable for the data containing noises at the part of the area other than the center of the flat area of the profile upper and/or lower than the threshold.

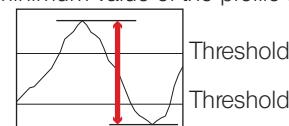
Description: Measures the height difference between the average height near the center of the profile upper than the threshold and the average height near the center of the profile lower than the threshold.



■[Peak - Valley]

Suitable for data of the profile where the maximum value of the profile upper than the threshold and the minimum value of the profile upper than the threshold are clearly identifiable.

Description: Measures the height difference between the maximum value of the profile upper than the threshold and the minimum value of the profile lower than the threshold.

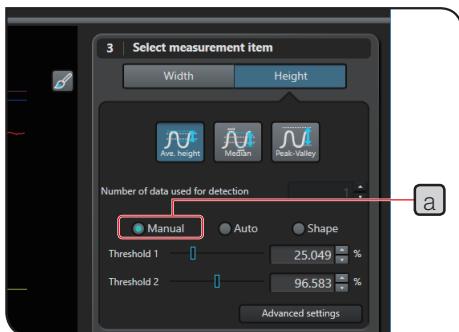


- 2** If [Median] is selected as the detection method, set the number of data used for detecting the height from the center in the [Number of data used for detection] setting field.

- 3** Select the method to set the settable range of the threshold of the profile.

There are three types of setting methods as described below.

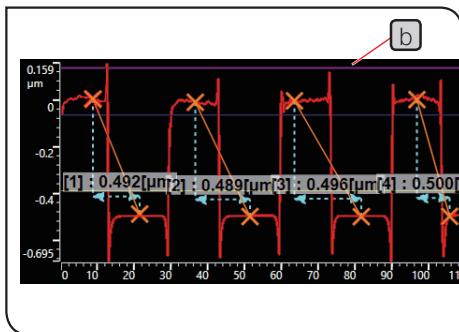
- [Manual]
- [Auto]
- [Shape]



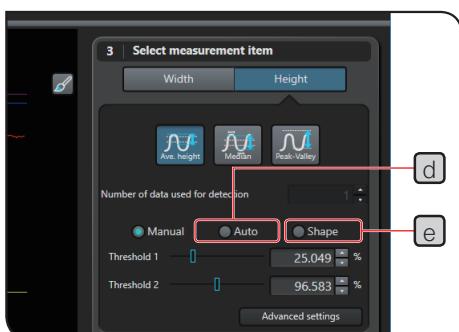
Setting the settable range of the threshold manually

Set the upper limit of the settable range of the threshold.

1. Select [Manual] **a**.



2. Drag the purple line (upper limit) **b** on the profile view area.



Setting the settable range of the threshold automatically

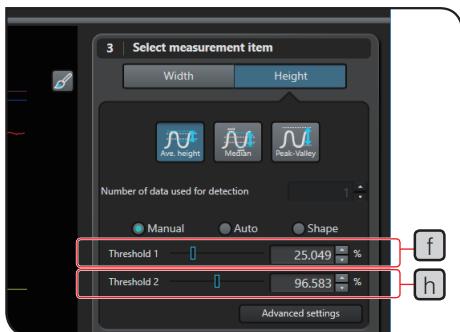
The settable range of the threshold is set automatically so that the upper edge and the lower edge of the profile fit the settable range.

1. Select [Auto] **c**.

Setting the settable range of the threshold from the histogram of the shape

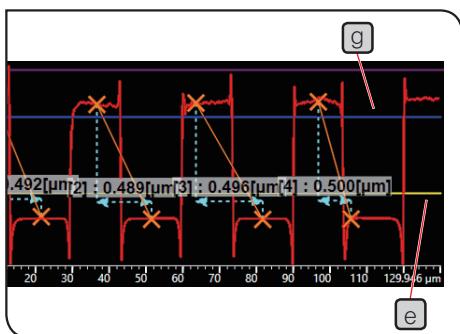
On the histogram obtained from the data on the measurement line or in the caliper frame, the leftmost (minimum value) peak is the lower limit and the highest (high distribution) peak is the upper limit. If both peaks are same, the second highest (high distribution) peak is the upper limit.

1. Select [Shape] **d**.

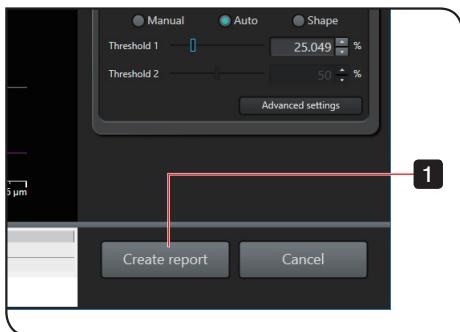


4 Set the threshold.

1. Set the threshold 1 by dragging the threshold 1 line (yellow color) **e** or using the [Threshold 1] slider or in the setting field **f**.
2. Set the threshold 2 by dragging the threshold 2 line (white color) **g** or using the [Threshold 2] slider or in the setting field **h**.



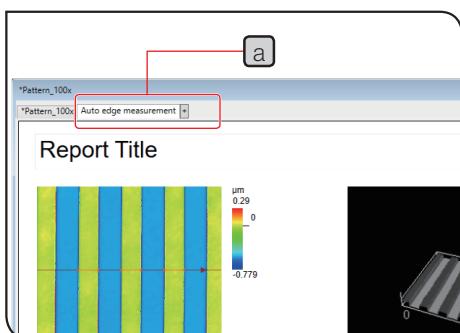
17-3-10 Creating the report



When you finish specifying measurement items, create the report.

- 1** Click the [Create report] button.

17



The [Auto edge measurement] tab **a** is added to the data view window and the report is displayed.

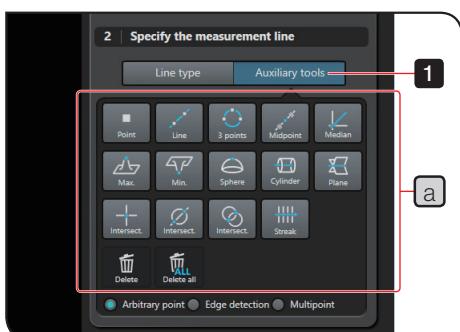
TIP

- You can redo the auto edge measurement by double-clicking on either 2D image data, 3D image data, profile or measurement results on the report.
- For details on redoing the measurement, see "3-3-4 Redoing the measurement analysis" (page 38).

17-4 Measurement line and auxiliary tools

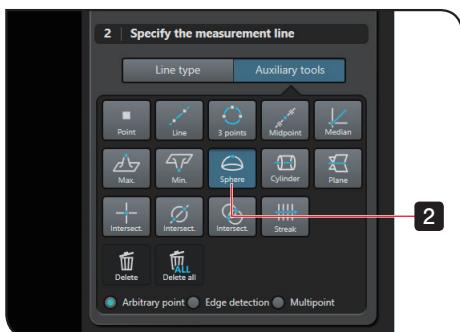
17-4-1 Specifying the measurement line using auxiliary tools

This section describes the procedures to search a sphere center and create a point using auxiliary tools by recognizing the three-dimensional shape in the region specified on the 2D image as a sphere surface, and to specify the measurement line using points created at 2 positions.



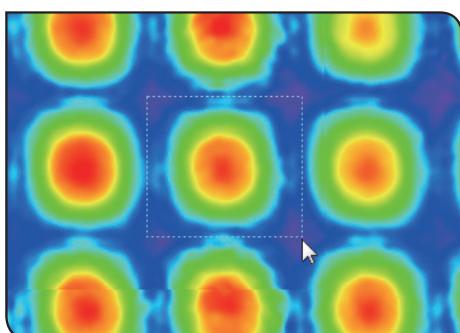
- 1 Click the [Auxiliary tools] button.

The auxiliary tools are displayed on the measurement line setting area a.

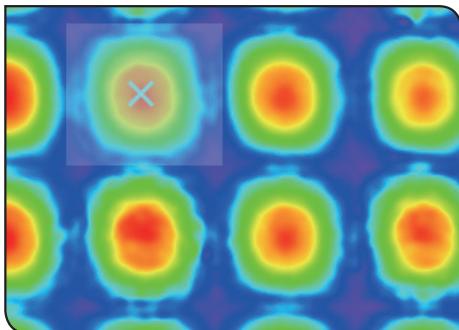


- 2 Click the [Sphere center] button.

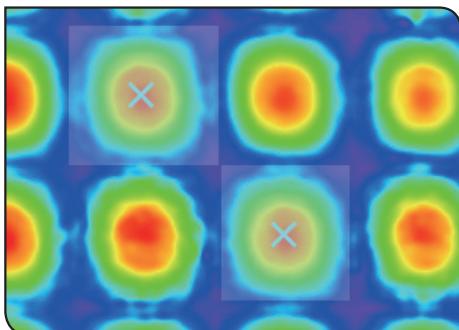
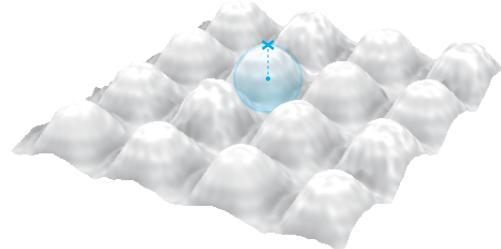
The [Sphere center] button is pressed.



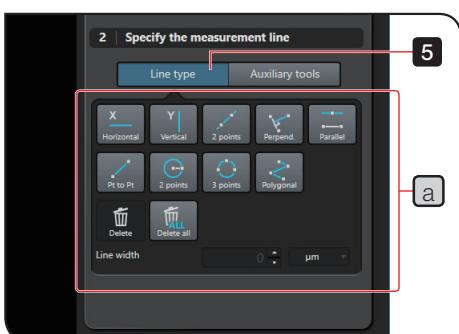
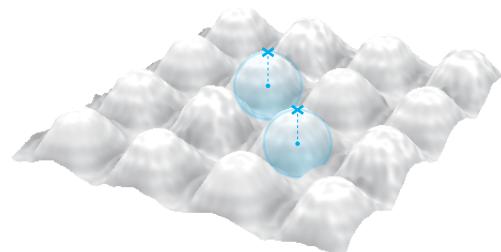
- 3 Drag a position you want to recognize as a sphere surface on the 2D image view area.



The specified region is recognized as a sphere surface, and a “specified point” with a cross line is created at the sphere center position.

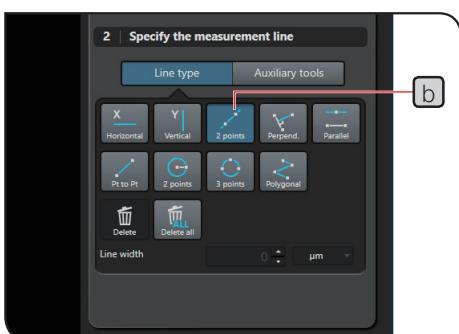


4 Repeat step **3** to specify the second specified point.



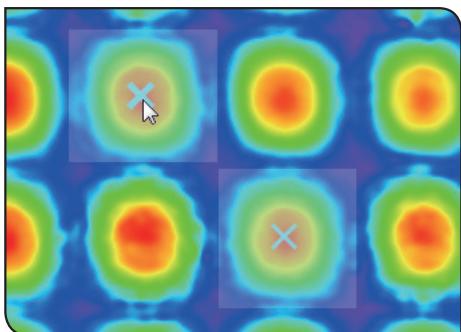
5 Click the [Line type] button.

The line types are displayed on the measurement line setting area **a**.

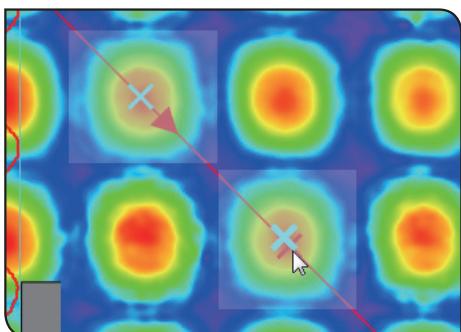


6 Click the [2 points line] button **b**.

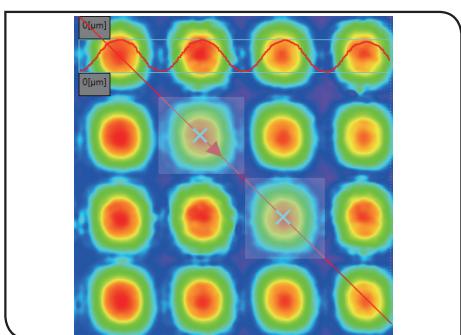
The [2 points line] button is pressed.



- 7 On the 2D image view area, move the mouse pointer closer to the first specified point and click the position where the specified point is highlighted.



- 8 Move the mouse pointer closer to the second specified point and click the position where the specified point is highlighted.



The measurement line passing through two specified points is created.

17-4-2 Measurement line types used in the auto edge measurement



■[Horizontal]

Draws a horizontal line passing through a single point.



■[2 points line]

Draws a line passing through two points.



■[Parallel line]

Draws a line that is parallel to the line passing through two points and that also passes through a third point.



■[2 points circle]

Draws a circle with a first point as a center of circle and with a second point as a circumference.



■[Multipoint]

Draws a polygonal line with a first point as a start point and with points after a second point as vertexes.



TIP For details on the measurement line, see "Measurement line types" (page 411).



■[Vertical]

Draws a vertical line passing through a single point.



■[Perpendicular line]

Draws a line that is perpendicular to the line passing through two points and that also passes through a third point.



■[Point to point]

Draws a line that connects a start point and an end point.



■[3 points circle]

Draws a circle with three points as a circumference.

17-4-3 Auxiliary tool types used in the auto edge measurement



■[Point]

Draws a point.



■[3 points circle]

Draws a circle with three points as a circumference.



■[Median line]

Draws a median line of two lines.



■[Minimum height]

Draws the lowest position in Z-axis direction in the region as a point.



■[Cylinder axis]

Recognizing the three-dimensional shape in the region as a side surface of the cylinder, draws a center axis as a line.



■[Intersection line to line]

Draws a point at the intersection of two lines.



■[Intersection circle to circle]

Draws a point at the intersection of two circles.



■[Line]

Draws a line passing through two points.



■[Midpoint]

Draws a midpoint of two points.



■[Maximum height]

Draws the highest position in Z-axis direction in the region as a point.



■[Sphere center]

Recognizing the three-dimensional shape in the region as a sphere, draws a point at the center position of the sphere.



■[Surface intersection line]

Recognizing the three-dimensional shape in the region as a plane, draws its cross line.



■[Intersection circle to line]

Draws a point at the intersection of circle and line.



■[Streak]

Draw a line orthogonal to the texture of the sample surface in the region.

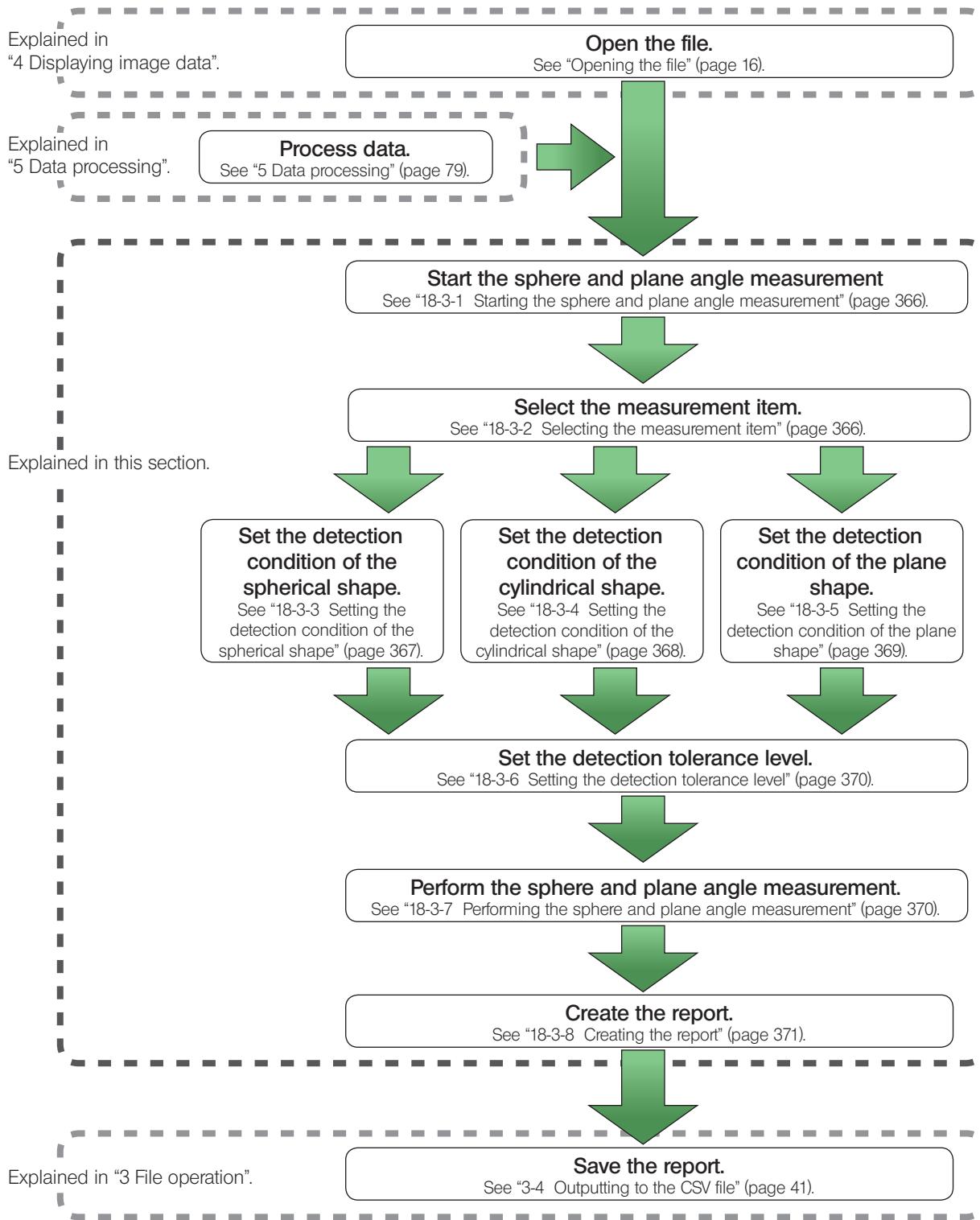


TIP For details on auxiliary tools, see "Auxiliary tool types" (page 416).

18 Sphere and plane angle measurement

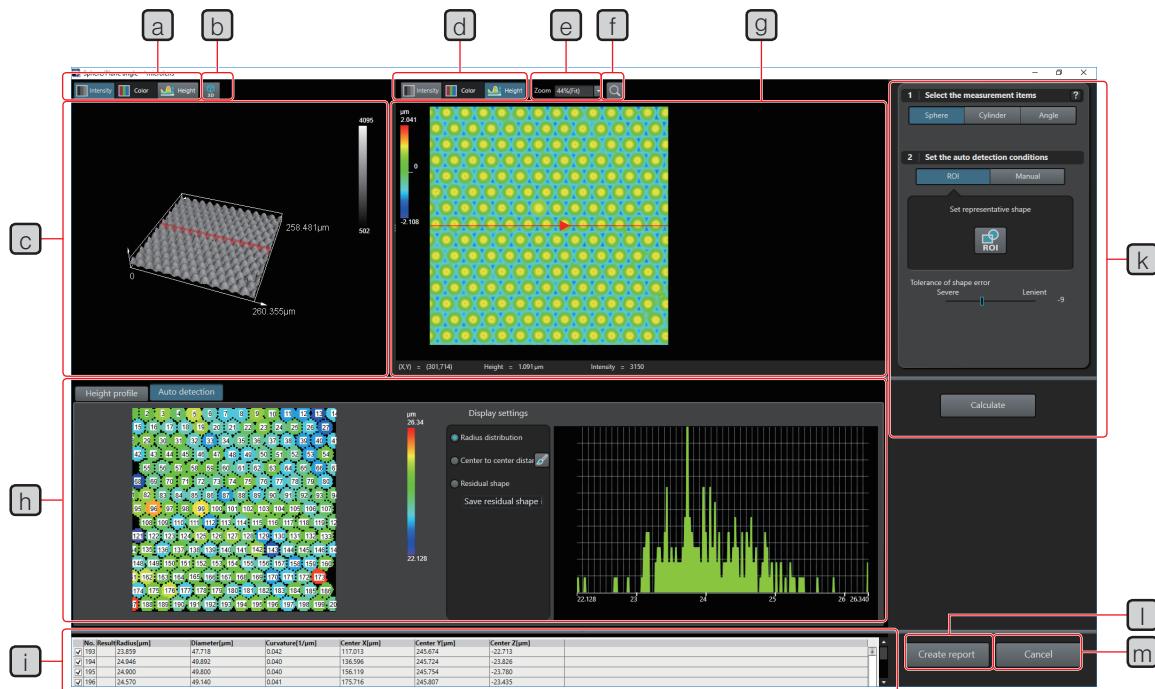
You can measure the radius, residual error and plane angle of the sample that has a repetitive shape, e.g. microlens array, etc.

