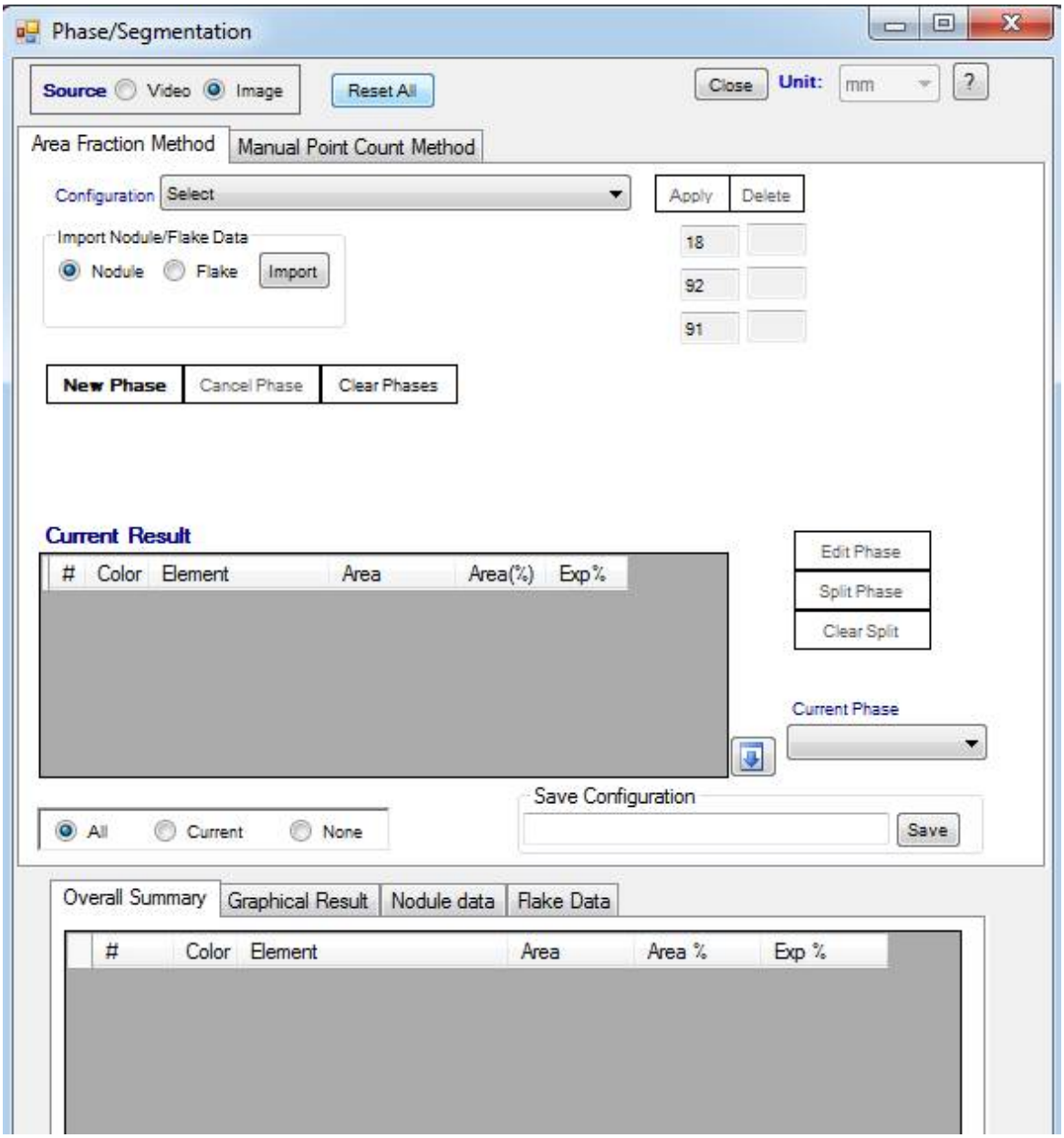
Phases/Segmentation

This method determines the phase/segmentation data for sample images. This will help you to find the perlite/ferrite content of the sample images. This method can be accessed through “Measurementsà Phases”. You can measure Phases for multiple samples and add each result to the final result list for report generation. This method identifies different components based on its color. The Phases window will be as shown below.



There are two methods for finding the Phase data

- **Area fraction method**
- **Manual Point count method**

Area Fraction method

This method determines the area % of each element identified on the image based on color range. This method also allows the user to filter out an element based on color as well as shape/size, thus enabling the user to split a phase into different elements which has same color range.

- Select Phases option from “Measurements--> Phases”
- The window displayed will be as shown above
- Select the Area fraction method tab
- Select the image source as Image (if already opened) or Video is Camera play is started
- Import Flake/Nodule result. These steps are explained here. THIS IS AN OPTIONAL STEP.
- If you already have **Phase Configuration** saved, select that phase from the “Configuration” drop down list and click “Apply” button, where the system will apply the defined configuration and detect the elements defined in the configuration.
- If you don't have any Configuration saved, create phase configuration as explained in the “**Phase Configuration**” section
- You will get result under “Current Result” box
- Click on the “Down Arrow” button as shown below to add the current result to “Overall Summary” box.

- If you have images from more samples, open the image by clicking on the image link on the right window pane, the current configuration defined/opened will apply automatically to the image opened, except for Manual marking of phases, Boundaries defined, and any Erasing done.
- To generate report, click on the “Report” button. You may need to add at least one sample to generate report.

· While generating report, you can have the images of all samples added in the report or any one image.

· You can select “All” to have images of all samples, or the field number from “Field Image” option

· Report can be in PDF or Excel. You can change the report format in **System Configuration**.

