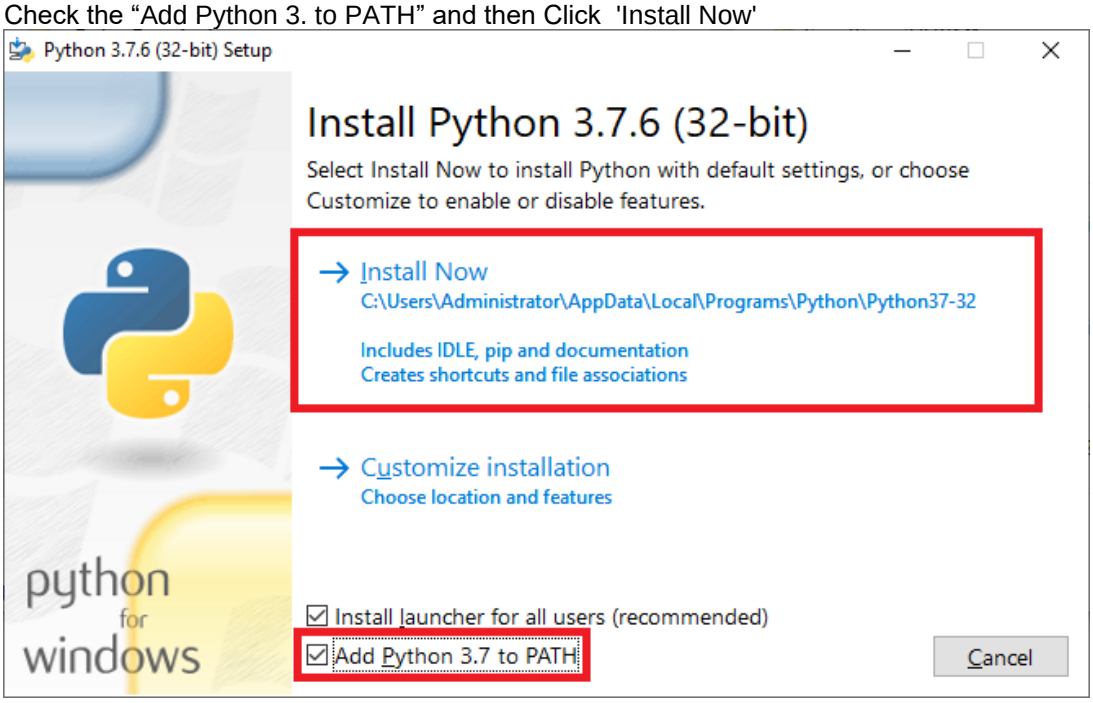
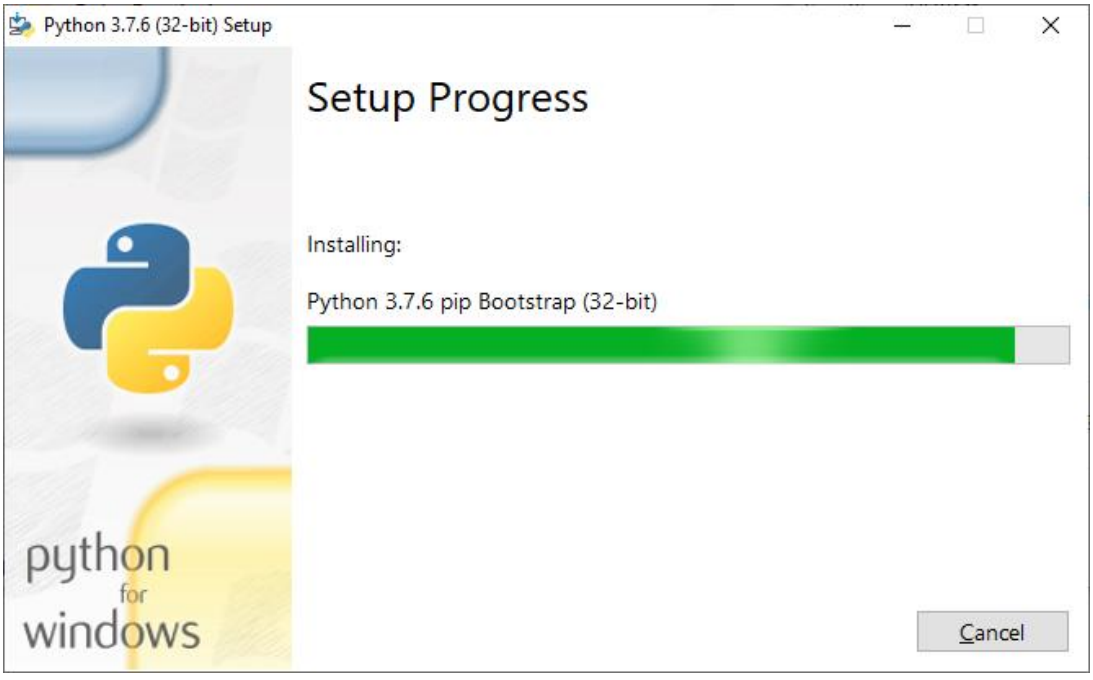
How to extract the Metadata using the PSPylib