18-1 Flow of the sphere and plane angle measurement



Explained in "3 File operation".

18-2 Screens used in the sphere and plane angle measurement



[a] 3D image data selection button

Selects either the laser intensity image, the color image or the height image on the 3D image view area.

[b] Advanced setting button for 3D image

Displays the screen to define advanced settings for displaying the 3D image. For details on the screen, see "4-2-1 Screens used with the 3D view" (page 51).

[c] 3D image view area

Displays the 3D image.

Dragging the image allows you to change the angle to display the image.

Rotating the mouse wheel on the image zooms in or out the image.

Dragging the image while holding down the right button of the mouse allows you to move the view position.

[d] 2D image data selection button

Selects either the laser intensity image, the color image or the height image on the 2D image view area.

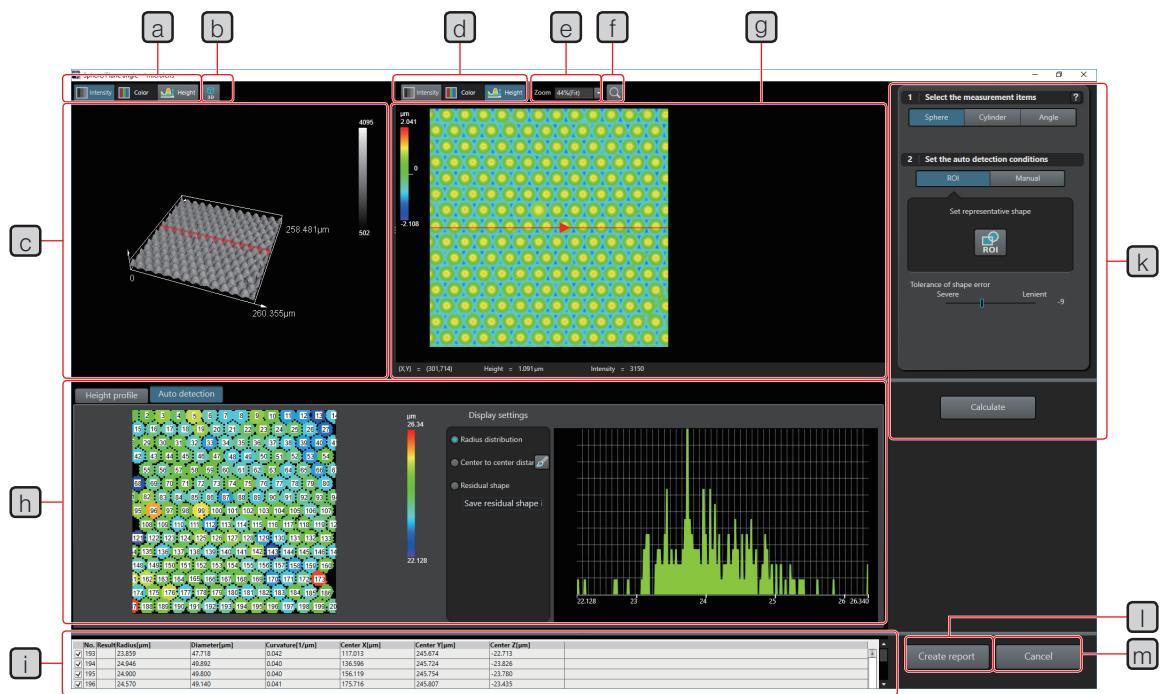
[e] Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

[f] Loupe button

Zooms in the mouse pointer position on the 2D image view area.

([g] to [m] are described on the next page.)



(a) to (f) are described on the previous page.)

[g] 2D image view area

Displays the 2D image and the measurement line. Rotating the mouse wheel on the image zooms in or out the image. You can change the color of the measurement line and auxiliary tools. Use the measurement line color button (g) to display the color pallet. The information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area is displayed on the status bar.

[h] Sphere and plane angle measurement information view area

Displays the profile and measurement results of automatically detected sphere, cylinder and plane. Rotating the mouse wheel on the profile zooms in or out the profile.

[i] Measurement results view area

Displays measurement results obtained from the measurement region, minimum value, maximum value, etc.

[k] Sphere and plane angle measurement setting area

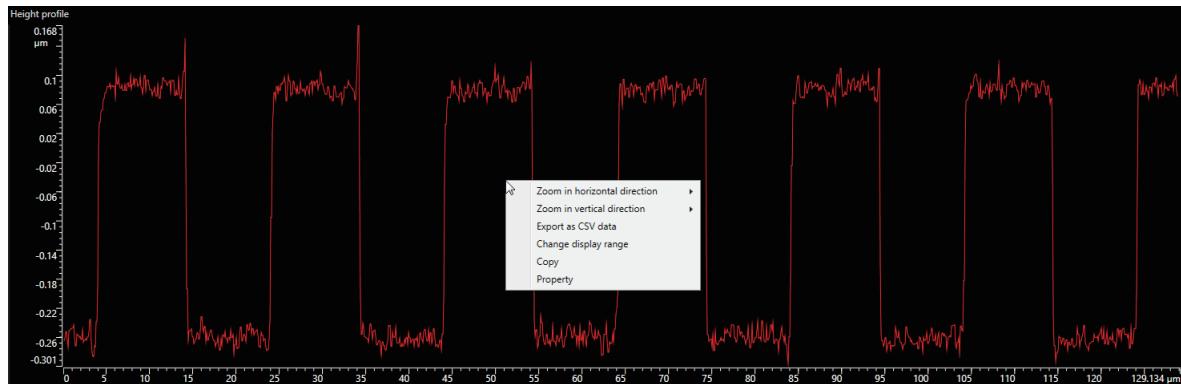
Set the shape (sphere, cylinder, plane angle) or the region you want to measure.

[l] [Create report] button

Creates the report based on measurement results obtained from the measurement region, minimum value, maximum value, etc.

[m] [Cancel] button

Cancels the sphere and plane angle measurement.

Profile

You can define following settings on the profile. Right-click on the profile to display the menu, and select the menu you desire.

- **[Zoom in horizontal direction]**

Sets the horizontal magnification of the profile.

- **[Zoom in vertical direction]**

Sets the vertical magnification of the profile.

- **[Export as CSV data]**

Outputs the profile in CSV file format.

- **[Change display range]**

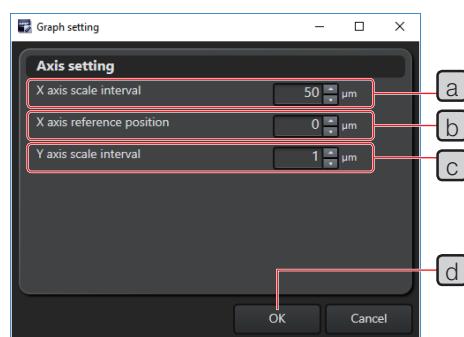
Sets the display range of the image and the profile. For setting the display range, see “4-4 Setting the display range” (page 60).

- **[Copy]**

Copies the profile as an image.

- **[Property]**

Sets the format of the profile. For setting the format, see “Setting the format of the profile” (page 365).

Setting the format of the profile

a [X-axis scale interval]

Sets the scale interval on the X-axis.

b [X-axis reference position]

Sets the value you want to use as a “0” position on the X-axis.

c [Y-axis scale interval]

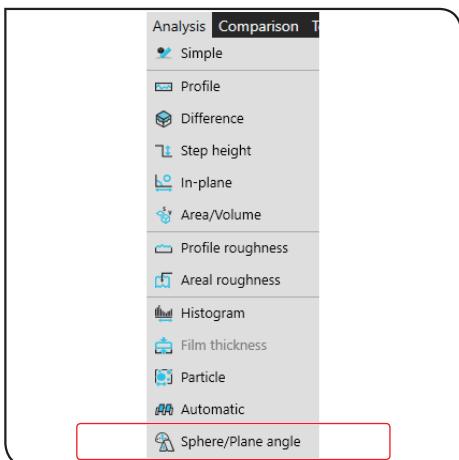
Sets the scale interval on the Y-axis.

d [OK] button

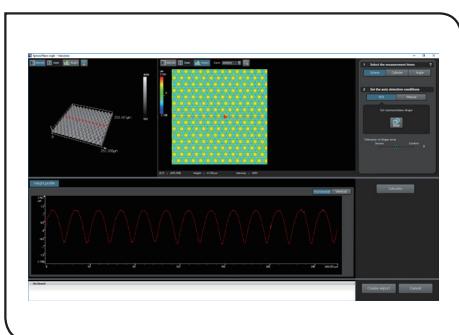
Changes the settings and closes the [Graph setting] screen.

18-3 Operating procedures of the sphere and plane angle measurement

18-3-1 Starting the sphere and plane angle measurement

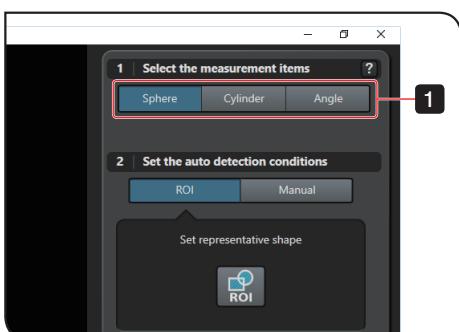


- 1 Select [Sphere/Plane angle] from the [Analysis] menu.



The [Sphere/Plane angle] screen appears.

18-3-2 Selecting the measurement item



- 1 Select a measurement item either from [Sphere], [Cylinder] or [Plane angle].

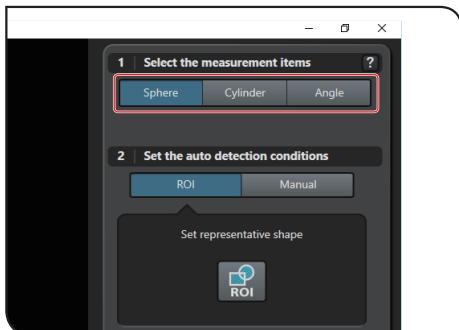
[Sphere]: Detects the spherical shape in the image and measures the radius distribution, distance between centers and height difference.

[Cylinder]: Detects the cylinder shape in the image and measures the radius distribution, center axis of cylinder and curvature.

[Plane angle]: Detects the plane in the image and measures the angle of intersection of adjacent two planes.

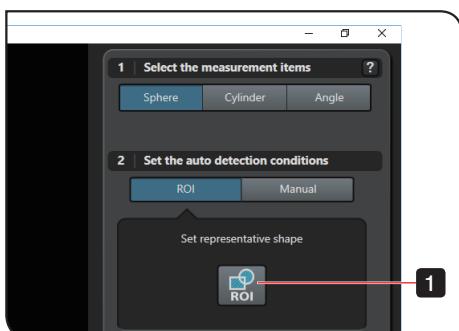
- TIP**
- If you select [Sphere], go to the next section "18-3-3 Setting the detection condition of the spherical shape" (page 367).
 - If you select [Cylinder], go to the section "18-3-4 Setting the detection condition of the cylindrical shape" (page 368).
 - If you select [Plane angle], go to the section "18-3-5 Setting the detection condition of the plane shape" (page 369).

18-3-3 Setting the detection condition of the spherical shape



If you select [Shape] for the measurement item, set the detection condition of the spherical shape according to procedures described in this section.

TIP For selecting the measurement item, see the previous section “18-3-2 Selecting the measurement item” (page 366).



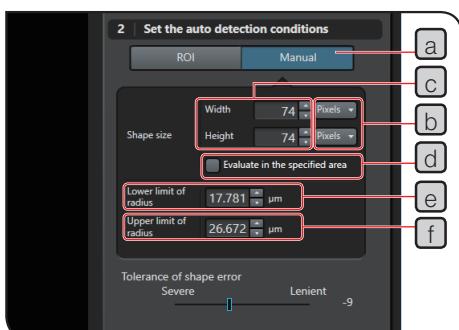
Creating a region on the typical spherical shape you want to detect on the 2D image:

1 Click the [ROI] button.

The [Set the region] screen appears.

2 Add a single ROI to the typical spherical shape.

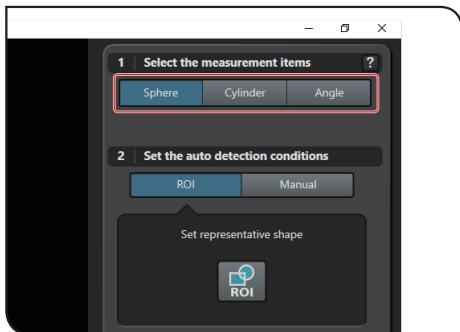
TIP For adding the ROI, see “Adding the ROI” (page 399).



TIP If you want to reproduce the same detection condition every time or if the spherical shape is not detected even though the ROI is added, set the detection condition manually.

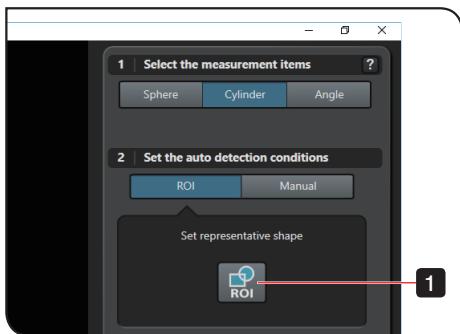
1. Click the [Manual] button **a**.
2. Select the method to specify the size of spherical shape you want to detect from [μm] or [Pixel] **b**.
3. Specify the size of spherical shape you want to detect either by length or pixel in [Width] and [Height] setting fields **c**.
4. If you evaluate the spherical shape component only for the specified region, check the [Evaluate in the specified area] checkbox **d**.
5. Set the minimum radius of spherical shape you want to detect in the [Lower limit of radius] setting field **e**.
6. Set the maximum radius of spherical shape you want to detect in the [Upper limit of radius] setting field **f**.

18-3-4 Setting the detection condition of the cylindrical shape



If you select [Cylinder] for the measurement item, set the detection condition of the cylindrical shape according to procedures described in this section.

TIP For selecting the measurement item, see “18-3-2 Selecting the measurement item” (page 366).



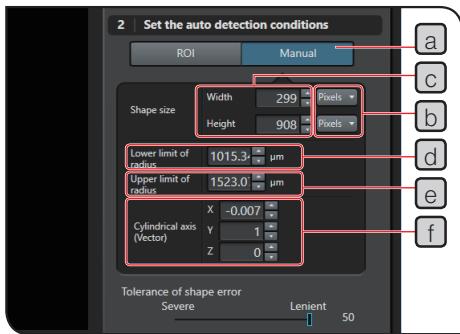
Creating a region on the typical cylindrical shape you want to detect on the 2D image:

- 1 Click the [ROI] button.

The [Set the region] screen appears.

- 2 Add a single ROI to the typical cylindrical shape.

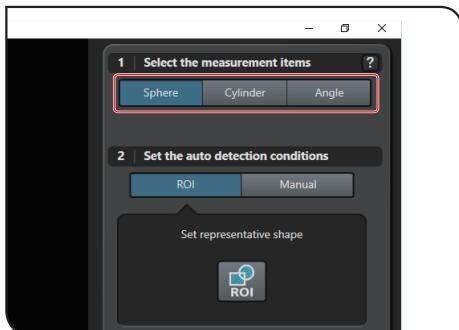
TIP For adding the ROI, see “Adding the ROI” (page 399).



TIP If you want to reproduce the same detection condition every time or if the cylindrical shape is not detected even though the ROI is added, set the detection condition manually.

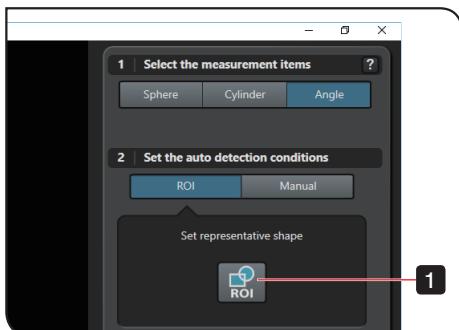
1. Click the [Manual] button **a**.
2. Select the method to specify the size of cylindrical shape you want to detect from [μm] or [Pixel] **b**.
3. Specify the size of cylindrical shape you want to detect either by length or pixel in [Width] and [Height] setting fields **c**.
4. Set the minimum radius of cylindrical shape you want to detect in the [Lower limit of radius] setting field **d**.
5. Set the maximum radius of cylindrical shape you want to detect in the [Upper limit of radius] setting field **e**.
6. Set the vector of the cylindrical axis in X, Y or Z direction you want to detect in the [X], [Y] or [Z] setting field **f**.

18-3-5 Setting the detection condition of the plane shape



If you select [Plane angle] for the measurement item, set the detection condition of the plane shape according to procedures described in this section.

TIP For selecting the measurement item, see “18-3-2 Selecting the measurement item” (page 366).



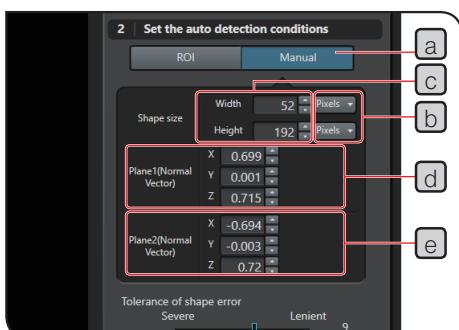
Creating a region on the typical plane shape you want to detect on the 2D image:

- 1 Click the [ROI] button.

The [Set the region] screen appears.

- 2 Add a single ROI to the typical plane shape.

TIP For adding the ROI, see “Adding the ROI” (page 399).

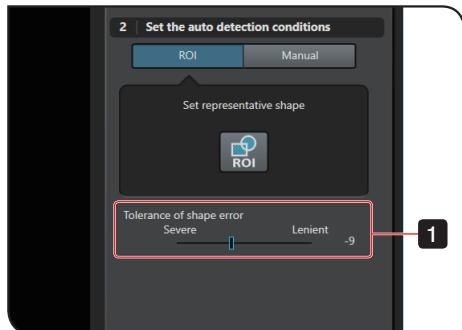


TIP If you want to reproduce the same detection condition every time or if the plane shape is not detected even though the ROI is added, set the detection condition manually.

1. Click the [Manual] button **a**.
2. Select the method to specify the size of plane shape you want to detect from [µm] or [Pixel] **b**.
3. Specify the size of plane shape you want to detect either by length or pixel in [Width] and [Height] setting fields **c**.
4. Set the vector of the plane 1 in X, Y or Z direction you want to detect in the [X], [Y] or [Z] setting field **d**.
5. Set the vector of the plane 2 in X, Y or Z direction you want to detect in the [X], [Y] or [Z] setting field **e**.