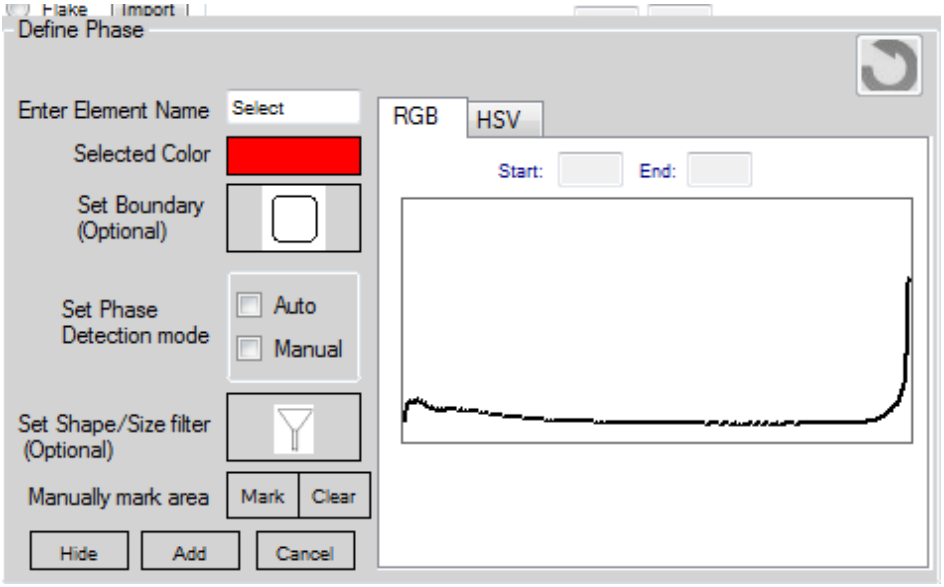
Phase Configuration

· To select a Phase, follow the below steps.

· **Start New Phase:** Click on “New Phase” button.

· A color dialog will appear where you have to select the color you want to apply for the phase you want to define

· Once color is selected, a new dialog box will appear as shown below.

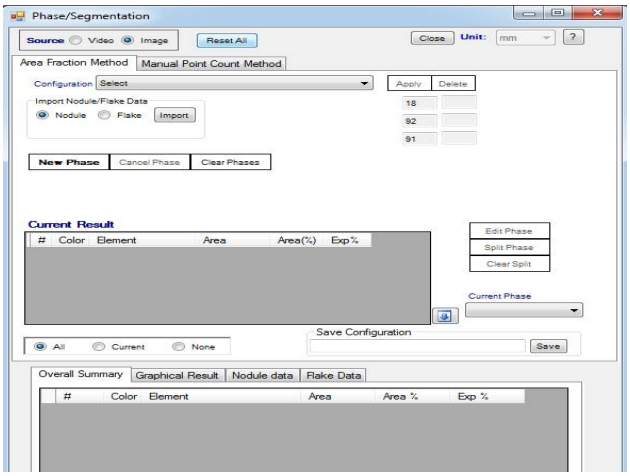


· **Enter Phase name:** Enter an unique phase name in the text box “Enter Element Name”.

· The selected color for this phase will be shown against “Selected Color” box

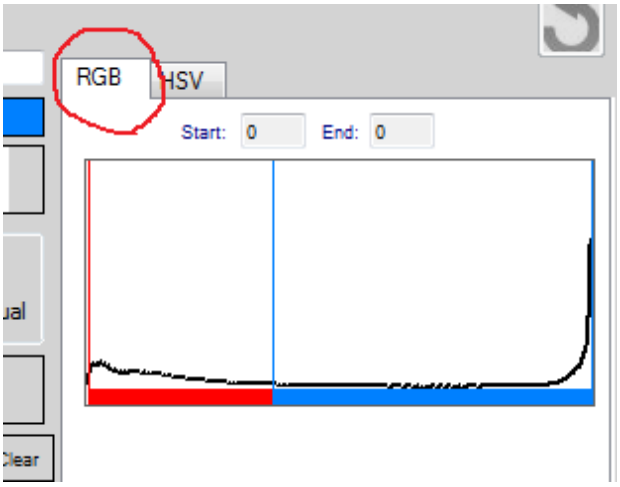
· **Set Boundary (OPTIONAL):** This is an OPTIONAL step. If you want to set a boundary limit within which you want to define this phase (eg: area close to the hardened case), you can use this feature. Clicking on this button will enable you to define closed contour areas

on the image which will act as boundary within which this phase will be detected. You can define more than one boundary. A contour can be defined using mouse left button – Press down, move/drag defining contour, release button. You don’t need to close the contour, system will automatically close the contour if open, by joining the end point and start point. A small dialog box as shown below will appear which will list the boundaries you have created. You can create new one or select existing ones created already. You can also delete any boundary already created. Once you have selected the boundary(s), click on the “Set” button to add these selected boundary conditions for this phase. You can select a Contour or ROI (Rest of Image).

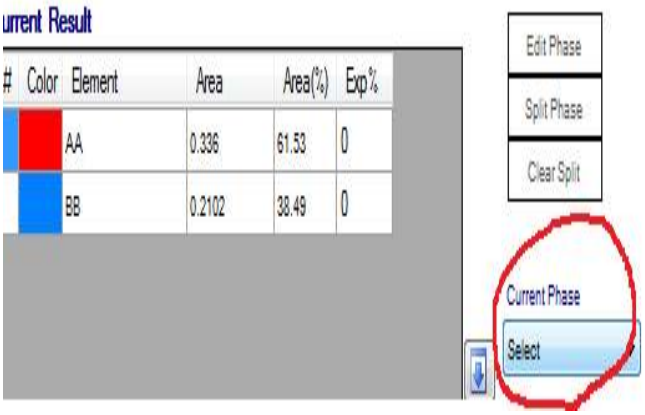


· **Select RGB/HSV Method:** There are two methods provided for image segmentation. Default method is RGB and should work for most of the images. In certain images (especially those with PINK shade), RGB method may not be appropriate for image segmentation by color/share. In such cases, please use HSV (by selecting HSV tab). In RGB method, image is segmented based on the gray scale value of each color/shade. In HSV method, the parameters Hue, Saturation, and Value are used for Image segmentation. If RGB method does not segment image properly, use HSV method. You can use RGB method for one Phase and HSV method for another phase in an image.