18-3-6 Setting the detection tolerance level

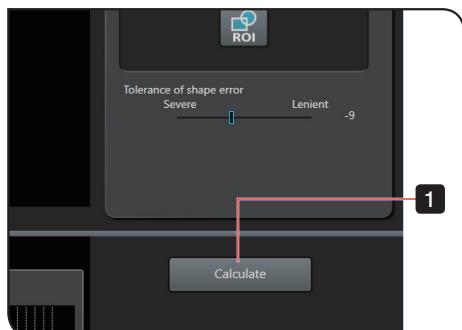
You can set the tolerance level of shape error.



1 Adjust the tolerance level using the [Tolerance of shape error] slider.

TIP The more you move the slider to the left, the smaller the tolerance level of shape error becomes.

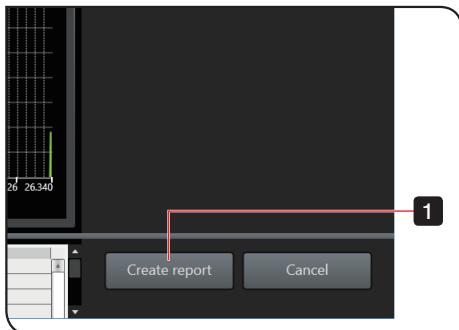
18-3-7 Performing the sphere and plane angle measurement



1 Click the [Calculate] button.

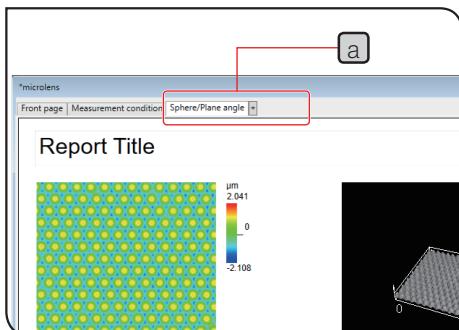
The measurement results of the automatically detected sphere, cylinder and plane are displayed at the bottom of the [Sphere/Plane angle] screen.

18-3-8 Creating the report



After performing the sphere and plane angle measurement, create the report.

- 1 Click the [Create report] button.



The [Sphere/Plane angle] tab **a** is added to the data view window and the report is displayed.

TIP

- You can redo the sphere and plane angle measurement by double-clicking on either 2D image data, 3D image data, histogram or measurement results on the report.
- For details on redoing the measurement, see “3-3-4 Redoing the measurement analysis” (page 38).

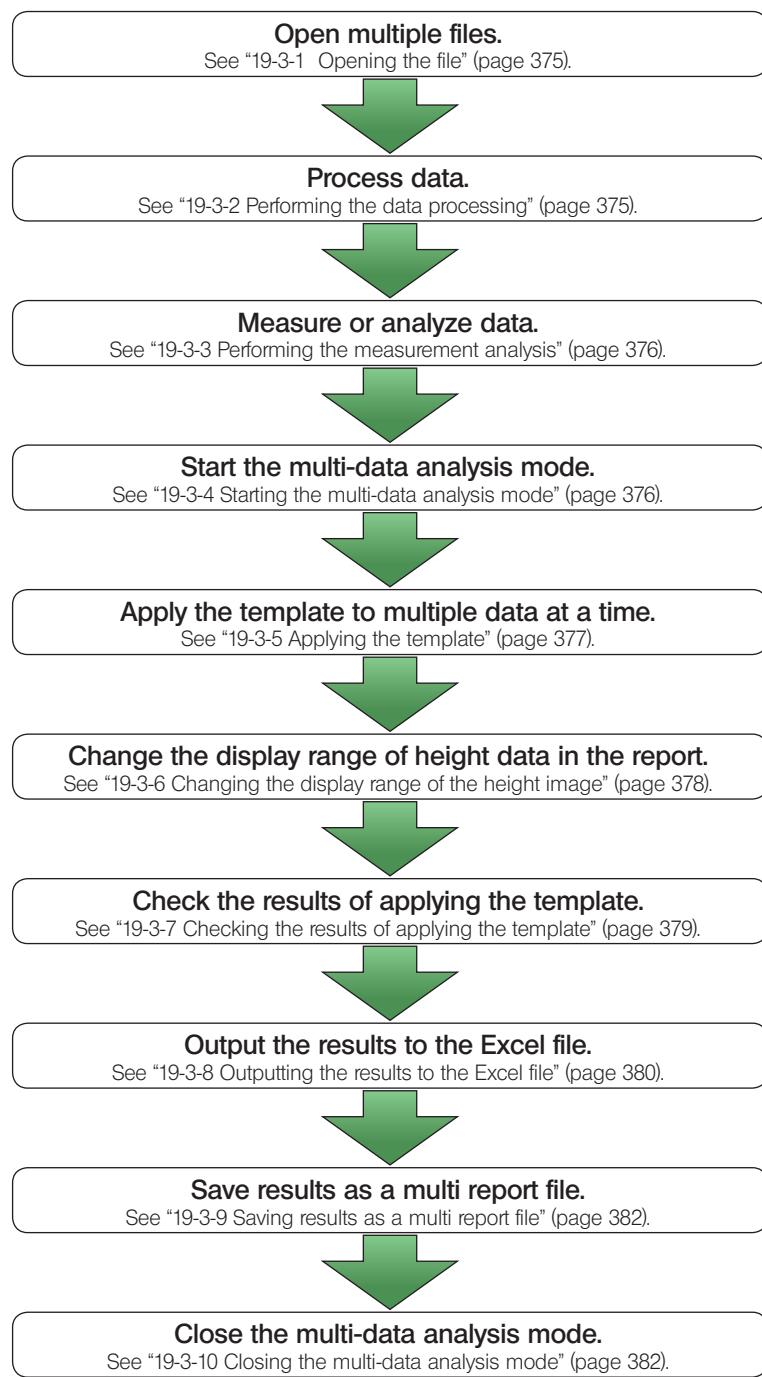
19 Multi-data analysis

With multi-data analysis, the following functions are available.

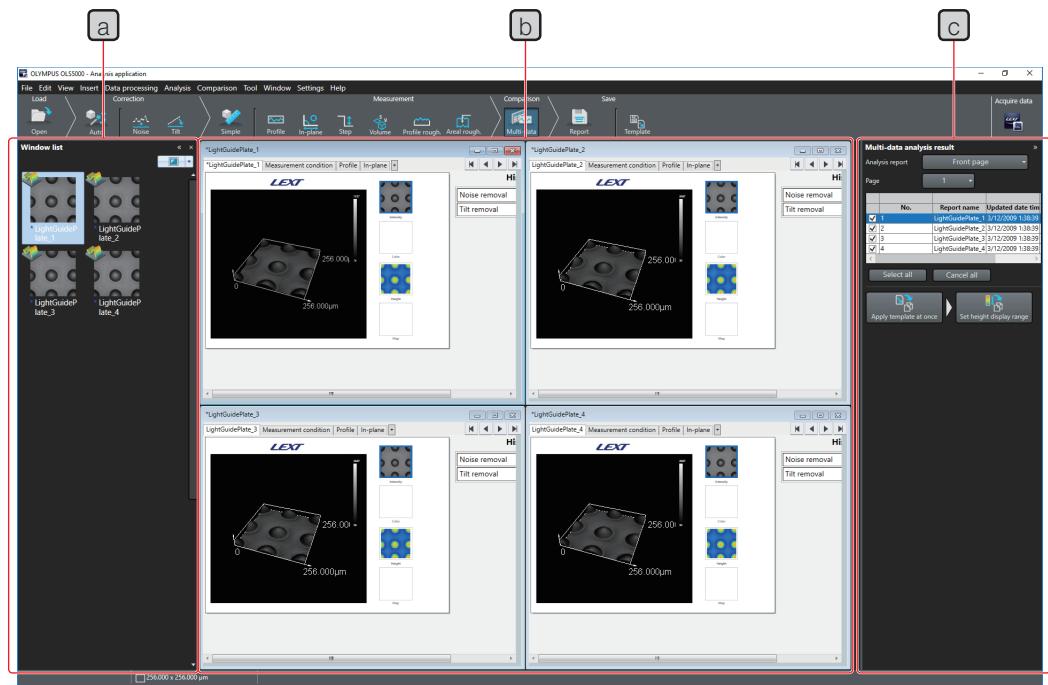
- Function that applies the template (contents of data processing or measurement analysis) to multiple data currently opened at a time.
- Function that compares measurement results among reports on the analysis application.
- Function that places images or measurement analysis results in multiple reports side by side, and outputs to the Excel file.
- Function that saves multiple reports as a single report file (multi report file).

TIP Microsoft Excel should have been installed on the controller or the PC in advance.

19-1 Flow of the multi-data analysis



19-2 Screen used in the multi-data analysis



a Window list view area

Displays the list of files currently opened in thumbnail.

Clicking the thumbnail displays the data view window of the clicked file on the front.

The file selected in the file list in the result view area for comparison **c** is also selected in the window list view area.

b Data view window view area

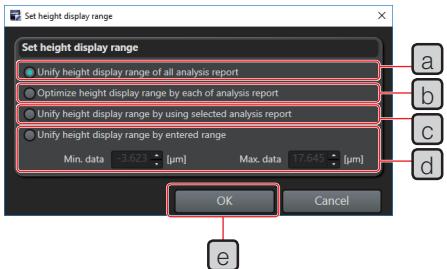
Displays the four data view windows currently opened side by side.

c Result view area for comparison

Displays measurement results obtained from the multiple files side by side.

You can change data items or report pages, or set the display range of height data (see page 374).

[Set height display range] screen



[a] [Unify height display range of all analysis report]

Detects the maximum value and the minimum value of height data in all reports, and sets the height display range of all reports using these maximum value and minimum value.

[b] [Optimize height display range by each of analysis report]

Sets the display range suitable for height data by each report.

[c] [Unify height display range by using selected analysis report]

Sets the current height display range of the selected report as the display range of all reports.

[d] [Unify height display range by entered range]

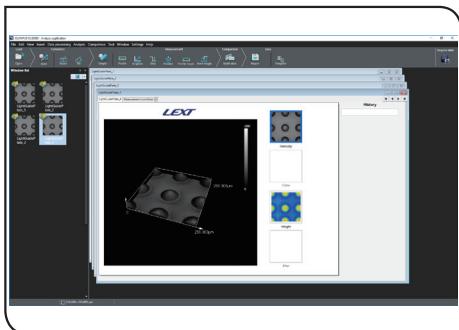
Sets the range specified by [Min. height] and [Max. height] as the height display range of all reports.

[e] [OK] button

Changes the settings and closes the [Set height display range] screen.

19-3 Operating procedures of the multi-data analysis

19-3-1 Opening the file



Open multiple files you want to perform the multi-data analysis.
For details, see “Opening the file” (page 16).

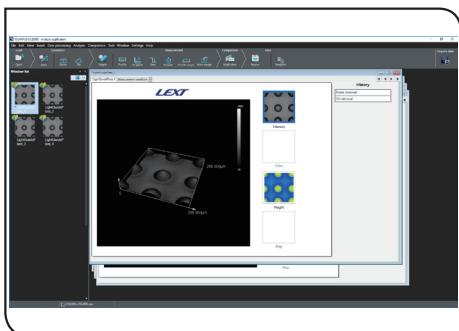
TIP Open the file in POIR, MPOIR, LEXT, REP or MREP format.

Point If the auto transfer function is enabled on the data acquisition application, data is transferred to the analysis application and displayed automatically when you acquire data.

If you open the multi report file (MREP format), all the image data included in the multi report file is displayed.

TIP If you open multiple multi report files, the multi report opened later is added to the multi report opened first.

19-3-2 Performing the data processing



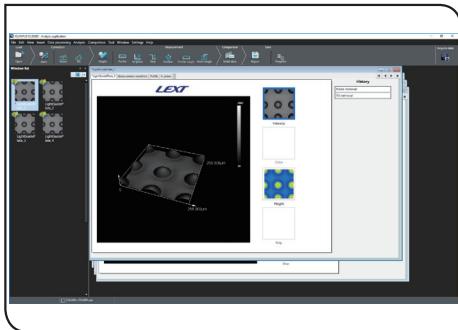
Perform the data processing to a single image data in the file currently opened.

For details, see “5 Data processing” (page 79).

1 Display image data you want to perform the data processing on the front before performing the data processing.

The picture on the left is an example showing that the noise removal and the tilt removal are applied to data opened first.

19-3-3 Performing the measurement analysis



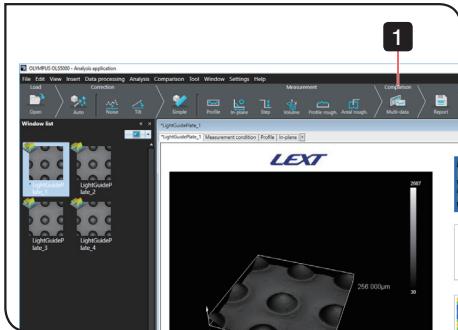
Perform the measurement analysis with single image data in the file currently opened.

For details, see “6 Simple measurement” (page 116) to “18 Sphere and plane angle measurement” (page 362).

- 1 Display image data you performed the data processing on the front before performing the measurement analysis.

The picture on the left is an example showing that the profile measurement and the in-plane measurement are applied to data you opened first.

19-3-4 Starting the multi-data analysis mode

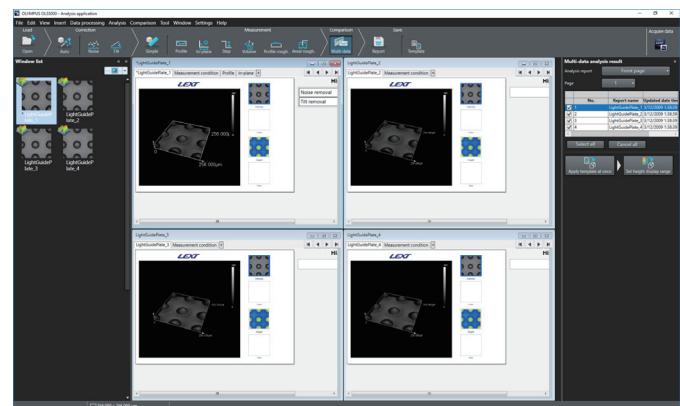


When you finish the data processing and the measurement analysis of the single file, start the multi-data analysis mode.

- 1 Click the [Multi-data] button of the shortcut bar.

The data view windows currently opened are displayed side by side, and the result view area for comparison is displayed on the right side of the screen.

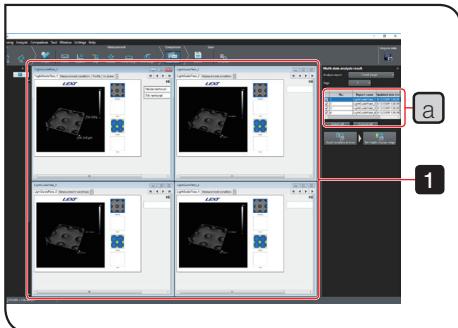
The multi-data analysis mode starts.



TIP

To change the number of display divisions of data view windows, select [Display in division] in the [Window] menu and select the number of divisions.

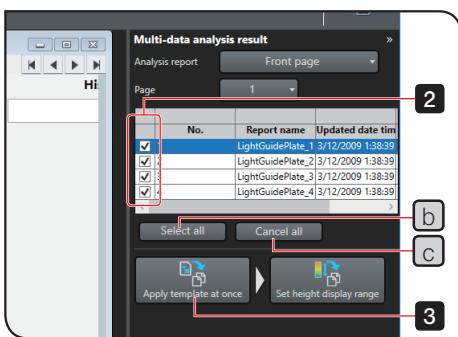
19-3-5 Applying the template



You can apply the contents (template) of data processing and the measurement analysis you performed to a single file to other files.

- Select the file (template) where the data processing and measurement analysis were performed from the data view window.

TIP You can also select the file from the data list [a].



- Check the checkbox of the file you want to apply the template.

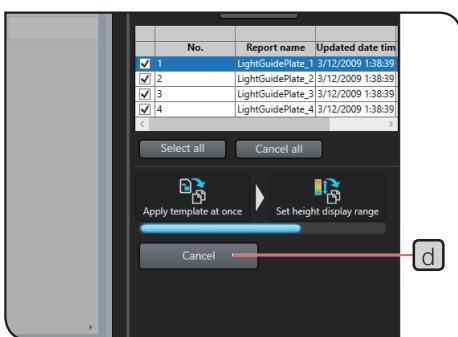
TIP Click the [Select all] button [b] if you want to check checkboxes of all files, and click the [Cancel all] button [c] if you want to uncheck checkboxes of all files.

- Click the [Apply template at once] button.

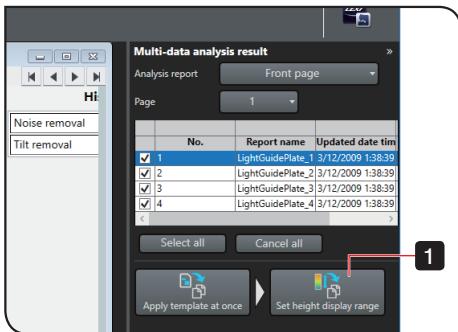
The template is applied to the file whose checkbox is checked.

- TIP**
- While the template is being applied, the progress bar and the [Cancel] button [d] is displayed.
 - To cancel applying the template, click the [Cancel] button.
 - The data where the template is applied before clicking the [Cancel] button is recognized as the data where the template is applied.
 - The tabs included in the file where the template is applied will be deleted.
 - Once the template is applied to the file, this operation cannot be undone.

The measurement analysis results in the file where the template is applied are displayed on the data list.



19-3-6 Changing the display range of the height image

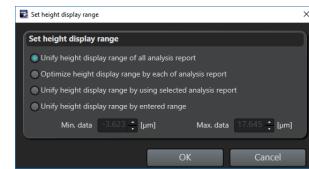


You can set the range to assign (display range) the upper limit and the lower limit of the color table among actual data of the height image in 2D and 3D displayed in the report.

Adjusting the display range allows you to display the image by emphasizing the height difference.

- 1 Click the [Set height display range] button.

The [Set height display range] screen appears.



- 2 Select the display range setting method.

[Unify height display range of all analysis report]

Detects the maximum value and the minimum value of height data in all reports, and sets the height display range of all reports using these maximum value and minimum value.

[Optimize height display range by each of analysis report]

Sets the display range suitable for height data by each report.

[Unify height display range by using selected analysis report]

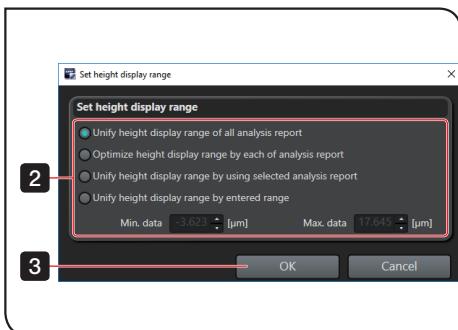
Sets the current height display range of the selected report as the display range of all reports.

[Unify height display range by entered range]

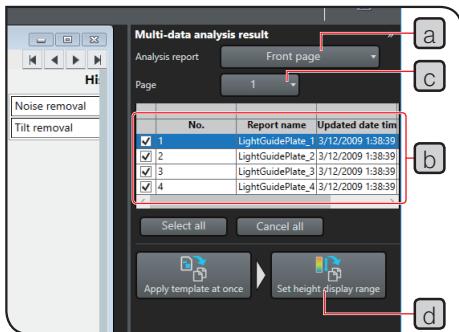
Sets the range specified by [Min. height] and [Max. height] as the height display range of all reports.

- 3 Click the [OK] button.

The display range of the height image is set.



19-3-7 Checking the results of applying the template



You can check the results of the data processing and the measurement analysis applied to other files.

Selecting the result you want to compare

Select the tab of the item you want to compare from the tab dropdown list [a].

The contents to be displayed on the data list [b] changes according to the selected item.

Example) If you want to compare measurement results of the profile measurement, select [Profile] from the tab dropdown list.

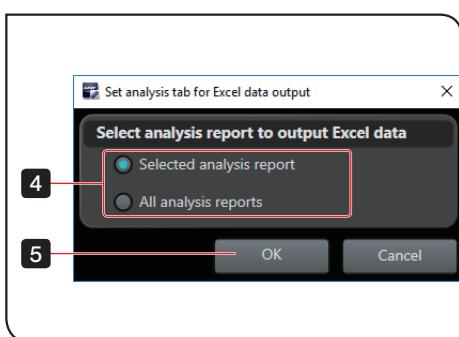
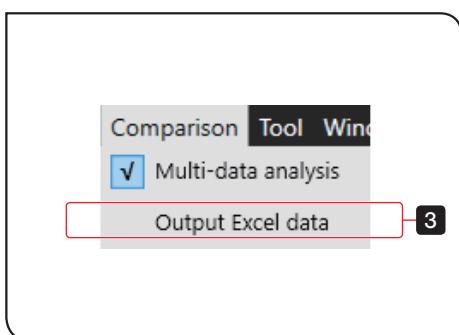
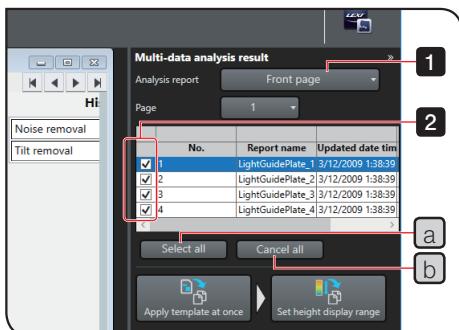
TIP The tab (other than measurement analysis) added by the user is not displayed on the list.

Selecting the report page

Select the page number of the report you want to compare from the page dropdown list [c].

Example) If you want to compare the items on page 2 of the areal roughness measurement report, select [2] from the tab dropdown list.

19-3-8 Outputting the results to the Excel file



You can output the analysis results of multiple files obtained from the multi-data analysis to a Microsoft Excel file (xlsx file format).

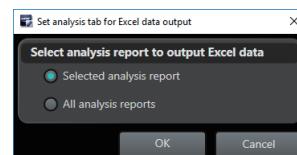
TIP If you want to save the Excel file individually, select [Output Excel data] from the [File] menu.

- 1 If you want to output only one type of analysis results, select the tab name you want to output from the tab dropdown list.
- 2 If you want to output only the selected file to the Excel file, check the checkbox of the file you want to output.

TIP Click the [Select all] button **a** if you want to check checkboxes of all files, and click the [Cancel all] button **b** if you want to uncheck checkboxes of all files.

- 3 Select [Output Excel data] from the [Comparison] menu.

The [Set analysis tab for Excel data output] screen appears.



- 4 Select the range of the report you want to output.

[Selected analysis report]

The analysis results of only the tab selected in Step 1 are outputted to the Excel file.

[All analysis reports]

The analysis results of all tabs are outputted to the Excel file.

- 5 Click the [OK] button.

The [Save as] screen appears.

- 6 Input the save location and the file name, and click the [Save] button.

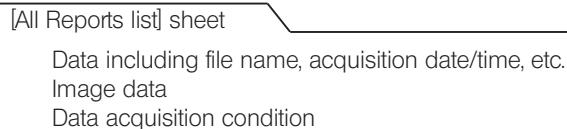
The Microsoft Excel file is saved.

TIP

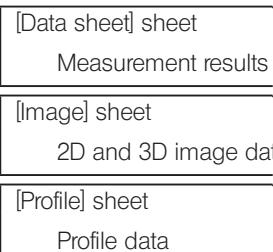
- The tab (other than measurement analysis) added by the user or objects (text, image, graphics, etc.) are not outputted.
- The Excel file is created for each tab.

Example) Configuration of the Excel file when all tabs of the file where the profile measurement and the in-plane measurement were performed are outputted

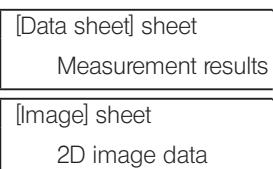
Excel file (Cover tab)



Excel file (Profile measurement tab)



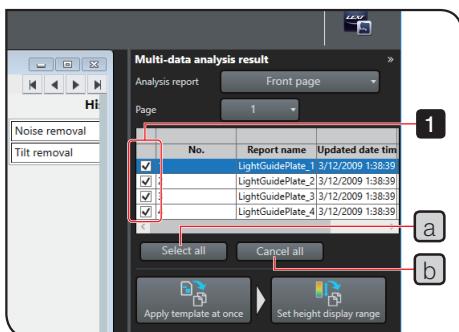
Excel file (In-plane measurement tab)



19-3-9 Saving results as a multi report file

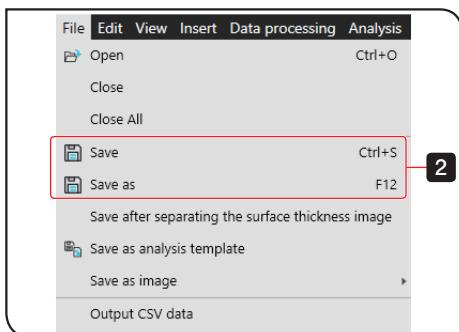
You can save the analysis results of multiple files obtained from the multi-data analysis as a single multi report file (MREP file format). You can also manage the compared data in a single file.

- TIP**
- The file format you can save is the multi report file (MREP file format) only.
 - If you want to save the report file (REP file format) individually, close the multi-data analysis mode before saving the report file.



- 1** Check the checkbox of the file you want to output to the Excel file.

TIP Click the [Select all] button **a** if you want to check checkboxes of all files, and click the [Cancel all] button **b** if you want to uncheck checkboxes of all files.



- 2** Select [Save] or [Save as] from the [File] menu.

If you select [Save as], the [Save as] screen appears.

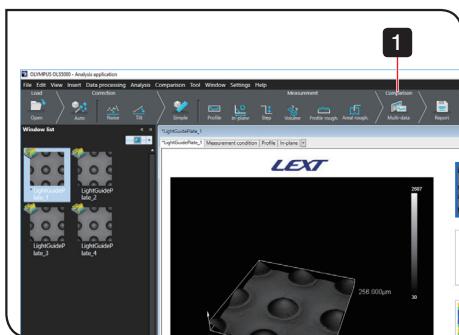
- 3** Select the file save destination.

- 4** Input the file name in the [File name].

- 5** Click the [Save] button.

The file is overwritten or saved with other name.

19-3-10 Closing the multi-data analysis mode



When you finish comparing the results of multiple files, close the multi-data analysis mode.

- 1** Click the [Multi-data] button of the shortcut bar.

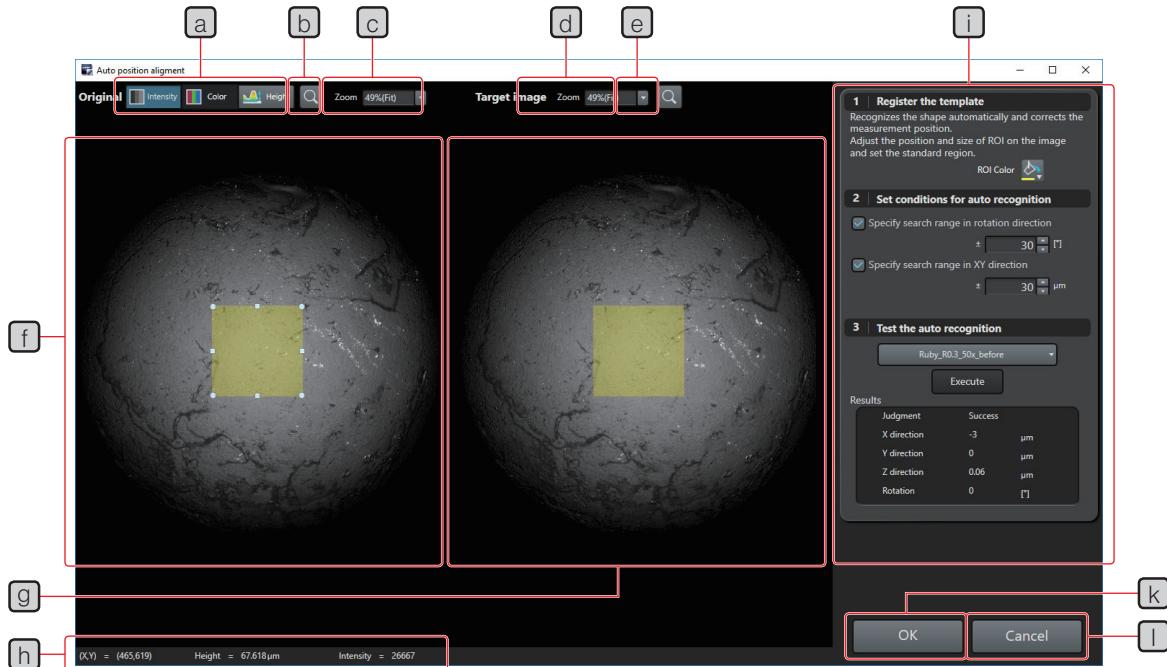
The result view area for comparison on the right side of the screen is hidden, and the multi-data analysis mode is closed.

20 Tool menu

20-1 Automatic centering

You can adjust the image so that the position on the image you want to measure and analyze comes to the center.

20-1-1 Screens used in the automatic centering



[a] 2D image data selection button

Selects either the laser intensity image, the color image or the height image on the 2D image view area (reference image).

[b] Loupe button

Zooms in the mouse pointer position on the 2D image view area (reference image).

[c] Magnification dropdown list

Select the magnification to display the image on the 2D image view area (reference image). Or input the numerical value.

[d] Magnification dropdown list

Select the magnification to display the image on the 2D image view area (target image). Or input the numerical value.

[e] Loupe button

Zooms in the mouse pointer position on the 2D image view area (target image).

[f] 2D image view area (reference image)

Displays the 2D image that will be a reference for the automatic centering and the ROI.

Rotating the mouse wheel on the image zooms in or out the image.

[g] 2D image view area (target image)

Displays the 2D image that will be a target of the automatic centering. Performing the automatic centering allows you to preview the corrected 2D image.

Rotating the mouse wheel on the image zooms in or out the image.

[h] Status bar

Displays information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area.

[i] Automatic centering setting area

Define settings of the automatic centering. The results of the automatic centering are also displayed.

[k] [OK] button

Performs the automatic centering.

[l] [Cancel] button

Cancels the automatic centering.

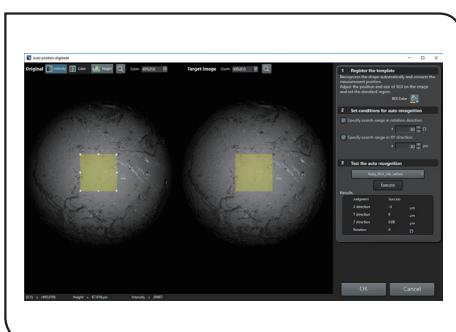
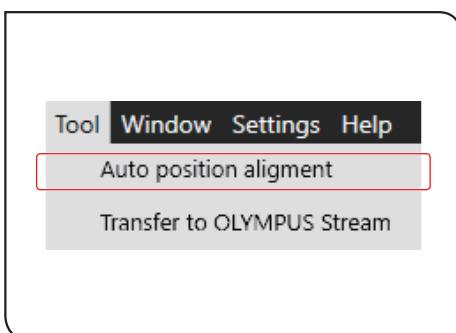
20-1-2 Operating procedures of the automatic centering

- 1 Open the file of the image (reference image) you want to use as a reference for the automatic centering and the file of the image (target image) you want to perform the automatic centering.

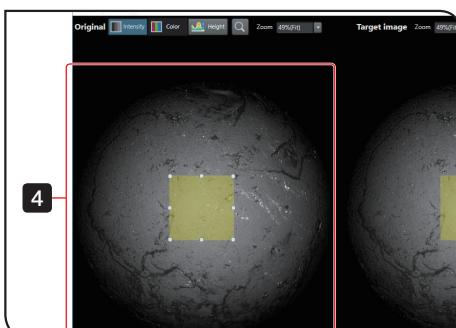
TIP For opening the file, see "Opening the file" (page 16).

- 2 Display the data view window of the reference image file on the front.

- 3 Select [Auto position alignment] from the [Tool] menu.



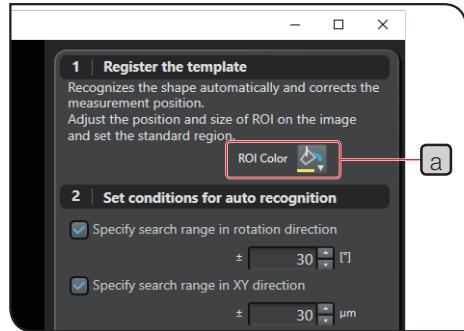
The [Auto position alignment] screen appears.



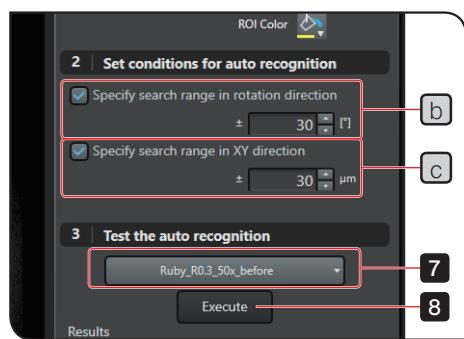
- 4 Move the ROI on the 2D image view area (reference image) to the position you want it to be the center of the image, and adjust the size.

TIP

- The ROI is corrected so that its top left comes to the top left of the target image.
- For changing the size or the aspect ratio of the ROI, or moving the ROI, see "Editing the ROI" (page 406).



TIP • You can change the color of the ROI. Click the [ROI color] button **a** to display the color palette, and select the color.



5 To specify the range (rotation direction) for recognizing the position automatically, perform following procedures.

1. Check the [Specify search range in rotation direction] checkbox **b**.
2. Specify the range in the text box.

TIP • The setting range is 0 to 360.
• The initial value is 30.

6 To specify the range (XY direction) for recognizing the position automatically, perform following procedures.

1. Check the [Specify search range in XY direction] checkbox **c**.
2. Specify the range in the text box.

TIP • The setting range is 0 to 10000.
• The initial value is 30.

7 Select the target image from the [Select the target image] dropdown list.

TIP The dropdown list shows the list of image files currently opened.

8 Click the [Execute] button.

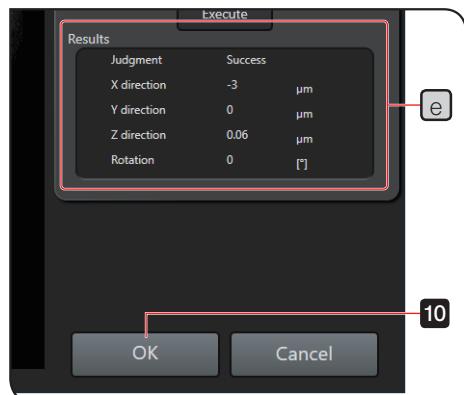
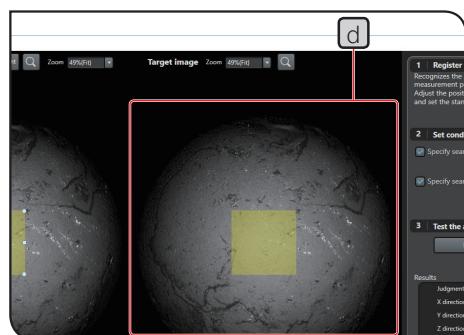
The corrected 2D image is previewed on the 2D image view area (target image) **d**.

The results or correction values are displayed in [Results] **e**.

9 Repeat steps from **3** to **7** until the corrected 2D image becomes appropriate.

10 Click the [OK] button.

The 2D image and the 3D image on the data view window are centered automatically and displayed.



20-2 Transferring data to OLYMPUS Stream

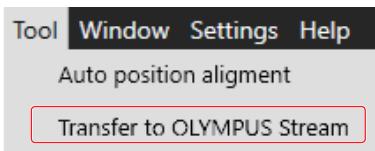
You can transfer image data displayed on the data view window to OLYMPUS Stream.

Using OLYMPUS Stream allows the more advanced measurement analysis.

TIP OLYMPUS Stream should have been installed on the controller or the PC in advance.

1 Select [Transfer to OLYMPUS Stream] from the [Tool] menu.

OLYMPUS Stream starts, and image data is displayed.



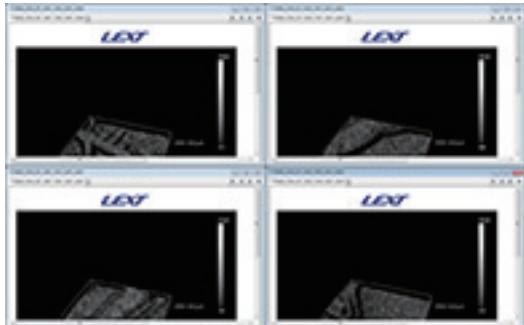
TIP The following restriction applies to data that is transferred to OLYMPUS Stream.

- Once the processed image data is transferred to OLYMPUS Stream, you cannot undo it.

21 Window menu

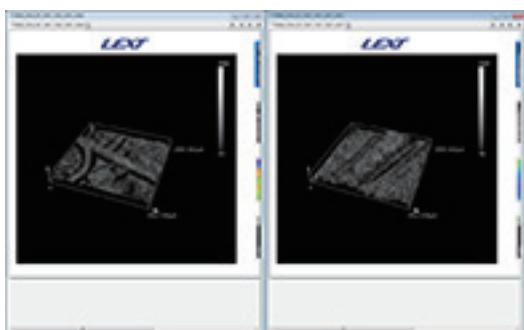
21-1 Displaying the data view window

You can change the layout of the data view windows currently opened.



■[Display side by side]

Displays the data view windows currently opened side by side.



■[Align horizontally]

Aligns the data view windows currently opened horizontally.



■[Align vertically]

Aligns the data view windows currently opened vertically.



■[Display in division]

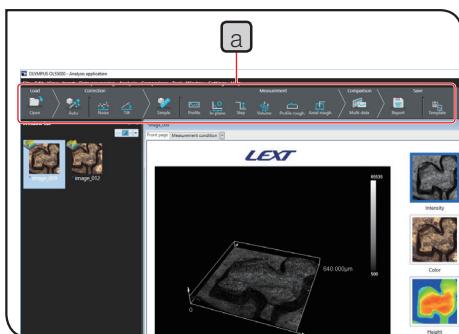
Displays two, four or nine data view windows currently opened side by side.

■[Minimize all windows]

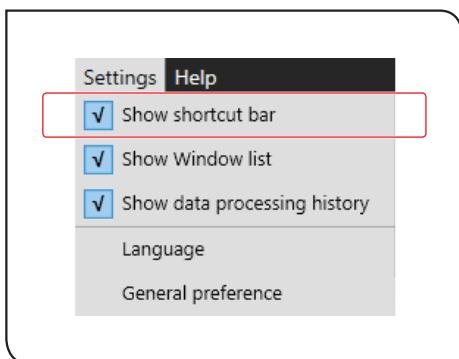
Minimizes all data view windows currently opened. Clicking the [Undo] button or the [Maximize] button in the upper area of the data view window displays the minimized data view window again.

22 Settings menu

22-1 Shortcut bar



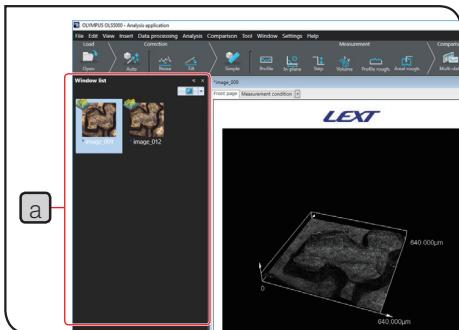
You can change between showing or hiding the shortcut bar [a].