RGB Segmentation



HSV Segmentation



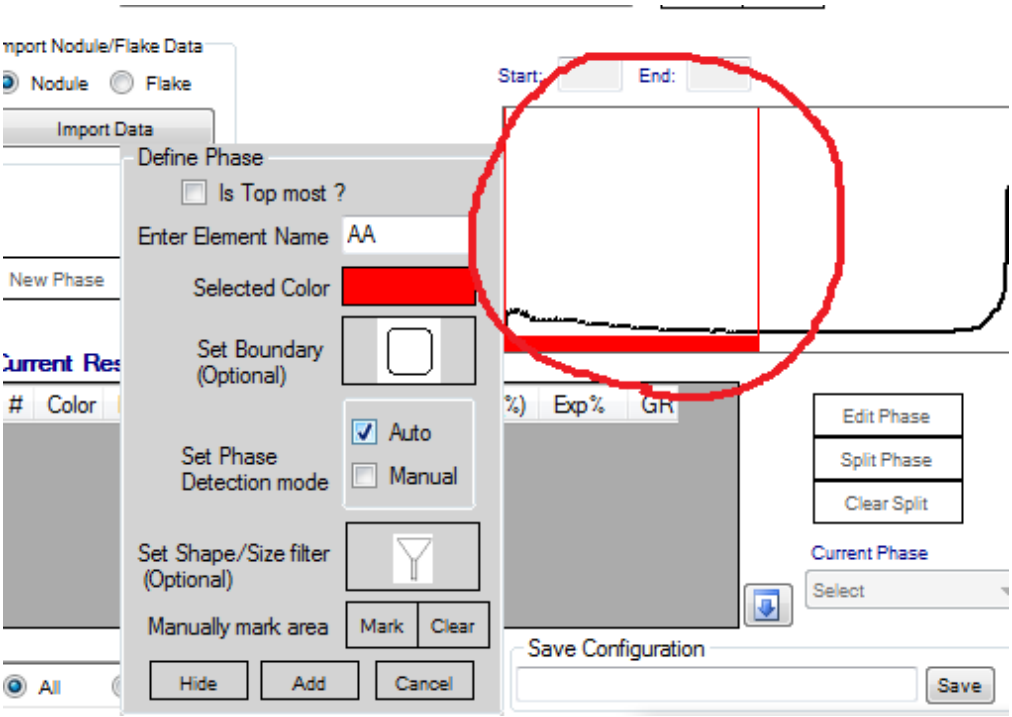
- **Set Phase Detection mode:** You can select the Auto mode or Manual mode for selecting the phase from the image.
- **Selecting Phase Color Range:**

  RGB Mode:

  In RGB Mode, if you select "**Auto**" option, system will automatically create a color range and apply for this phase. The image will be updated accordingly as well as the Image histogram updated for this phase. The image histogram will be as shown below. You can adjust the phase color range using mouse the phase histogram boundaries.

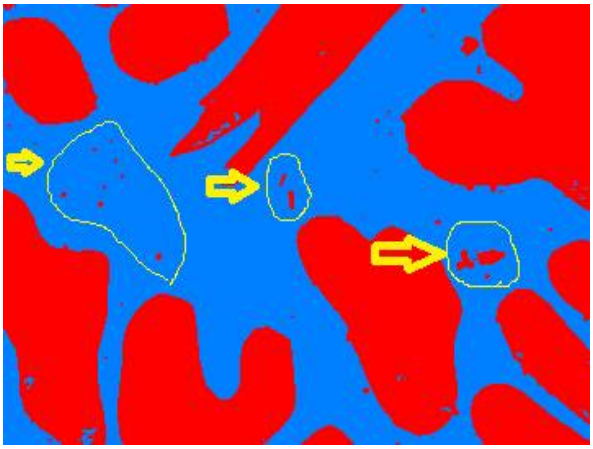
The histogram has a range of 0 – 255. You can move the left and right boundary lines of the phase color range to adjust it.

If you are using “**Manual”** option, you need to select the color from the image for building the phase color range. You can select the color for building the phase color range using mouse single click of left button or by defining a small contour (mouse left button – press, drag/move to create contour shape, release) over the phase area on the image you want to select. The system will automatically identify the color range of the point you clicked or the area you selected using mouse and will build your phase color range accordingly. Simultaneously, you can also adjust the boundary lines created on the histogram. You have to scan the whole image to make sure that all image area which has this phase color range is selected.