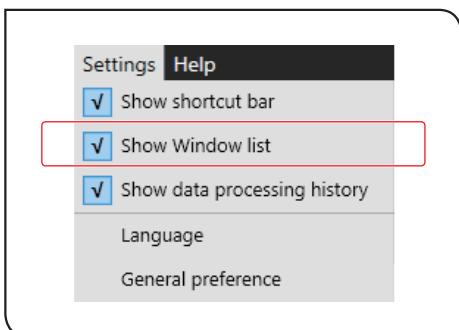
- 1 Select [Show shortcut bar] from the [Settings] menu.

When the [Show shortcut bar] is checked, the shortcut bar is displayed.

22-2 Window list



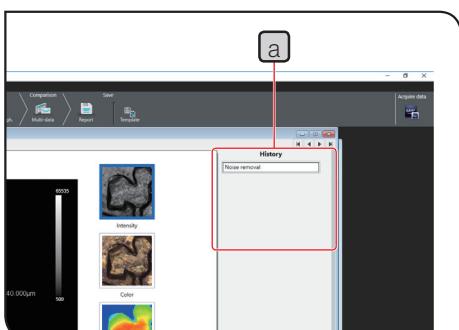
You can change between showing or hiding the window list [a].



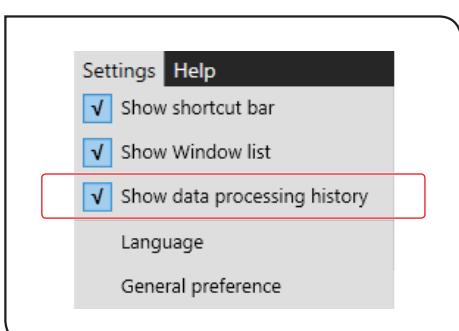
- 1 Select [Show Window list] from the [Settings] menu.

When the [Show Window list] is checked, the window list is displayed.

22-3 Data processing history



You can change between showing or hiding the data processing history [a] on the data view window.

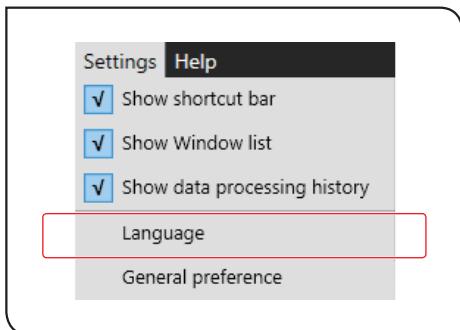


- 1 Select [Show data processing history] from the [Settings] menu.

When the [Show data processing history] is checked, the data processing history is displayed.

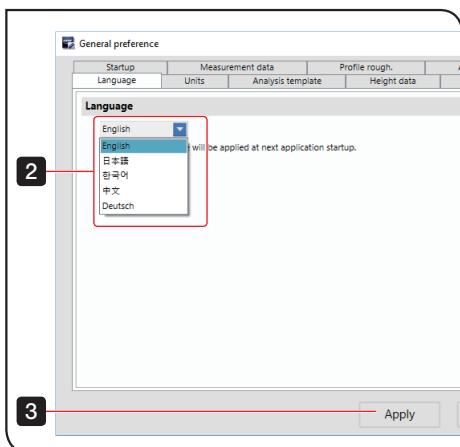
22-4 Language

You can set the language to be displayed on the analysis application screens or dialog boxes. You can select Japanese, English, Korean Chinese (simplified character) or German.



- 1 Select [Language] from the [Settings] menu.

TIP You can also display the [General preference] screen by selecting [General preference] from the [Settings] menu.



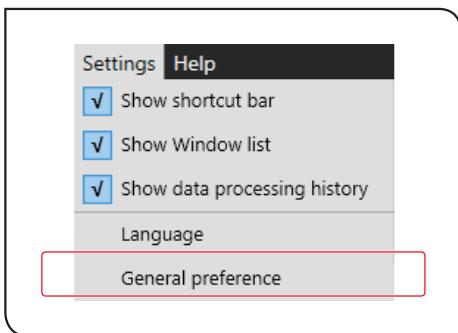
The [Language] tab is displayed on the [General preference] screen.

- 2 Select the language you want to display from the [Language] dropdown list.

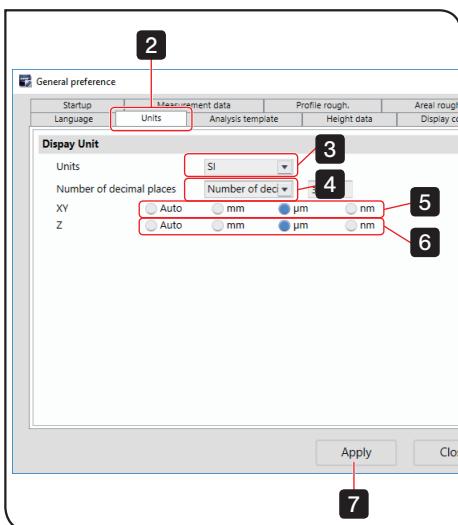
TIP If you change the language, restart the analysis application.

22-5 Unit and digit

You can set an unit or a number of decimal places you want to display on the scale of data on the data view window (image and measurement analysis results) or data on the measurement analysis window per data image file.



- Select [General preference] from the [Settings] menu.

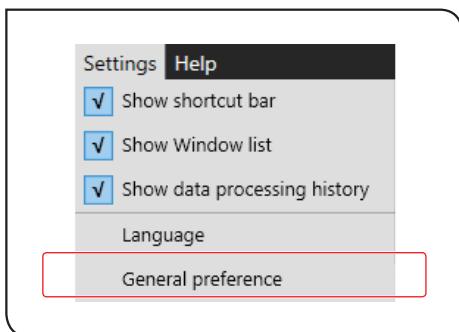


The [General preference] screen appears.

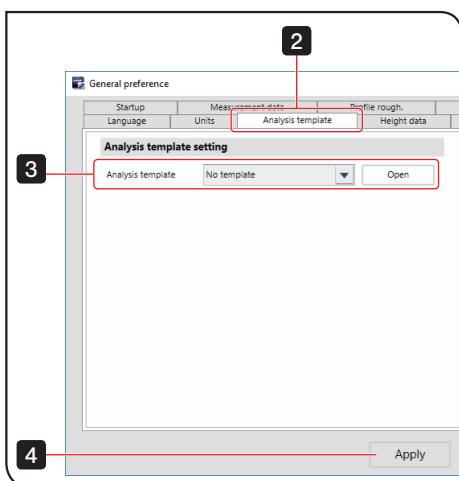
- Display the [Units] tab on the front.
- Select the unit you want to display from the [Units] dropdown list.
- TIP** You can select the unit either in metric system or yard-pound system (inch).
- To specify the number of decimal places, select [Number of decimal places] from the [Number of decimal places] dropdown list and input the number of decimal places in the next text box.
- TIP** The setting range is 1 to 6 (integer). To specify the number of digits combining integers and decimal places, select [Number of digits] from the [Number of decimal places] dropdown list, and input the number of digits in the next text box.
- Select the unit to display the X-axis and the Y-axis.
- Select the unit for displaying the Z-axis.
- Click the [Apply] button to close the [General preference] screen.

22-6 Template

When you transfer data acquired using the data acquisition application to the analysis application, you can set the template that applies to data.



- 1 Select [General preference] from the [Settings] menu.

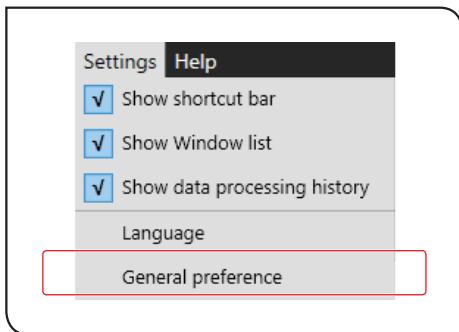


The [General preference] screen appears.

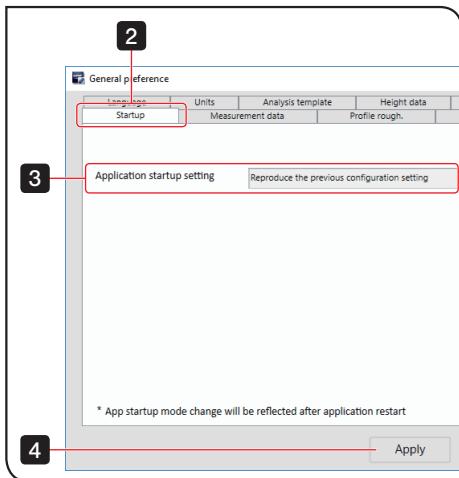
- 2 Display the [Analysis template] tab on the front.
- 3 Select the template for transferring data to the analysis application from the [Analysis template] dropdown list.
 - TIP If you cannot find a desired template in the dropdown list, click the [Open] button to display the [Open] screen, and select the template file (TPL file format).
- 4 Click the [Apply] button to close the [General preference] screen.

22-7 Setting the application startup

When you start the analysis application, you can select either to start it by reproducing the last configuration setting or to start it with the default setting.



- 1 Select [General preference] from the [Settings] menu.



The [General preference] screen appears.

- 2 Display the [Startup] tab on the front.
3 Select the configuration setting for starting the analysis application from the [Application startup setting] dropdown list.

[Reproduce the previous configuration setting]:

Starts the analysis application by reproducing the last configuration setting.

[Startup the application with default settings]:

Starts the analysis application with default settings.

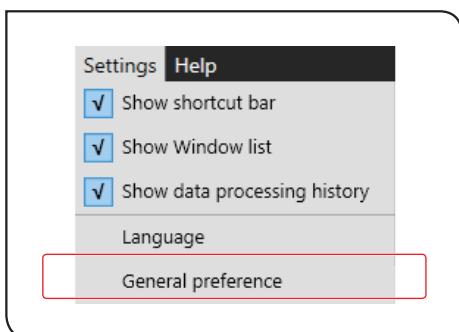
- 4 Click the [Apply] button to close the [General preference] screen.

22-8 Height data

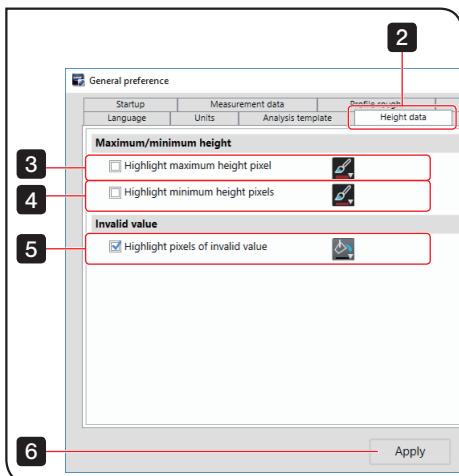
When displaying the laser intensity image or the height image, you can highlight the position where height data becomes the maximum or the minimum or the position where height data becomes invalid (pixel determined as a noise during image acquisition).

TIP

You can highlight the invalid value only when performing the profile roughness measurement or the in-plane measurement.



- 1 Select [General preference] from the [Settings] menu.

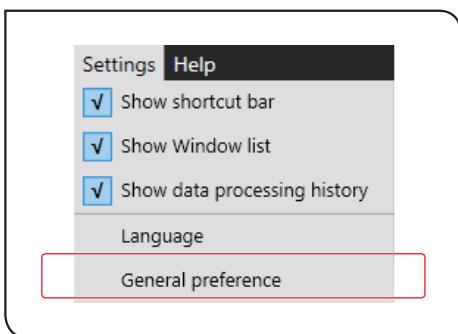


The [General preference] screen appears.

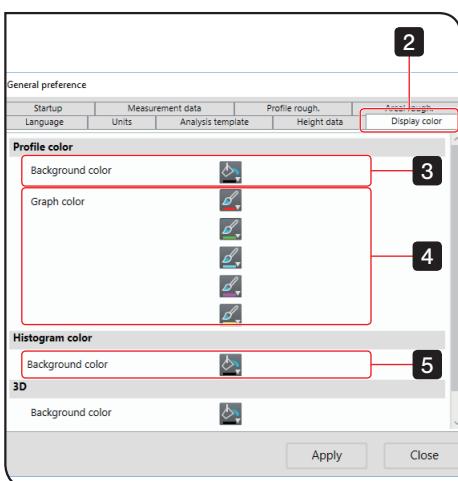
- 2 Display the [Height data] tab on the front.
- 3 If you want to highlight pixels with maximum height data, check the [Highlight maximum height pixel] checkbox, click the (Color) button to display the color pallet, and select the color to highlight the pixels.
- 4 If you want to highlight pixels with minimum height data, check the [Highlight minimum height pixels] checkbox, click the (Color) button to display the color pallet, and select the color to highlight the pixels.
- 5 If you want to highlight pixels determined as noises during data acquisition, check the [Highlight pixels of invalid value] checkbox, click the (Color) button to display the color pallet, and select the color to highlight the pixels.
- 6 Click the [Apply] button to close the [General preference] screen.

22-9 Color in view

You can set the color of the profile or the histogram on the data view window.



- Select [General preference] from the [Settings] menu.



The [General preference] screen appears.

- Display the [Display color] tab on the front.



- To change the background color of the profile, click the (Color) button to display the color pallet, and select the color.



- To change the color of the profile, click the (Color) button to display the color pallet, and select the color.



TIP You can set up to five color types of the profile. The five color types repeat in the order of the created profiles.

- To change the background color of the histogram, click the (Color) button to display the color pallet, and select the color.



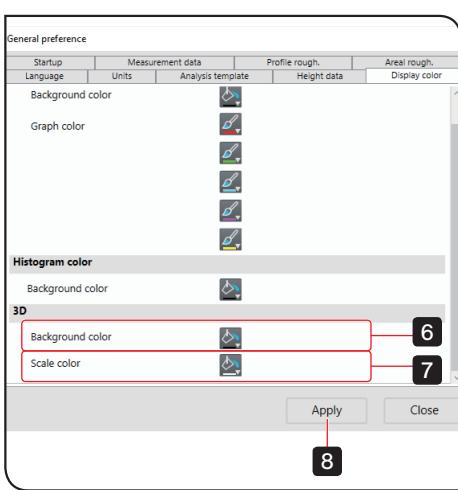
- To change the background color of the 3D image, click the (Color) button to display the color pallet, and select the color.



- To change the histogram color of the 3D image, click the (Color) button to display the color pallet, and select the color.



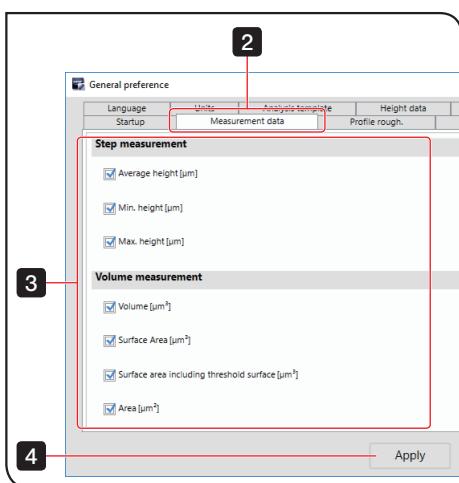
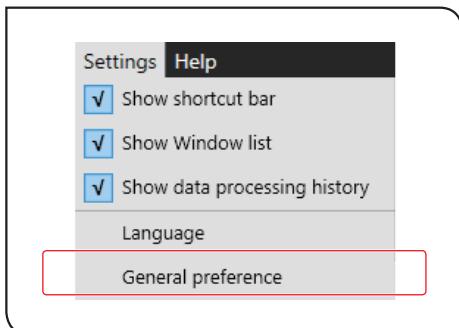
- Click the [Apply] button to close the [General preference] screen.



22-10 Measurement analysis options

Select the measurement analysis items you want to hide in the measurement analysis results of the step height measurement and the volume measurement.

- 1 Select [General preference] from the [Settings] menu.



The [General preference] screen appears.

- 2 Display the [Measurement data] tab on the front.
- 3 Uncheck the measurement analysis items you want to hide.
- 4 Click the [Apply] button to close the [General preference] screen.

Appendix

ROI settings

The ROI (Region Of Interest) is a region on the image to perform the data processing or the measurement analysis.



The ROI is used for the data processing or the measurement analysis listed below.

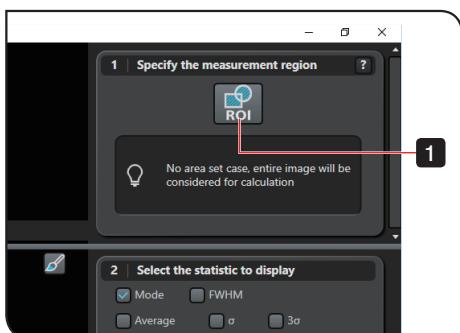
Data processing

- Auto noise judgment in noise removal
- Tilt removal
- Sphere, cylinder and multi-degree curved surface in form removal
- Smoothing

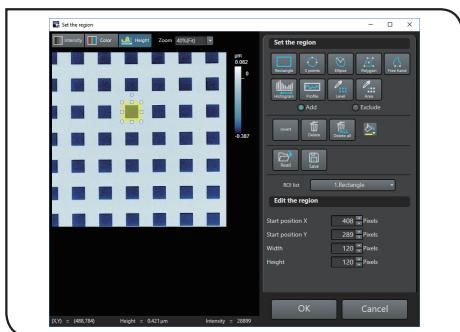
Measurement analysis

- Step height measurement
- Volume measurement
- Areal roughness measurement
- Histogram analysis

Displaying the [Set the region] screen.

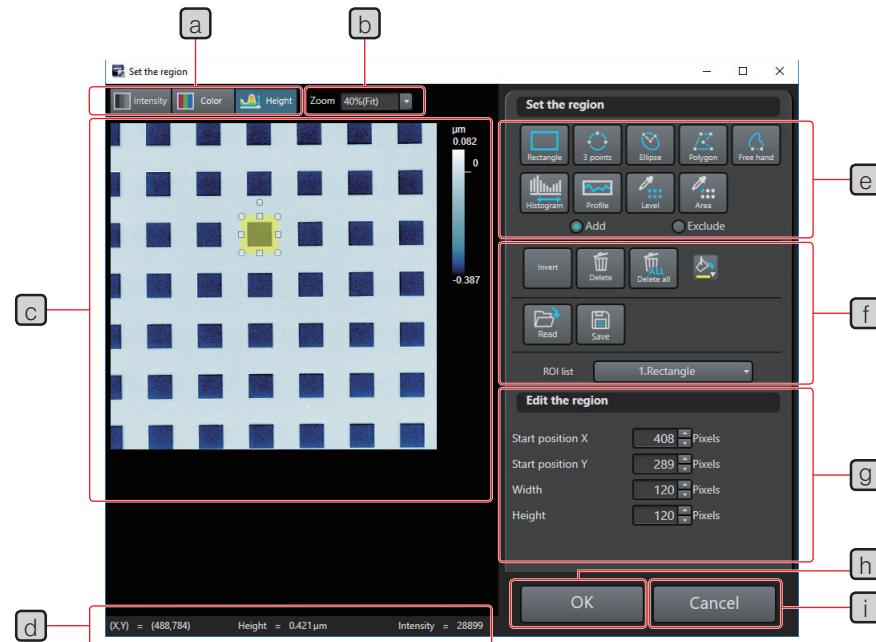


- 1 Click the [ROI] button on the data processing screen or the measurement analysis screen.



The [Set the region] screen appears.

Screens used in the ROI setting



[a] 2D image data selection button

Selects either the laser intensity image, the color image or the height image on the 2D image view area.

[b] Magnification dropdown list

Select the magnification to display the image on the 2D image view area. Or input the numerical value.

[c] 2D image view area

Displays the 2D image and the ROI.
Rotating the mouse wheel on the image zooms in or out the image.

[d] Status bar

Displays information of the mouse pointer position (X coordinate, Y coordinate, height and laser intensity) on the 2D image view area.

[e] ROI creation area

Select the ROI type you want to create on the image on the 2D image view area.

[f] ROI editing area

Edit the ROI created on the image on the 2D image view area.

[g] ROI setting area

Define advanced settings of the ROI.

[h] [OK] button

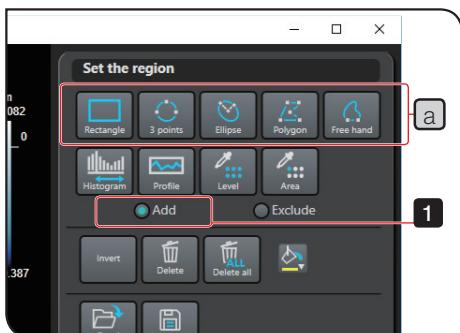
Determines the ROI created on the 2D image view area.

[i] [Cancel] button

Cancels creating the ROI.

Adding the ROI

Drawing graphics



1 Make sure that the [Add] radio button on the ROI creation area is selected.

2 On the ROI creation area, click the button to draw graphics **a** [Rectangle], [3-point circle], [Ellipse], [Polygon] or [Free hand] button.

[Rectangle]: Draws a rectangle.

Hold down the mouse button at the position you want to set as a vertex of the rectangle on the image, and drag it diagonally.

[3-point circle]: Draws a circle.

Click three points you want to set as a circumference on the image.

[Ellipse]: Draws an ellipse.

Hold down the mouse button at the position you want to set as a start point on the image, and drag the rectangle circumscribing the circle diagonally.

[Polygon]: Draws a polygon.

Click a position you want to set as a start point on the image, click the next vertex one after another and double-click a position you want to set as an end point.

[Free hand]: Draws graphics freely.

Hold down the mouse button at the position you want to set as a start point on the image, and drag freely.

3 Draws graphics freely on the 2D image.

The ROI you have drawn is masked.

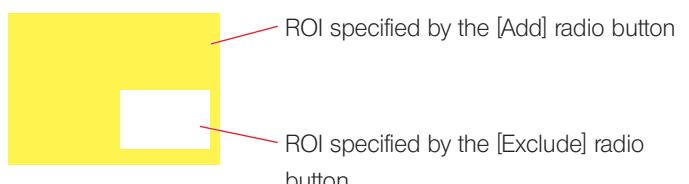
TIP

You can change the color of the ROI.

For procedures to change the color, see “Changing the ROI color” (page 409).

Setting the excluded region

If you want to exclude a part of the created ROI, select the [Exclude] radio button in the step **1**, select the button to draw graphics, and specify the region you want to exclude on the 2D image.



Setting the threshold on the histogram

Setting the upper limit and the lower limit of the threshold allows you to extract pixels within the threshold from the entire image and set them as a ROI.

The data to set the threshold differs depending on the image type being displayed.

The threshold is set to intensity data when displaying the laser intensity image, to color data when displaying the color image (RGB total) and to height data when displaying the height image respectively.

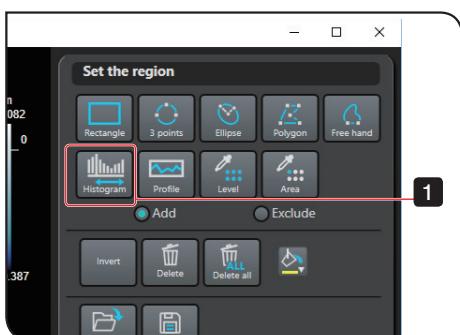
Point

As the ROI is set by specifying the threshold to original data, this method is useful when setting the ROI under the same condition to data acquired under the same data acquisition condition.

- Click the [Histogram] button in the ROI creation area.

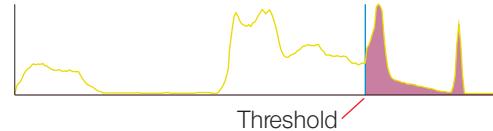
[Histogram]: Sets the threshold on the histogram.

The histogram is displayed in the lower area of the 2D image view area.



- Click the [Upper], [Inside] or [Lower] button.

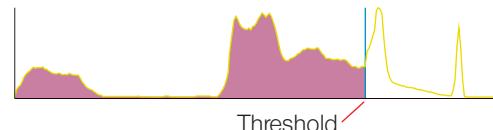
[Upper]: Sets the value higher than the threshold as a ROI.

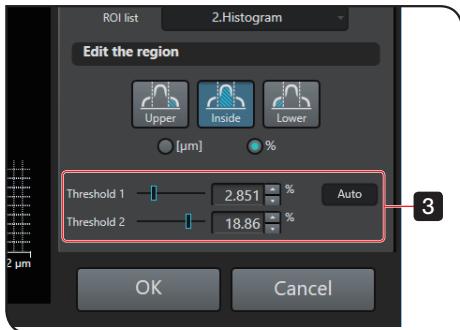


[Inside]: Sets the value between the higher limit and the lower limit of the threshold as a ROI.



[Lower]: Sets the value lower than the threshold as a ROI.





- 3 Set the threshold on the histogram.

Or set the threshold using the [Threshold 1] or [Threshold 2] slider in [Edit the region].

The region to set ROI on the histogram is displayed in pink color.

The ROI you have created is masked on the 2D image.

TIP You can change the color of the ROI.

For procedures to change the color, see "Changing the ROI color" (page 409).

Setting the threshold on the profile

Setting the upper limit and the lower limit of the threshold allows you to extract pixels within the threshold from the entire image and set them as a ROI.

The data to set the threshold differs depending on the image type being displayed.

The threshold is set to intensity data when displaying the laser intensity image, to color data when displaying the color image (RGB total) and to height data when displaying the height image respectively.

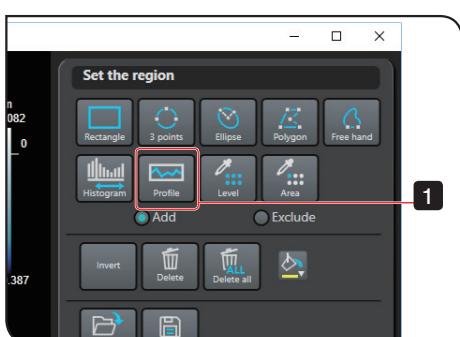


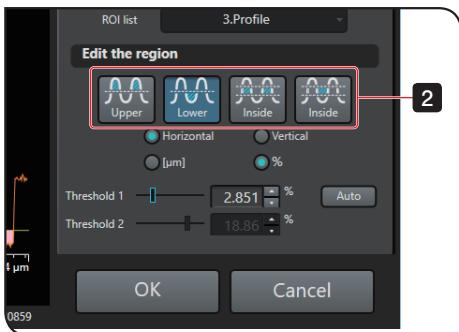
As the ROI is set by specifying the threshold to original data, this method is useful when setting the ROI under the same condition to data acquired under the same data acquisition condition.

- 1 Click the [Profile] button on the ROI creation area.

[Profile]: Sets the threshold on the profile on the arbitrary line (horizontal or vertical) on the 2D image.

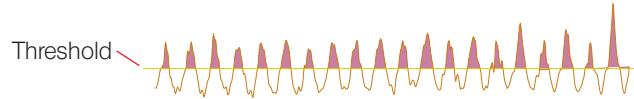
The profile is displayed in the lower area of the 2D image view area.



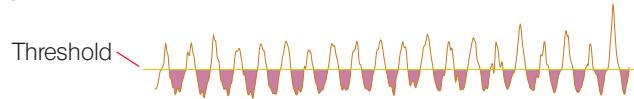


2 Click the [Upper], [Lower], [Inside] or [Inside] button.

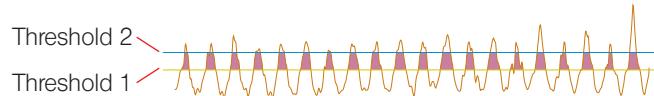
[Upper]: Sets the material volume higher than the threshold as a ROI.



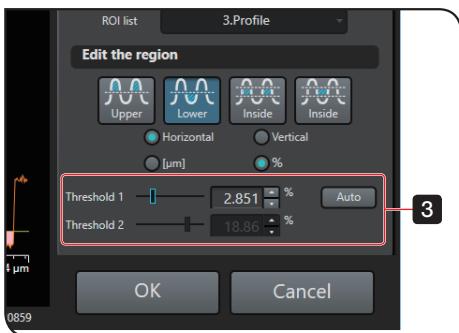
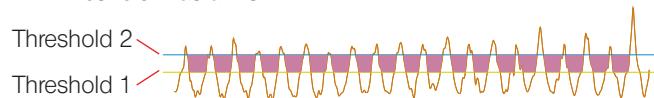
[Lower]: Sets the void volume lower than the threshold as a ROI.



[Inside]: Sets the material volume between the threshold 1 and the threshold 2 as a ROI.



[Inside]: Sets the void volume between the threshold 1 and the threshold 2 as a ROI.



3 Set the threshold on the profile.

Or set the threshold using the [Threshold 1] or [Threshold 2] slider in [Edit the region].

The region to set ROI on the profile is displayed in pink color.

The ROI you have created is masked on the 2D image.

TIP

You can change the color of the ROI.

For procedures to change the color, see "Changing the ROI color" (page 409).

Extracting the level

Using the pixel value on the image as a base value, extract only pixels that fall in the tolerance specified from this base value, and set them as a ROI.

Data to be used as a base value differs depending on the image type being displayed.

Data to be used as a base value is intensity data when displaying the laser intensity image, color data when displaying the color image (RGB total) and height data when displaying the height image respectively.

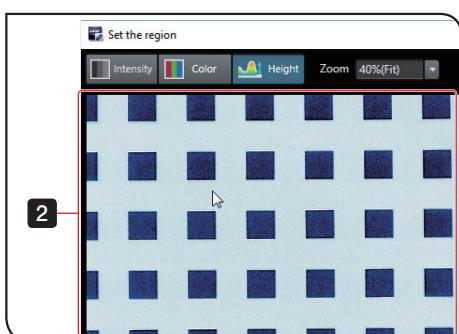
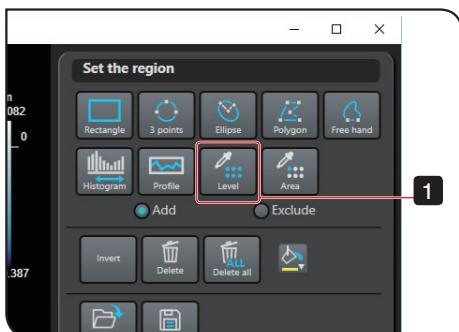
Point

As pixels that fall in the tolerance are set as a ROI, this method is useful when setting the ROI under the same condition to data acquired under a different data acquisition condition.

- Click the [Level] button on the ROI creation area.



[Level]: Sets the base pixel value and its tolerance as a ROI.



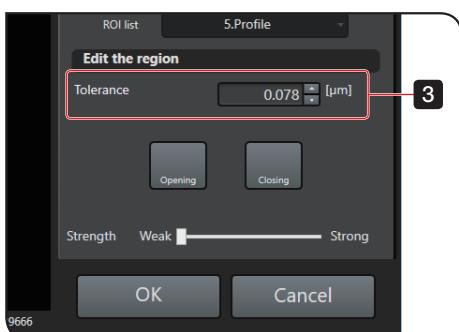
- Click a pixel you want to use as a base on the 2D image.

The ROI is masked on the 2D image.

TIP

You can change the color of the ROI.

For procedures to change the color, see “Changing the ROI color” (page 409).



- If necessary, set the tolerance using the [Tolerance] text box while checking the ROI on the 2D image.

TIP

- The initial value is 0.

- For the laser intensity image, you can set the integer from 0 to 65535.
- For the color image, you can set the integer from 0 to 255.
- For the height image, you can set the value (μm) down to three decimal places from 0 to maximum height data. (For example, if you input the fourth decimal place or after, the fourth decimal place is rounded.)

Extracting the region

Using the pixel value on the image as a base value, extract only pixels that fall in the tolerance specified from this base value and also are adjacent to pixels in the tolerance, and set them as a ROI.

Data to be used as a base value differs depending on the image type being displayed.

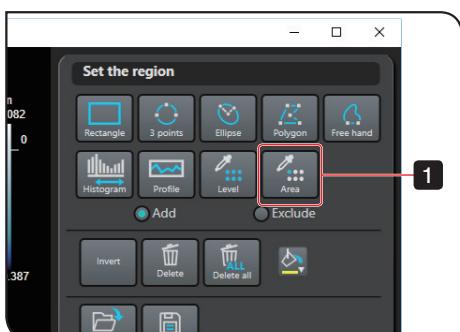
Data to be used as a base value is intensity data when displaying the laser intensity image, color data when displaying the color image (RGB total) and height data when displaying the height image respectively.

Point

As pixels that fall in the tolerance are set as a ROI, this method is useful when setting the ROI under the same condition to data acquired under a different data acquisition condition.

- Click the [Area] button on the ROI creation area.

 [Area]: Sets the base pixel and its tolerance and pixels adjacent to pixels in the tolerance as a ROI.



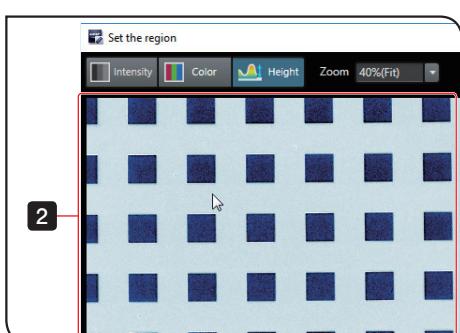
- Click a pixel you want to use as a base on the 2D image.

The ROI is masked on the 2D image.

TIP

You can change the color of the ROI.

For procedures to change the color, see “Changing the ROI color” (page 409).





- 3** If necessary, set the tolerance using the [Tolerance] text box while checking the ROI on the 2D image.

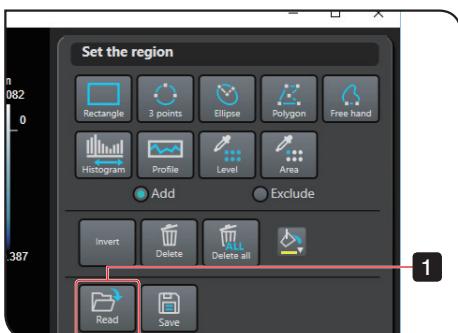
TIP • The initial value is 0.

- For the laser intensity image, you can set the integer from 0 to 65535.
- For the color image, you can set the integer from 0 to 255.
- For the height image, you can set the value (μm) down to three decimal places from 0 to maximum height data.
(For example, if you input the fourth decimal place or after, the fourth decimal place is rounded.)

Loading the ROI setting file

Load the ROI setting file (roix format) saved in advance.

TIP For saving the ROI setting file, see “Saving the ROI setting file” (page 410).



- 1** Click the [Read] button on the ROI editing area.

The [Open] screen appears.

- 2** Specify the ROI setting file (roix file format) and click the [Open] button.

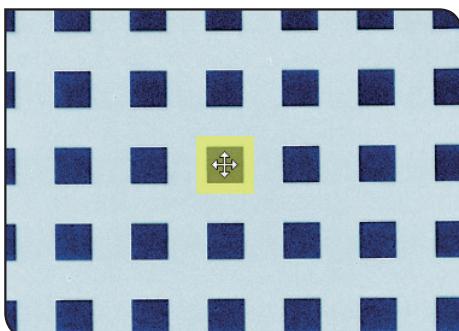
The loaded ROI is masked on the 2D image.

TIP You can change the color of the ROI.

For procedures to change the color, see “Changing the ROI color” (page 409).

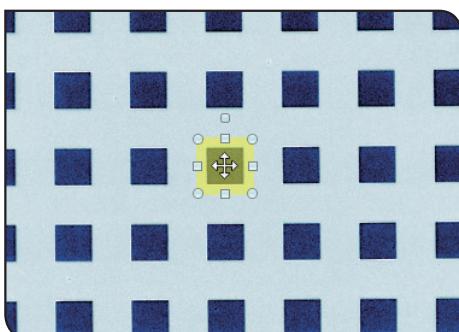
Editing the ROI

Selecting the ROI

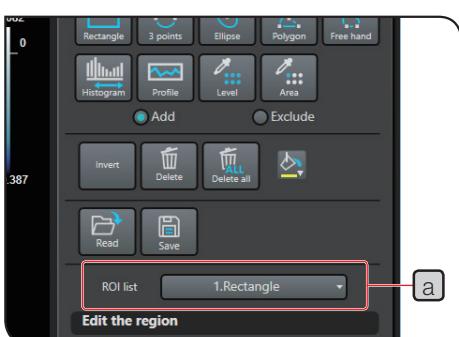


You can select the ROI created using the button to draw graphics on the 2D image.

Place the mouse pointer on the ROI. When the mouse pointer changes its shape to the double-headed arrow, click the ROI to select it.



The handles are displayed on the outside frame of the ROI you selected.

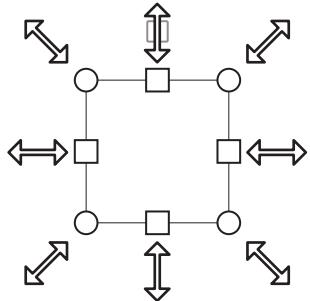


You cannot select the ROI created by specifying the threshold or the region on the 2D image.

Select the ROI No. from the [ROI list] dropdown list **a**.

The sequential number is attached to the ROI in the order of creating the ROI.

Changing the size and the aspect ratio of the ROI



You can change the size or the aspect ratio of the ROI created using the button to draw graphics on the 2D image.

Select the ROI. The handles are displayed on the outside frame of the ROI.

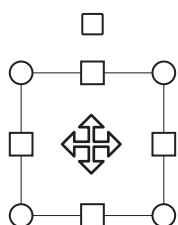
Place the mouse pointer on the handle. When the mouse pointer changes its shape to the double-headed arrow, drag the handle to change the size or the aspect ratio of the ROI.

The diagonal vertex is a base point.

Dragging the handle while holding down the **Shift** key of the keyboard allows you to change the size of the ROI without changing its aspect ratio.

Dragging the handle while holding down the **Ctrl** key of the keyboard allows you to change the size of the ROI without changing its center position and aspect ratio.

Moving the ROI

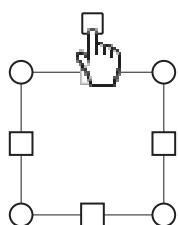


You can move the ROI created using the button to draw graphics.

Select the ROI. The handles are displayed on the outside frame of the ROI.

Place the mouse pointer on the ROI. When the mouse pointer changes its shape to the cross arrow, drag the ROI to move it.

Rotating the ROI

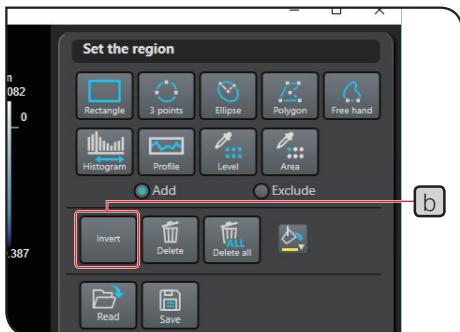


You can rotate the ROI created using the button to draw graphics.

Select the ROI. The handles are displayed on the outside frame of the ROI.

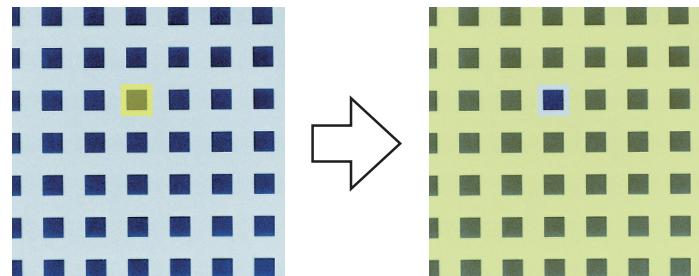
Place the mouse pointer on the handle displayed on the ROI. When the mouse pointer changes its shape to the hand shape, drag the handle to rotate the ROI.