HSV Mode:

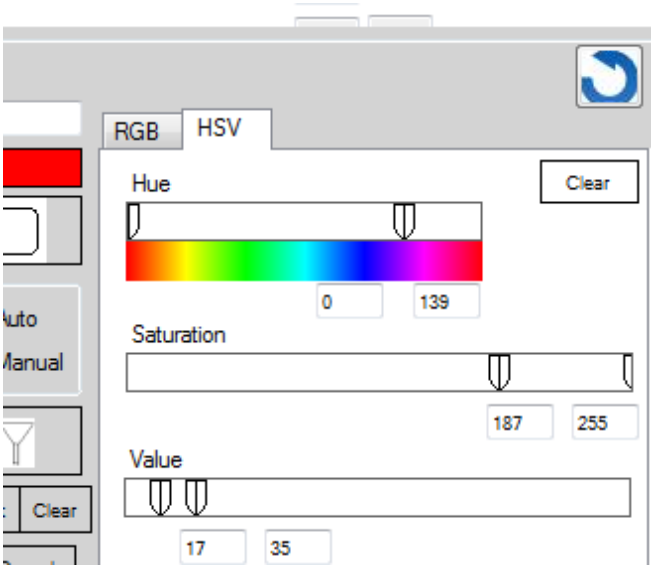
In HSV Mode, whether you select “Auto” or “Manual” option, system will reset the Hue/Saturation/Value selection bars to ZERO as shown below.



If you select “Auto” option, you can create phase color range by adjusting the double track bars for Hue, Saturation and Value.

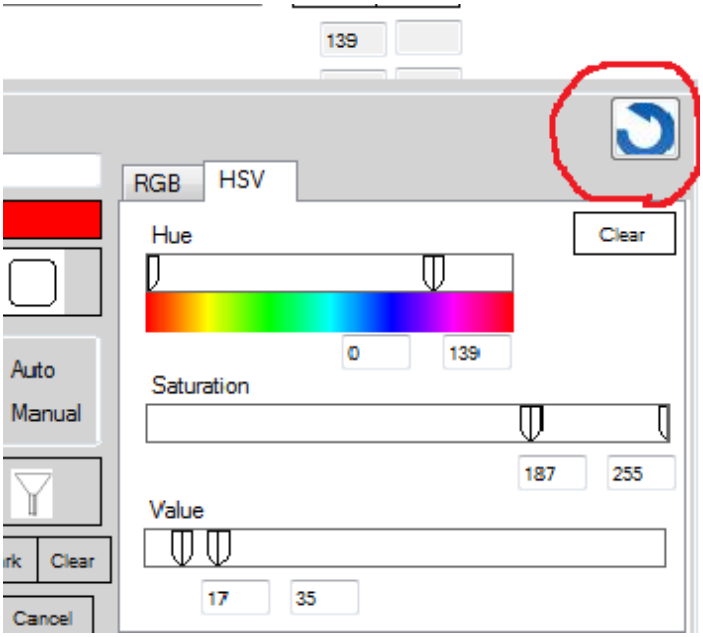
Recommended option for HSV mode is “Manual”. You can select the color for building the phase color range using mouse single click of left button or by defining a small contour (mouse left button – press, drag/move to create contour shape, release) over the phase area on the image you want to select. The system will automatically identify the color range (Hue, Saturation and Value) of the point you clicked or the area you selected using mouse and will build your phase color range accordingly. Simultaneously, you can also adjust the double track bar for Hue, Saturation and Value. You have to scan the whole image to make sure that all image area which has this phase color range is selected.

An updated HSV range shall look like below.



UNDO changes in Phase Color range detection

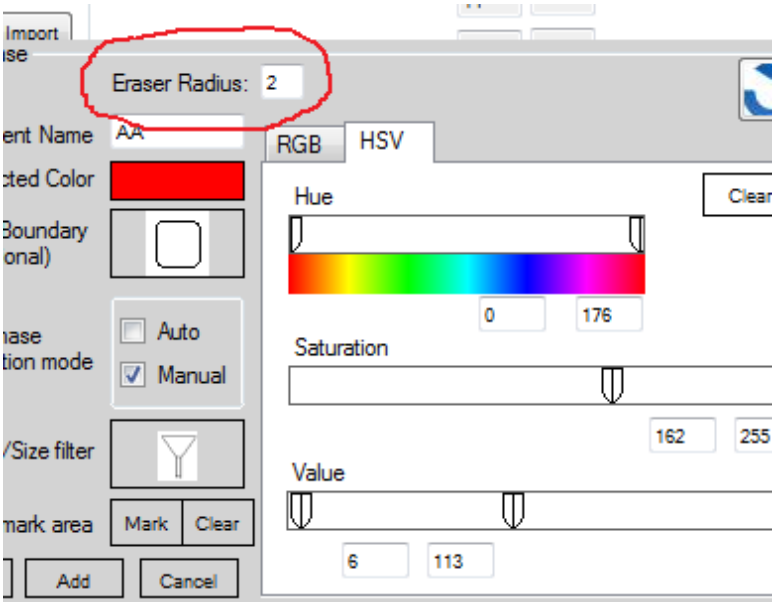
You can UNDO the changes done during Phase color range selection process by clicking on the UNDO/ROLLBACK button as shown below. You can undo all the changes up to the start for each Phase.



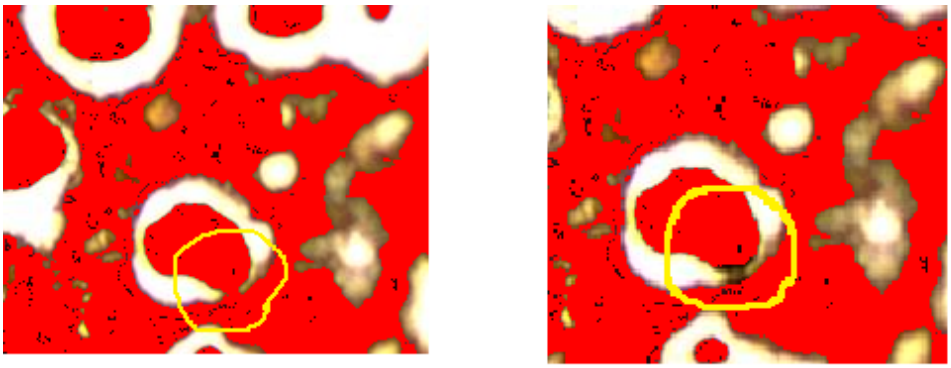
- **Multiple HSV Ranges:** You can set multiple HSV ranges while creating HSV color range for the current Phase. If a phase color range selection may overlap with color for other phase elements, then we may need to split the over HSV color range for the current Phase. This is done using the “Set” button in the HSV window. Each time you click on the “Set” button after defining a partial HSV range for the phase, the current HSV range shall be added to the HSV range list. Now you can start again fresh for the next partial range. You can add any number of partial ranges. The OVERALL HSV range for the current Phase will be the combination of all the partial HSV ranges you have added through “Set” button.

- **Erase part of Phase selected:** You can manually erase part of the phase selected on the image. This can be done using Mouse Right button. On the area of phase which needs to be erased, press down

mouse right button and move over the area to be erased. Upon completion, release mouse right button. The radius of the eraser can be set in the text box as shown below.



An example is shown in the below image: Image on the left size before erase and on the right side after erase. On the right image, the connection has been erased.



Before **After**

· **Set Shape/Size Filter (OPTIONAL):** Once you have created the phase color range for your phase, you need to set any shape/size filter for this phase. THIS STEP IS OPTIONAL. This can be done by

clicking on the “Set Shape/Size filter” button. You will get a new dialog box as below.

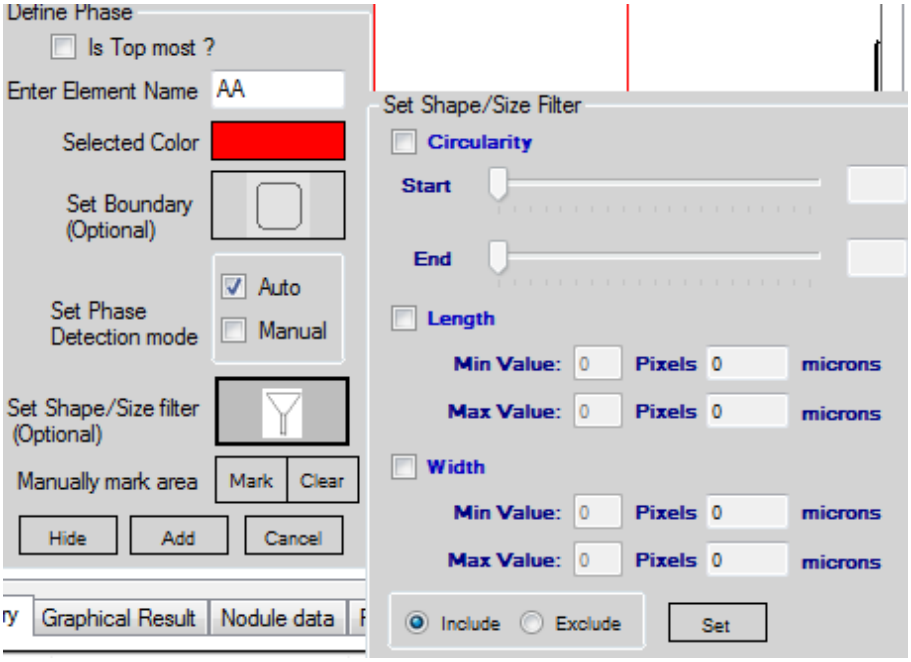
You can filter the phase by circularity or shape factor, length and width.

To set filter by circularity, check the “Circularity” check box and adjust and Start and End values for circularity. The Start and End values can be adjusted by moving the bar left or right. The corresponding values will be displayed in the text boxes on their right side. Circular shapes will have a high value of start and end values while elongated shapes will have low value for start and values.

You can filter the phase by length by checking the “Length” check box, and setting the Min and Max values

You can filter the phase by width by checking the “Width” check box, and setting the Min and Max values

Click on “Set” button to add the filter conditions to this phase definition.

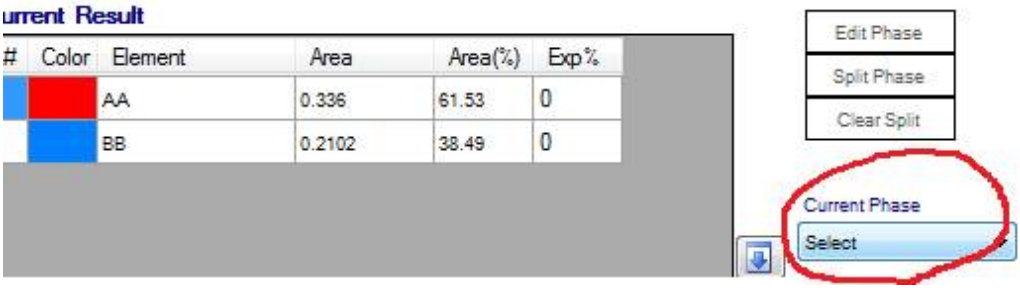


· **Manually mark area (OPTIONAL):** You can also manually mark any area for this phase, which has not be selected by the above discussed methods. This method is used to detect the cases where

some areas of the phase are not detected by the normal methods and the user wants to isolate them. After clicking on the "**Mark**" button, user can create any number of closed contours which will mark the areas not already detected by the previous steps. When you click on "**Mark**" button, the text will change to "**End**" and "Add" phase button will be disabled. This step has to be repeated each time you measure this phase, and cannot be added to the phase definition. Once manual marking is complete, click on "**End**" button. Upon clicking "**End**" button, "**Add**" phase button will be enabled.