Inverting the ROI



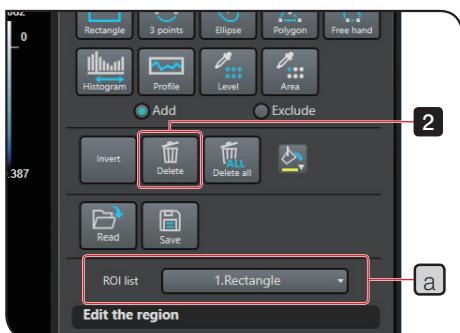
Click the [Invert] button **b**.

The [Invert] button is ON and all ROIs on the 2D image are inverted.



To undo the inversion of the ROI, click the [Invert] button **b** again to set the button to OFF.

Deleting the ROI

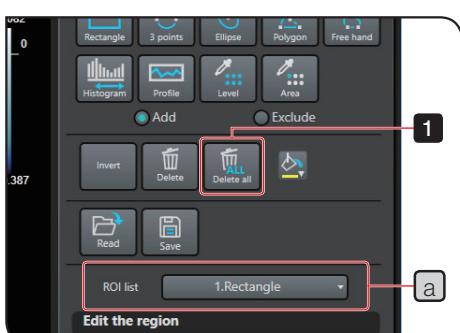


Deleting the selected ROI

- 1 Select the ROI you want to delete on the 2D image or in the [ROI list] dropdown list **a**.
- 2 Click the [Delete] button on the ROI editing area.

The ROI is deleted.

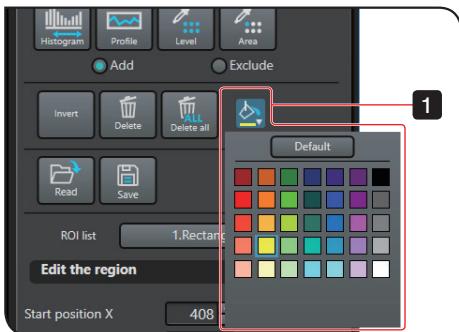
TIP You can also delete the ROI by pressing the **Delete** key of the keyboard.



Deleting all ROIs

- 1 Click the [Delete all] button on the ROI editing area.
- 2 The all ROIs are deleted.

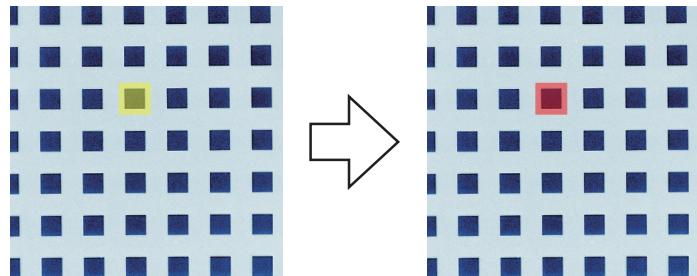
Changing the ROI color



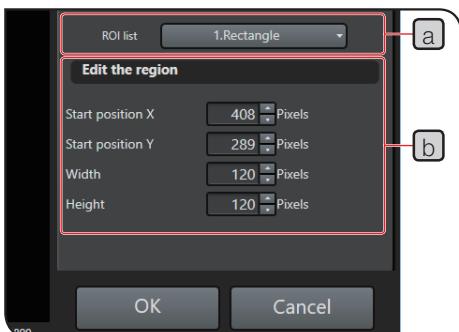
1 Click the [Fill color] button on the ROI editing area.

Select the color from the color pallet displayed.

The colors of all ROIs on the 2D image are changed.



Setting the ROI again



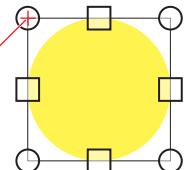
1 Select the ROI you want to set again on the 2D image or in the [ROI list] dropdown list **a**.

Information of the selected ROI is displayed on the ROI setting area **b**.

TIP • The information displayed on the ROI setting area differs depending on the graphics drawing, threshold, level extraction and region extraction when the ROI was created.

- If you select the ROI created using the button to draw graphics, [Start position X] and [Start position Y] are displayed. On [Start position X] and [Start position Y], X and Y coordinate values of the upper left position of the rectangle circumscribing the ROI are displayed.

Coordinates of [Start position X] and
[Start position Y]



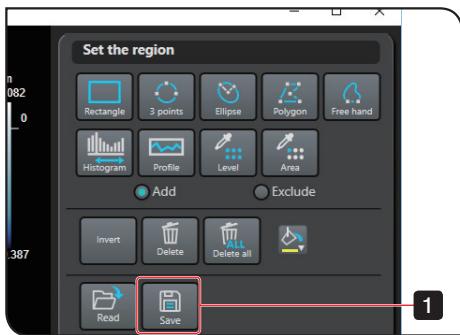
2 Change the ROI settings on the 2D image or the ROI setting area.

The ROI is changed.

Functions used with the ROI

Saving the ROI setting file

Save the current ROI in the ROI setting file (roix format).



1 Click the [Save] button on the ROI editing area.

The [Save as] screen appears.

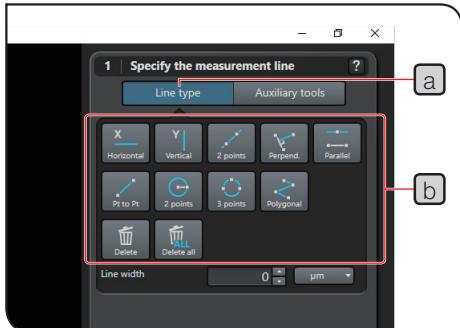
2 Input the save location and the file name, and click the [Save] button.

The ROI settings are saved in the file.

Measurement line and auxiliary tools

This section describes the measurement line and auxiliary tools used in the profile measurement, difference analysis, in-profile measurement and profile roughness measurement.

Measurement line types



Click the [Line type] button **a** on the measurement line setting area.

The line types are displayed on the measurement line setting area **b**.

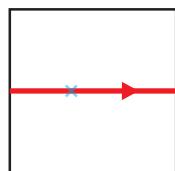
TIP

- The available line types differ depending on measurement analysis types.
- “7-4-2 Measurement line types used in the profile measurement” (page 159)
- “8-5-2 Measurement line types used in the difference analysis” (page 201)
- “10-4-2 Measurement line types used in the in-plane measurement” (page 222)
- “12-4-2 Measurement line types used in the profile roughness measurement” (page 259)
- “15-4-2 Measurement line types used in the film thickness measurement” (page 320)
- “17-4-2 Measurement line types used in the auto edge measurement” (page 361)



■[Horizontal]

Draws a horizontal line passing through a single point.



1 Click the [Horizontal] button.

2 Click any position on the 2D image view area.

Moving the mouse displays the line.

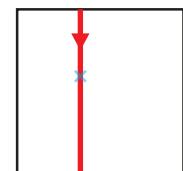
3 Click a position you want to create a measurement line.

The measurement line is created.



■[Vertical]

Draws a vertical line passing through a single point.



1 Click the [Vertical] button.

2 Click any position on the 2D image view area.

Moving the mouse displays the line.

3 Click a position you want to create a measurement line.

The measurement line is created.

To edit:

Dragging the measurement line or the point allows you to move the measurement line.

TIP

The measurement line (cross section) is also displayed on the 3D image view area. You can also move the measurement line by dragging the measurement line on the 3D image view area.

To edit:

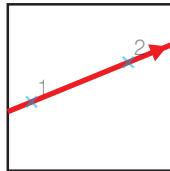
Dragging the measurement line or the point allows you to move the measurement line.

TIP

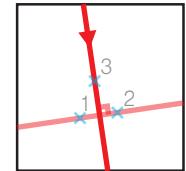
The measurement line (cross section) is also displayed on the 3D image view area. You can also move the measurement line by dragging the measurement line on the 3D image view area.



■[2 points line]
Draws a line passing through two points.



■[Perpendicular line]
Draws a line that is perpendicular to the line passing through two points (reference line) and also that passes through a third point.



- 1 Click the [2 points line] button .

- 2 Click a position you want to set as a first point of the line on the 2D image view area.

Moving the mouse displays the line.

- 3 Click a position you want to set as a second point of the line.

The measurement line is created.

To edit:

Dragging the measurement line allows you to move the measurement line.

Dragging the point allows you to adjust the angle of the measurement line.

- 1 Click the [Perpendicular line] button

- 2 Click a position you want to set as a first point of the reference line on the 2D image view area.

Moving the mouse displays the reference line.

- 3 Click a position you want to set as a second point of the reference line.

The reference line is created. Moving the mouse displays the perpendicular line.

- 4 Click a position you want to create a perpendicular line.

The measurement line is created.

To edit:

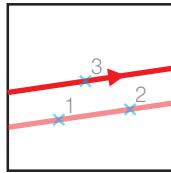
Dragging the reference line or the perpendicular line allows you to move the line.

Dragging the point on the reference line allows you to adjust the angle of the reference line.

Dragging the point on the perpendicular line allows you to move the perpendicular line.

**[Parallel line]**

Draws a line that is parallel to the line passing through two points (reference line) and that also passes through a third point.



- 1 Click the [Parallel line] button.

- 2 Click a position you want to set as a first point of the reference line on the 2D image view area.

Moving the mouse displays the reference line.

- 3 Click a position you want to set as a second point of the reference line.

The reference line is created. Moving the mouse displays the parallel line.

- 4 Click a position you want to create a parallel line.

The measurement line is created.

To edit:

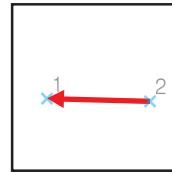
Dragging the reference line or the parallel line allows you to move the line.

Dragging the point on the reference line allows you to adjust the angle of the reference line.

Dragging the point on the parallel line allows you to move the parallel line.

**[Point to point]**

Draws a line that connects a start point and an end point.



- 1 Click the [Point to point] button .

- 2 Click a position you want to set as a start point of the line on the 2D image view area.

Moving the mouse displays the line.

- 3 Click a position you want to set as an end point of the line.

The measurement line is created.

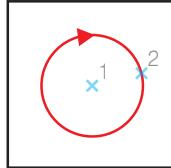
To edit:

Dragging the measurement line allows you to move the measurement line.

Dragging the point allows you to move the start point or the end point of the measurement line.



■[2 points circle]
Draws a circle with a first point as a center of circle and with a second point as a circumference.



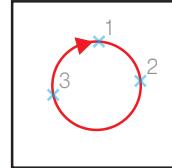
- 1 Click the [2 points circle] button .
- 2 Click a position you want to set as a center of the circle on the 2D image view area.
Moving the mouse displays the circle.
- 3 Click a position you want to set as a circumference.
The measurement line is created.

To edit:

Dragging the measurement line (circle) allows you to move the measurement line (circle).
Dragging the point at the center of the measurement line (circle) allows you to move the measurement line (circle).
Dragging the point on the circumference of the measurement line (circle) allows you to adjust the size of the measurement line (circle).



■[3 points circle]
Draws a circle with three points as a circumference.



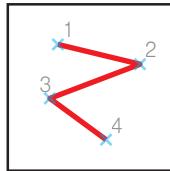
- 1 Click the [3 points circle] button .
- 2 Click a position you want to set as a first point of the circle on the 2D image view area.
- 3 Click a position you want to set as a second point.
Moving the mouse displays the circle.
- 4 Click a position you want to set as a third point.
The measurement line is created.

To edit:

Dragging the measurement line (circle) allows you to move the measurement line (circle).
Dragging the point at the center of the measurement line (circle) allows you to move the measurement line (circle).
Dragging the point on the circumference of the measurement line (circle) allows you to adjust the position or the size of the measurement line (circle).

**[Multipoint]**

Draws a polygonal line with a first point as a start point and with points after a second point as vertexes.



- 1** Click the [Multipoint] button.
- 2** Click a position you want to set as a start point on the 2D image view area.
Moving the mouse displays the line.
- 3** Click a position you want to set as a vertex.
- 4** Double-click a position you want to set as an end point.

The measurement line is created.

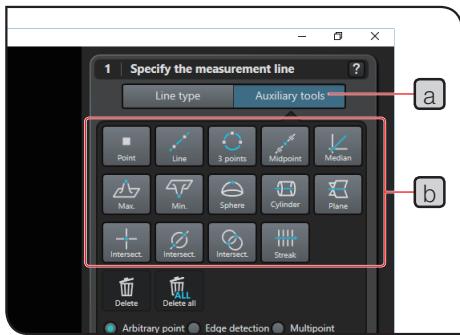
To edit:

Dragging the point allows you to adjust the vertex position of the polygonal line.

TIP

The arrow of the measurement line indicates the direction of the profile.

Auxiliary tool types



[a] Click the [Auxiliary tools] button on the measurement line setting area.

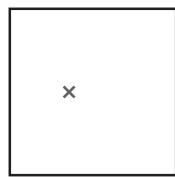
The auxiliary tools are displayed on the measurement line setting area [b].

TIP • The available auxiliary tool types differ depending on measurement analysis types.

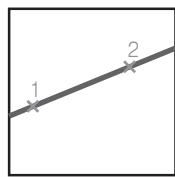
- "7-4-3 Auxiliary tool types used in the profile measurement" (page 159)
- "8-5-3 Auxiliary tools used in the difference analysis" (page 201)
- "10-4-4 Auxiliary tool types used in the in-plane measurement" (page 232)
- "12-4-3 Auxiliary tool types used in the profile roughness measurement" (page 259)



■[Point]
Draws a point.



■[Line]
Draws a line passing through two points.



1 Click the [Point] button .

2 Click any position on the 2D image view area.

The point is created.

To edit:

Dragging the point allows you to adjust the point position.

1 Click the [Line] button .

2 Click a position you want to set as a first point of the line on the 2D image view area.

Moving the mouse displays the line.

3 Click a position you want to set as a second point of the line.

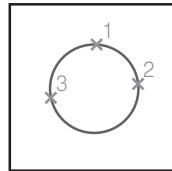
The line is created.

To edit:

Dragging the line allows you to move the line.
Dragging the point allows you to adjust the angle of the line.



[3 points circle]
Draws a circle with three points as a circumference.



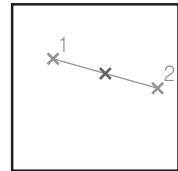
- 1 Click the [3 points circle] button .
- 2 Click a position you want to set as a first point of the circle on the 2D image view area.
- 3 Click a position you want to set as a second point.
Moving the mouse displays the circle.
- 4 Click a position you want to set as a third point.
The circle is created.

To edit:

Dragging the circumference allows you to move the circle.
Dragging the point at the center of the circle allows you to move the circle.
Dragging the point on the circumference allows you to adjust the position or the size of the circle.



[Midpoint]
Draws a midpoint of two points.



- 1 Click the [Midpoint] button .
- 2 Click a position you want to set as a first point on the 2D image view area.

Moving the mouse displays the line.

- 3 Click a position you want to set as a second point.

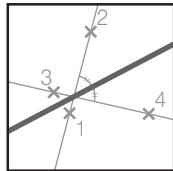
The midpoint of the line that connects two points is created.

To edit:

Dragging the line allows you to move the line.
Dragging the point at the end of the line allows you to adjust the angle or the length of the line.
Editing the line allows you to update the midpoint.

**■[Median line]**

Draws a median line of two lines.



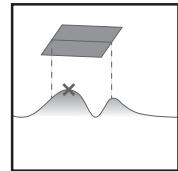
- 1 Click the [Median line] button .
- 2 Click a position you want to set as a first point of the line 1 on the 2D image view area.
Moving the mouse displays the line 1.
- 3 Click a position you want to set as a second point of the line 1.
The line 1 is created.
- 4 Click a position you want to set as a first point of the line 2.
Moving the mouse displays the line 2.
- 5 Click a position you want to set as a second point of the line 2.
The line 2 and the median line of the line 1 and line 2 are created.

To edit:

Dragging the line 2 allows you to move the line 2.
Dragging the point on the line 2 allows you to adjust the angle of the line 2.
Editing the line 2 allows you to update the median line.

**■[Maximum height]**

Draws the highest position in Z-axis direction in the region as a point.



- 1 Click the [Maximum height] button.
- 2 Drag from a position you want to set as a start point of the region to a position you want to set as an end point of the region on the 2D image view area.

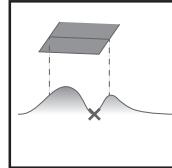
The region is created and the point is created at the highest position in the region.

To edit:

Dragging the region allows you to move the region.
Dragging the handle on the outside frame of the region allows you to adjust the position and the size of the region.
Editing the region allows you to update the point at the highest position.

**[Minimum height]**

Draws the lowest position in Z-axis direction in the region as a point.



- 1** Click the [Minimum height] button.
- 2** Drag from a position you want to set as a start point of the region to a position you want to set as an end point of the region on the 2D image view area.

The region is created and the point is created at the lowest position in the region.

To edit:

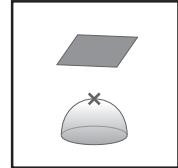
Dragging the region allows you to move the region.

Dragging the handle on the outside frame of the region allows you to adjust the position and the size of the region.

Editing the region allows you to update the point at the lowest position.

**[Sphere center]**

Recognizing the three-dimensional shape in the region as a sphere, draws a point at the center position of the sphere.



- 1** Click the [Sphere center] button.
- 2** Drag from a position you want to set as a start point of the region to a position you want to set as an end point of the region on the 2D image view area.

The region is created. A point is created at the sphere center position when recognizing the three-dimensional shape in the region as a sphere.

To edit:

Dragging the region allows you to move the region.

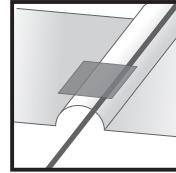
Dragging the handle on the outside frame of the region allows you to adjust the position and the size of the region.

Editing the region allows you to update the point at the center position.



■[Cylinder axis]

Recognizing the three-dimensional shape in the region as a side surface of the cylinder, draws a center axis as a line.



- 1 Click the [Cylinder axis] button.

- 2 Drag from a position you want to set as a start point of the region to a position you want to set as an end point of the region on the 2D image view area.

The region is created. The line of the center axis of the cylinder when recognizing the three-dimensional shape in the region as a cylinder is created.

To edit:

Dragging the region allows you to move the region.

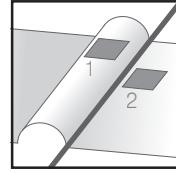
Dragging the handle on the outside frame of the region allows you to adjust the position and the size of the region.

Editing the region allows you to update the line of the center axis.



■[Surface intersection line]

Recognizing the three-dimensional shape in the region as a plane, draws its cross line.



- 1 Click the [Surface intersection line] button .

- 2 Drag from a position you want to set as a start point to a position you want to set as an end point of the first region on the 2D image view area.

The first region is created.

- 3 Drag from a position you want to set as a start point to a position you want to set as an end point of the second region on the 2D image view area.

The second region is created. The surface intersection line when recognizing the three-dimensional shape in the first region and the second region as a plane in each region is created.

To edit:

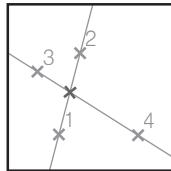
Dragging the region allows you to move the region.

Dragging the handle on the outside frame of the region allows you to adjust the position and the size of the region.

Editing the region allows you to update the line of the center axis.

**■[Intersection line to line]**

Draws a point at the intersection of two lines.



- 1** Click the [Intersection line to line] button .
- 2** Click a position you want to set as a first point of the line 1 on the 2D image view area.
- Moving the mouse displays the second point of the line 1 (pink color).
- 3** Click a position you want to set as a second point.
- 4** In the same manner, create a line 2 (green color).