- **Adding Phase:** Once you have completed the detection of the phase, click on the "Add" button to add this phase to the phase configuration.
- Repeat the above processes to create next phase, until you have completed the definition of all the required phases.
- Now save this configuration by entering an unique Configuration name and clicking on the "Save" button. This will help the user to use the definitions for all future phase measurements. User can create any number of configurations that suits the specific measurement requirement.
- **Save Phase Configuration:** The above Phase configuration steps (for all Phases created) can be saved in the system for future use, so that the manual steps explained above need not be repeated for each sample. Since the phase configuration values and phases to be detected shall vary for different sample material, system provides the option to create and save any number of configurations. User can create configurations for each material type or phase element type wise.

- **Editing Phase:** You can edit added phase. Once you have created the phases for your image, the phase window will look as below.



From the list under “Current Phase”, select the phase you want to edit. After selecting the Phase to be edited, click on “Edit Phase”.

The Phase creation dialog window will be opened, with the phase details populate.

If the phase was created in “Auto” mode, the “Auto” checkbox will be selected.

If the phase was created with “Manual” mode, “Manual” checkbox will be selected.

If the phase color range was created using RGB method, RGB tab will be selected, with the Histogram updated. You can adjust the color range by adjusting the position of the vertical lines, which stands for start and end values in the gray scale range.

If the phase color range was created using HSV method, HSV tab will be selected, with Hue, Saturation and Value track bars updated for the current phase. You can adjust these track bars to update the color range selection.

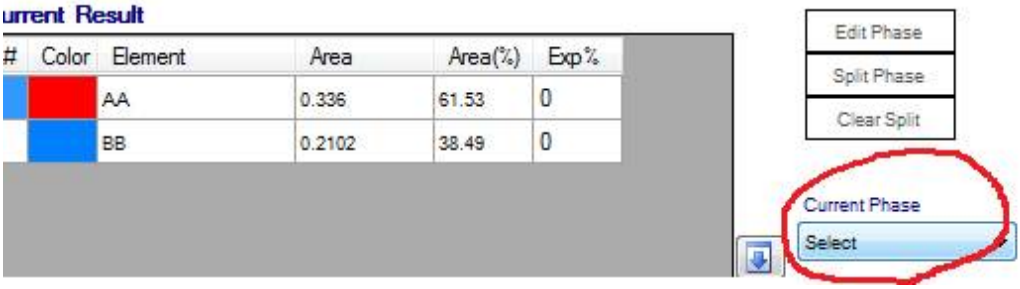
You can update phase range selection using Histogram/Track bar, or by clicking/defining area on the Image to update the color range selection (If Manual mode).

You can also add/remove other optional filters like “Set Boundary” and “Set Shape/Size filter”.

Once you have completed the changes, click on “Add” button. The phase data will be updated with the changes.

· **Split Phase:** You can split a phase created, which may consists of 2 elements, but with same color range. To split a Phase, follow the below steps.

Select the phase you want to split

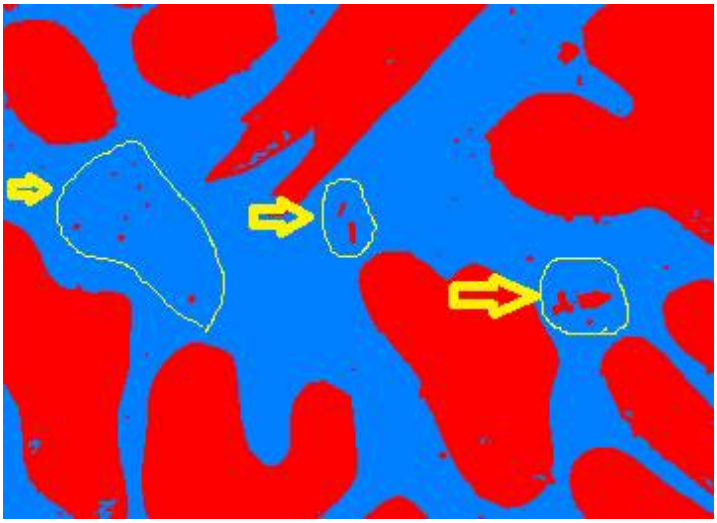


Click on “Split Phase” button. A color dialog will be opened, where you have to select the color to be applied for the split phase area.

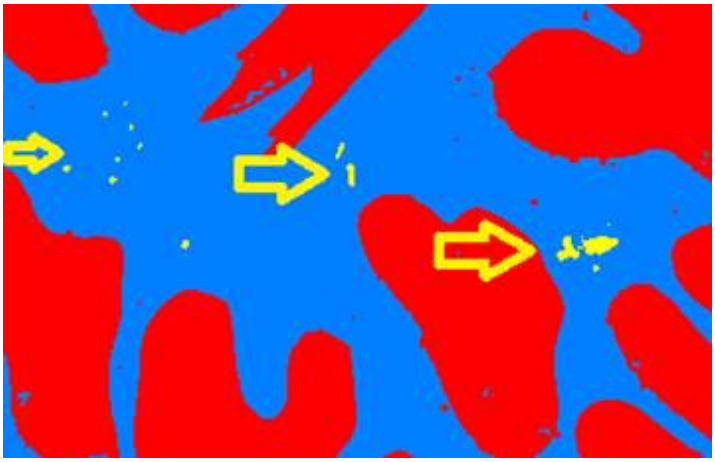
Once color is selected, the phase creation dialog will be opened. You will not be able to change any properties of the phase here.

Mark areas using mouse right button pressed around the phase features which needs to be split or separated from the current phase. The marking is done by defining an area with mouse left button pressed, and releasing the button at the end. You can mark any number of areas separately. The contour boundary will have the same color as the split phase color selected at the start of the split phase process.

The image will look as below after marking completed.



Once you have finished marking, click on “Add” button. The phase features inside the marked areas will be split into another phase and color of those areas will be changed to the split phase color. Below image will show how the changes will be effected.

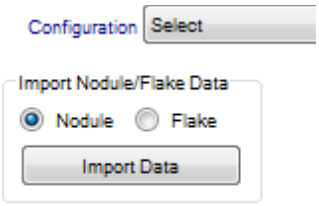


To clear the split, select the phase which was split earlier, and click on “Clear Split” button.

Import Nodule/Flake result

This feature is used where Nodularity/Flake data is already analyzed and saved in the system and needs to be added to the Phase report. Please refer Nodule Analysis and Flake Analysis sections on how to save the Nodule/Flake data to be used in Phase analysis.

- To import Nodule or Flake data, please follow the below steps
- Select whether Nodule or Flake you want to import and click on “Import Data” button under “Import Nodule/Flake Data” section as shown below.



A browser dialog will open where you need to select the Nodule or Flake data result saved and click “OK” button

· You will get a message that “Data imported successfully”

· Now you can select your Phase configuration and apply or create new configuration as mentioned in “Phase Configuration”.

· Once you have defined all your phases, if you have selected Import Nodule/Flake data option, you may need to tell the system which phase element is your Graphite component. The “Current result” window will have one new column called “GR” as a check box, as shown below

· Check the Graphite element. System will recalculate the Area % including the graphite % imported through Nodule/Flake data result

· For example, if your Pearlite is 90% and Ferrite is 10%, and your graphite% imported is 10%. If you have checked Pearlite as the graphite element, system will substract graphite% from Pearlite%, and then recalculate the Pearlite and Ferrite % so that their sum will be 100.

· Click on the “Down Arrow” button as shown below to add the current result to “Overall Summary” box.

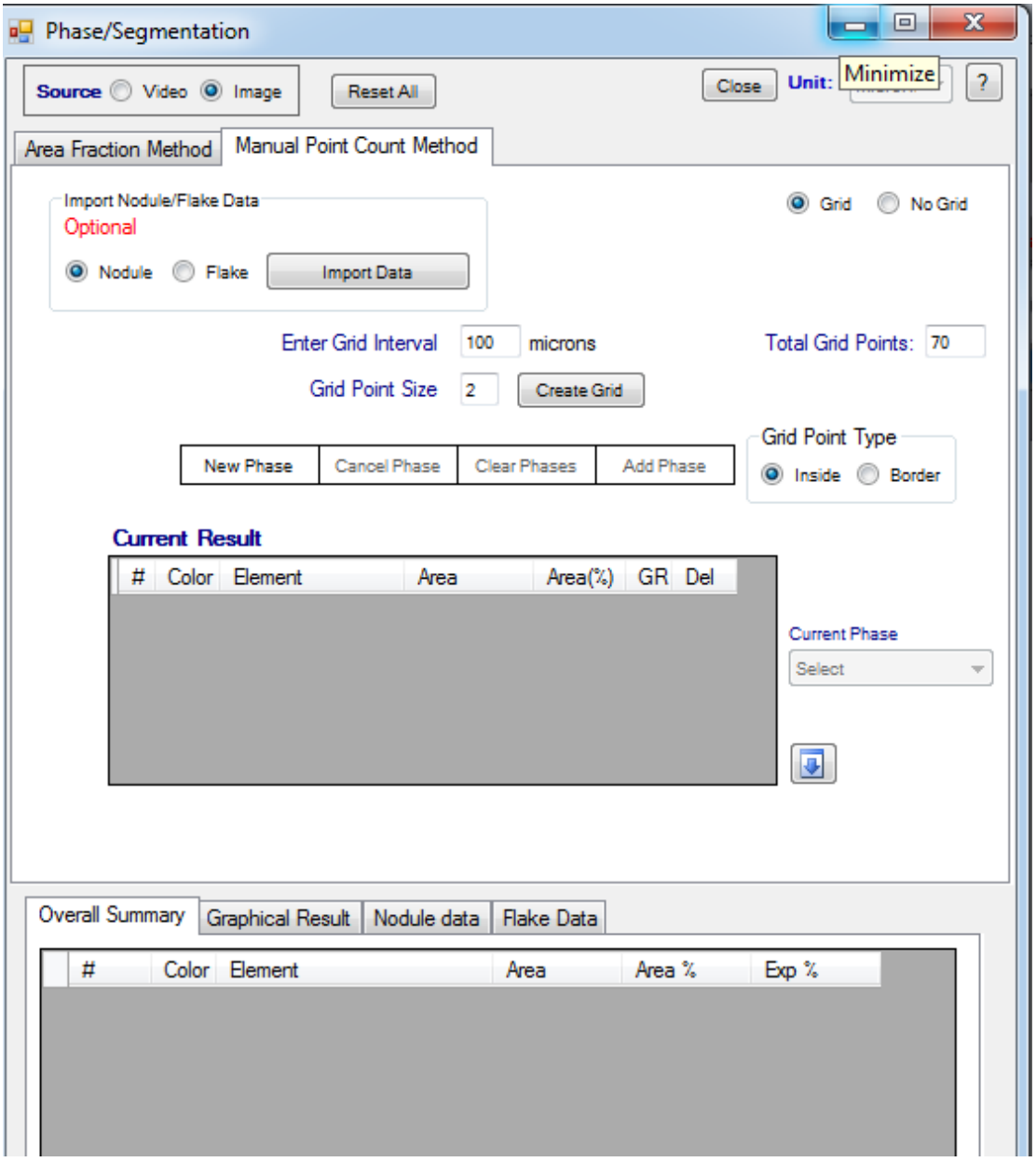
- You can add results from mode samples

· Reports in Excel can be generated by clicking on the “Report” button. A small window will be shown where user has the option (OPTIONAL) to enter details which will be displayed in the report along with the result.