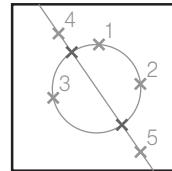
The intersection point of two lines is created on the profile.

To edit:

Dragging the line 1 (pink color) or the line 2 (green color) allows you to move the line 1 or the line 2. Dragging the point on the line 1 or the line 2 allows you to adjust the line 1 or the line 2.

**■[Intersection circle to line]**

Draws a point at the intersection of circle and line.



- 1** Click the [Intersection circle to line] button .
- 2** Click a position you want to set as a first point of the circle on the 2D image view area.
- 3** Click a position you want to set as a second point.
- Moving the mouse displays the circle.
- 4** Click a position you want to set as a third point.
- The circle is created.
- 5** Click a position you want to set as a first point of the line.
- Moving the mouse displays the line.
- 6** Click a position you want to set as a second point of the line.
- The line and the intersection points (circle and line) are created.

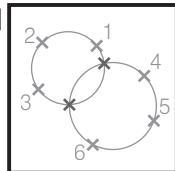
To edit:

Dragging the circumference allows you to move the circle. Dragging the point at the center of the circle allows you to move the circle. Dragging the point on the circumference allows you to adjust the position or the size of the circle. Dragging the line allows you to move the line. Dragging the point on the line allows you to adjust the angle of the line. Editing the circle or the line allows you to update the intersection point.



■[Intersection circle to circle]

Draws a point at the intersection of two circles.



- 1 Click the [Intersection circle to circle] button .
 - 2 Click a position you want to set as a first point of the circle 1 on the 2D image view area.
 - 3 Click a position you want to set as a second point.
- Moving the mouse displays the circle.
- 4 Click a position you want to set as a third point.

The circle 1 is created.

- 5 In the same manner, create the circle 2.

The intersection points (circle 1 and circle 2) are created.

To edit:

Dragging the circumference allows you to move the circle.

Dragging the point at the center of the circle allows you to move the circle.

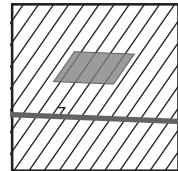
Dragging the point on the circumference allows you to adjust the position or the size of the circle.

Editing the circle allows you to update the intersection point.



■[Streak]

Draw a line orthogonal to the texture of the sample surface in the region.



- 1 Click the [Streak] button .
- 2 Drag from a position you want to set as a start point to a position you want to set as an end point of the region on the 2D image view area.

The region is created. A line orthogonal to the texture on the sample surface in the region is created.

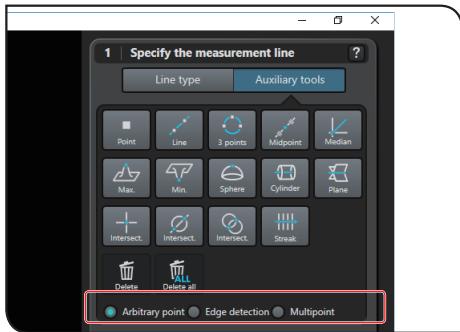
To edit:

Dragging the region allows you to move the region.

Dragging the handle on the outside frame of the region allows you to adjust the position and the size of the region.

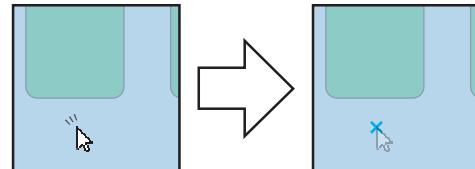
Editing the region allows you to update the orthogonal line.

Detecting a point or a line



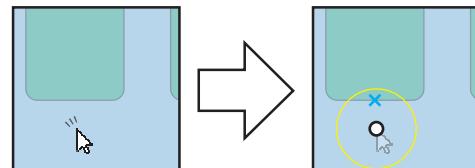
■[Arbitrary point]

Creates a “point” or a “line” on the clicked position.



■[Auto edge detection]

Detects the edge automatically from the surrounding area of the clicked position and creates “point” or a “line”, etc. This function is not available for [Maximum height], [Minimum height] or [Average].

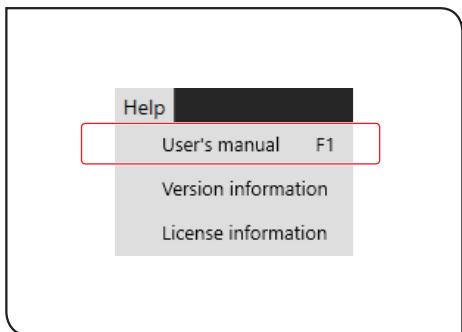


■[Multipoint]

Specifies a point or a line from multiple points using the least-square method. This function is not available for [Point], [Midpoint], [Maximum height], [Minimum height], [Sphere center], [Cylinder axis], [Surface intersection line] or [Streak].

Viewing the instruction manual

You can view this instruction manual on the monitor.



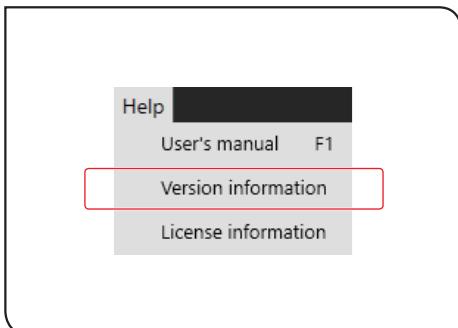
- 1 Select [User's manual] from the [Help] menu.

This instruction manual is displayed on the monitor.

Checking the version and license information

This section describes the procedures to check the version of the system or the analysis application and license information of optional functions.

Version information of the system and the analysis application



You can check the version of the system and the analysis application.

- Select [Version information] from the [Help] menu.

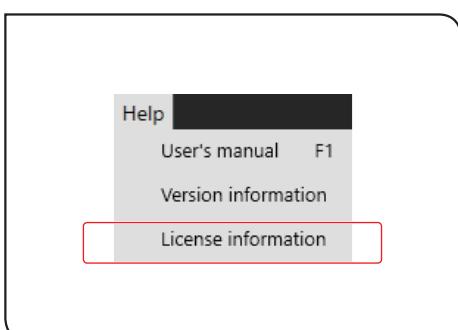


The [Version information] screen appears.

Name	Description
a) [Application version]	Displays the version of the analysis application.

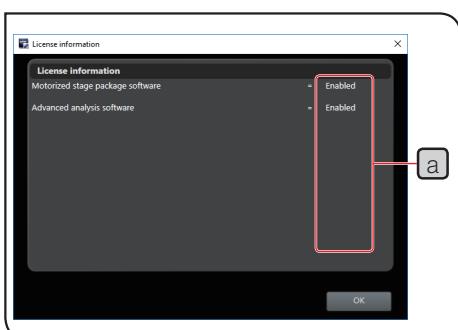
- When you finish checking the version, click the [OK] button to close the [Version information] screen.

License information of the analysis application



You can check license information of optional functions of the analysis application.

- Select [License information] from the [Help] menu.



The [License information] screen appears.

Name	Description
a) Enable/Disable	[Enable]: You can use optional functions. [Disable]: You cannot use optional functions.

- When you finish checking the license information, click the [OK] button to close the [License information] screen.

Installation and Uninstallation of the analysis application

Operating environment of the analysis application

Refer to the material "OLS50-BSW" provided with the installation DVD of the analysis application.

Installing of the analysis application

NOTE

- Login to Windows as an administrator.
- Before installing the analysis application, remove the USB license key from the USB port of the PC.
- When the authorization inquiry screen appears, select the button indicating to permit all.
- After installation, be sure to restart the PC.
- If .NET Framework of the unsupported version is installed on the PC, uninstall it before installing the analysis application.
- After installation, insert the USB license key to the USB port of the PC before using the analysis application.

1 Insert the installation medium into the disk drive of the PC.

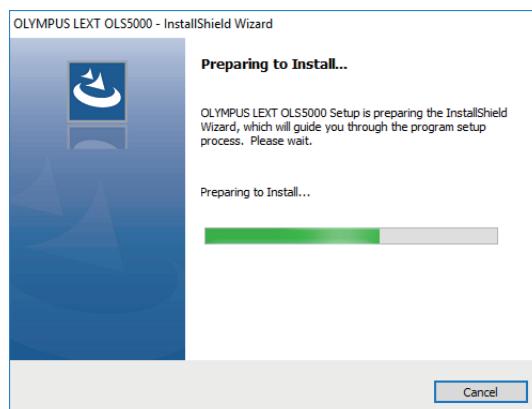
2 Double-click Setup.exe (or Setup) of the following folder of the installation medium.

D:\02_AnalysisApp_Installer\64bit

(If "D:" drive is not a DVD drive, change the part of "D:" to the character of the DVD drive.)

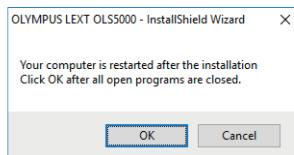
(If you are using a 32bit PC, the folder is "D:\02_AnalysisApp_Installer\32bit".)

3 The screen below is displayed.

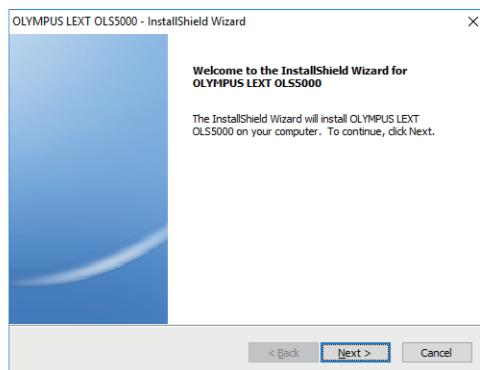


- 4** Click the [OK] button when the screen below is displayed.

Caution : Close the other running applications



- 5** Click the [Next] button when the screen below is displayed.

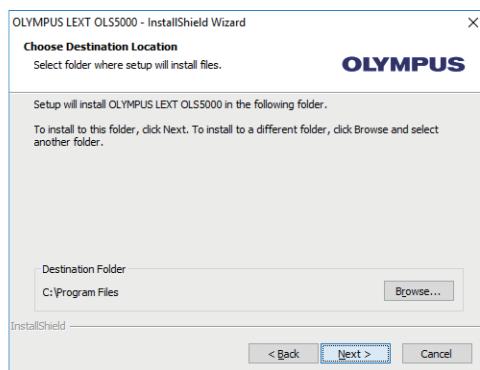


- 6** Select the [I accept the terms of the license agreement] and click the [Next] button.

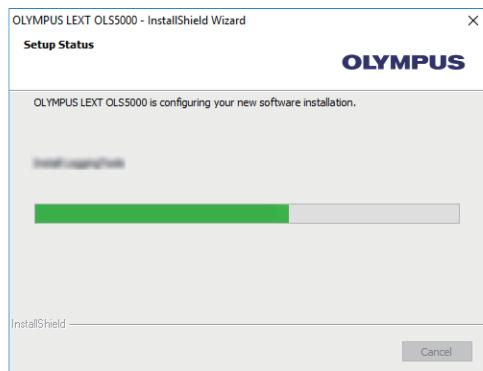


- 7** If you do not change the destination folder, click the [Next] button.

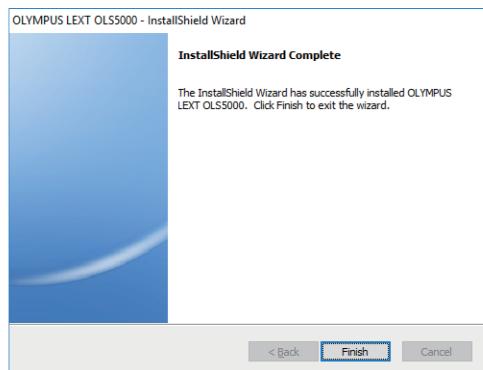
If you change the destination folder, click the [Browse...] button to select the destination folder, and click the [Next] button.



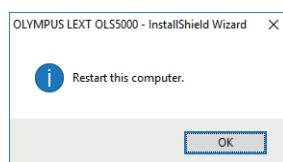
- 8** When installation starts, the screen below is displayed.



- 9** Click the [Finish] button after installation is completed.



- 10** Click the [OK] button after the screen below is displayed to restart PC.



Uninstalling of the analysis application

NOTE • Login to Windows as an administrator.

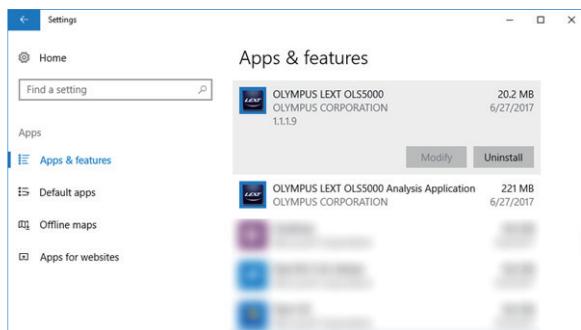
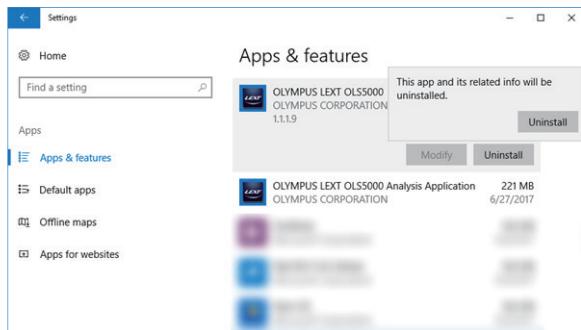
- Before uninstalling the analysis application, remove the USB license key from the USB port of the PC.
- When the authorization inquiry screen appears, select the button indicating to permit all.
- After uninstallation, be sure to restart the PC.

1 Display the program list.Windows 10

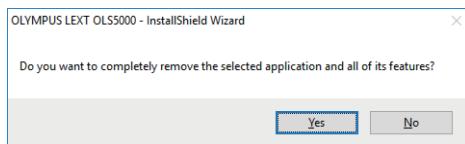
Select in the order of [Start] menu, [Settings], [System] and [Apps & features].

Windows 7

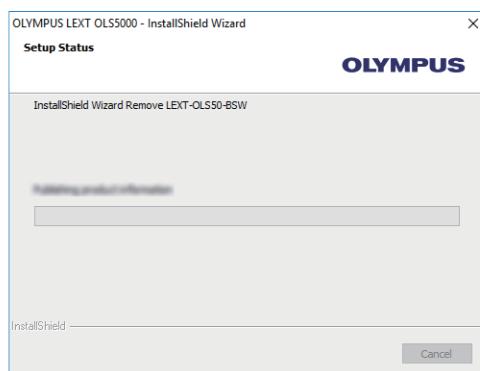
Select in the order of [Start] menu, [Control panel] and [Programs and Features]

2 Select the [OLYMPUS LEXT OLS5000] from the program list and click the [Uninstall] button.**3** Click the [Uninstall] button again.

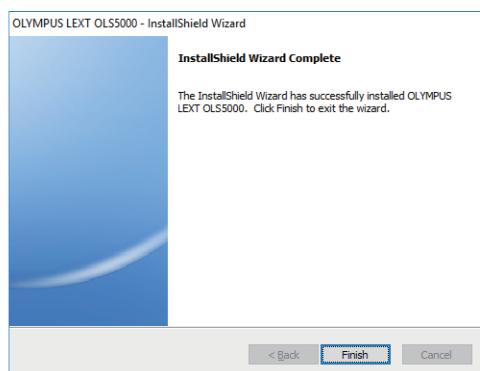
- 4** Click the [Yes] button when the screen below is displayed.



- 5** When uninstallation starts, the screen below is displayed.



- 6** Click the [Finish] button after uninstallation is completed.



- 7** Restart PC after uninstallation is completed.

Installation of optional applications

When you purchase optional applications, be sure to install them on the controller or the PC by yourself. When they are installed, you can use the optional functions on the data acquisition application or the analysis application.

NOTE

- Be sure to install the optional applications on the controller or the PC where the data acquisition application or the analysis application is installed.
- Log in to Windows with the administrator authority.
- If you install the multiple optional applications, follow the procedures described below by each optional application.

- 1 Close the data acquisition application and the analysis application.
- 2 Make sure that the USB license key is connected to the controller or the PC.
- 3 Insert the installation medium of the optional application into the disk drive of the controller or the PC.
- 4 Double-click “OLS50-S-XXX.exe (or OLS50-S-XXX)” in the installation medium.
(XXX: Name of the optional application)
- 5 On the screen where the following message is displayed, press the **[y]** key of the keyboard and press the **[Enter]** key.
“YYY is currently disabled. Do you wish to enable it? [y/n]”
(YYY: Function name of the optional application)
- 6 When the following message is displayed, the optional application is installed successfully. Press the **[Enter]** key of the keyboard.
“YYY has been enabled.”
“Press ENTER to exit.”
(YYY: Function name of the optional application)
- 7 Start the data acquisition application or the analysis application and make sure that optional functions are enabled.

TIP

For checking whether the optional functions are enabled or not, see “License information of the analysis application” (page 425).

Log file collection

You can collect information (log file) of the PC.

- 1 Right-click the following files in Windows Explorer.

C:\Program Files\OLYMPUS\LEXT-OLS50-SWTTools\LogTools
LogCollection.exe

- 2 Select [Run as administrator] from the menu displayed.

The [OLSLogCollectionTool] screen appears.

TIP • To change the language on the screen, select the language from the [Language] dropdown list **a**.

• You can select [Japanese] or [English].

- 3 Set the term to collect information.

Collecting all information from the time you started using the PC

1. Select the [CollectingAll] radio button **b**.

Collecting information in the specified term

1. Select the [CollectingTerm(yyyymmdd)] radio button **c**.

2. Input a start date of the term you want to collect information in the text box (left side) **d** below the radio button.

TIP • You can use only numerical character.

• Input in the order of Year (4 digits), Month (2 digits) and Date (2 digits).

3. Input an end date of the term you want to collect information in the text box (right side) **e** below the radio button.

4. If you save only the information file (TXT file), select the [NonCompression] radio button, and if you save both the information file and the ZIP file, select the [Compression] radio button.

TIP The [Compression] radio button is selected as default. You do not need to change it.

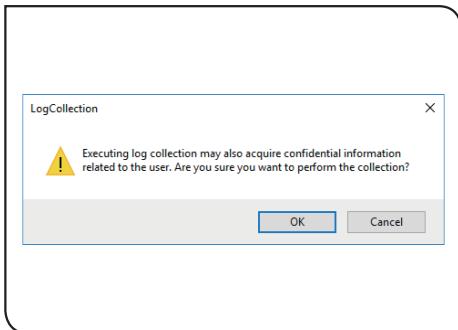
- 5 Click the [OpenFileDialog] button .

The [Browse for Folder] screen appears.

- 6 Specify the save destination of the information file and click the [OK] button.

The specified save destination is displayed in [Destination] **f**.

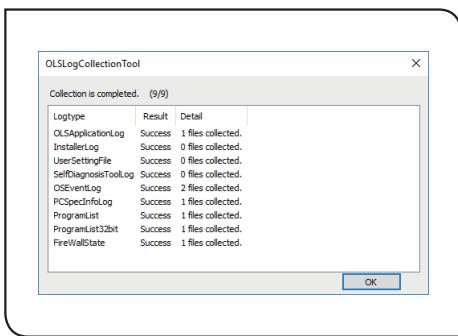
- 7 Click the [Collection] button .



- 8** When the message asking to start collecting information appears, click the [OK] button.

The information collection starts.

- TIP** It is recommended not to operate the PC while collecting information.



When the information collection is completed, the [Collection is completed] screen appears

- 9** Click the [OK] button to close the [Collection is completed] screen.



You are back to the [OLSLogCollectionTool] screen.

- 10** Click the [Close] button at the top right of the [OLSLogCollectionTool] screen to close the [OLSLogCollectionTool] screen.

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MEMO

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