· While generating report, user has the option to select the image to be displayed in the report. User can also select “All” images.

Manual Point Count method

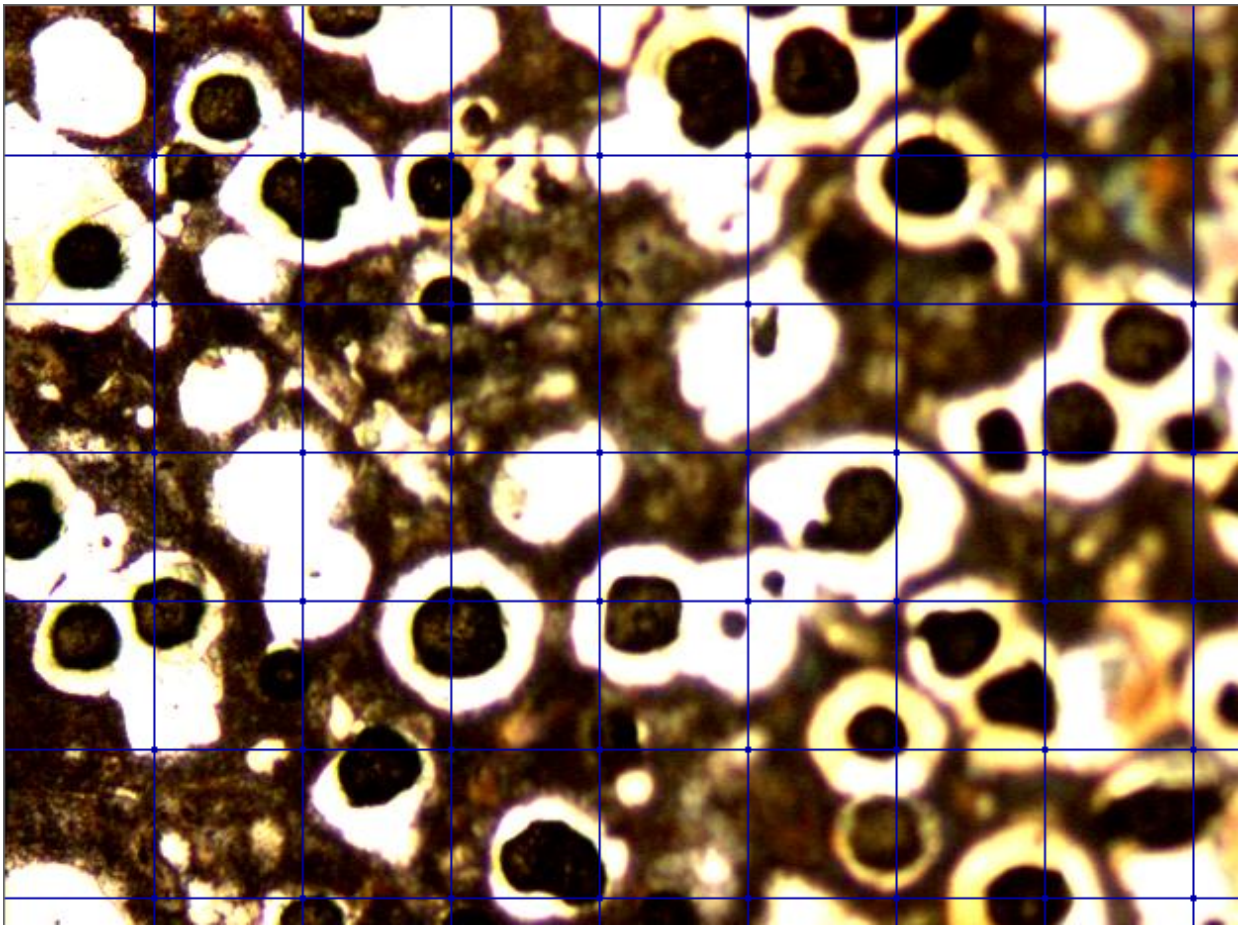
This is another method for detecting the phase, using a grid. The interface is as shown below:



The work flow is as below:

- User can import the Nodule Flake data as explained before here. This is an OPTIONAL step.

· User has to create a grid by clicking on the “Create Grid” button. System will prompt the user for grid color. User also can set the Grid interval in microns and grid line width. The grid on the image will look as below



· Click on the new phase button. Cancel Phase will cancel the current phase. Clear Phases will clear all phases defined

· System will prompt for Phase name, enter the unique phase name

· System will prompt for Phase color, select the phase color

· Now user has to select the grid intersection points which fall on the phase to be created. This can be done by mouse click on the grid intersection that falls on the phase or by drawing a contour shape around the intersection point(s) to be selected for the phase. If the user has drawn a contour shape to select the intersection points, all the points that fall inside the contour shape shall be selected. For each grid intersection thus selected by the user, user can to select whether the

intersection falls inside the phase or on the phase boundary. This can be done by selecting “Grid point Type: Inside or Boundary” If user clicks again on the selected grid intersection, it will be unselected.

· Once user has completed selecting all grid intersections for this phase, click on “Add Phase” button

· Repeat the above process for other phases to be detected

· Click on the “Down Arrow” button as shown below to add the current result to “Overall Summary” box.

· You can add results from mode samples

· Reports in Excel can be generated by clicking on the “Report” button. A small window will be shown where user has the option (OPTIONAL) to enter details which will be displayed in the report along with the result.

· While generating report, user has the option to select the image to be displayed in the report. User can also select “All” images.