1.1 Installing Python

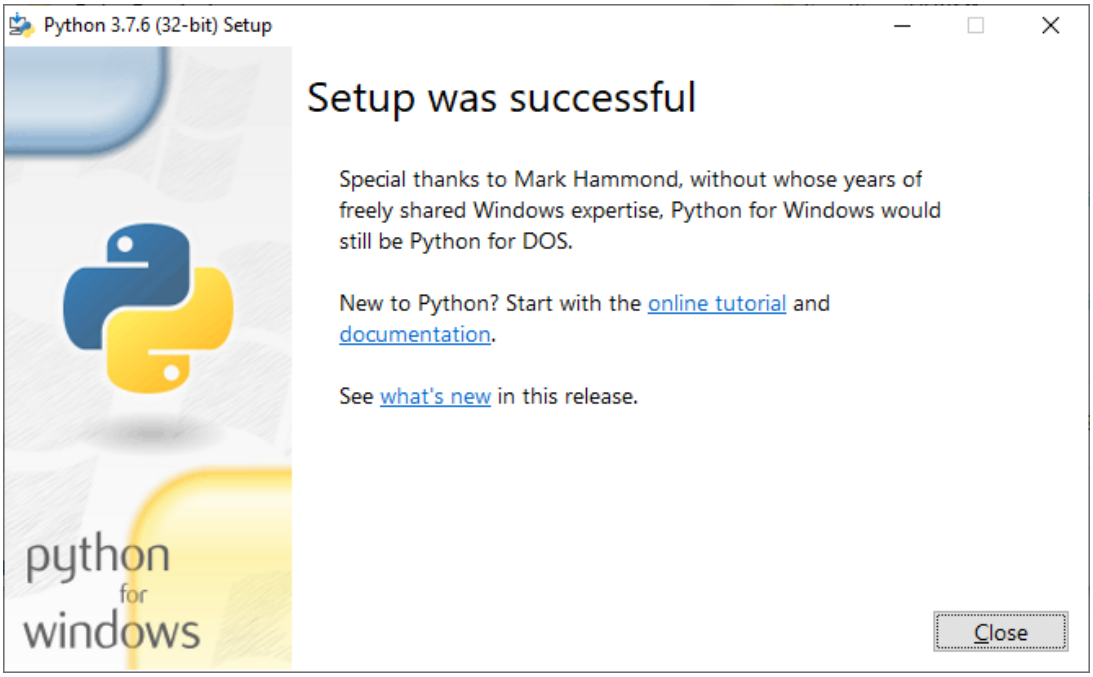
- Download the Python 3.7.6 32bit (https://www.python.org/ftp/python/3.7.6/python-3.7.6.exe)
- Open “python-3.7.6.exe”
- Check the “Add Python 3. to PATH” and then Click 'Install Now'



- The installation is automatic.

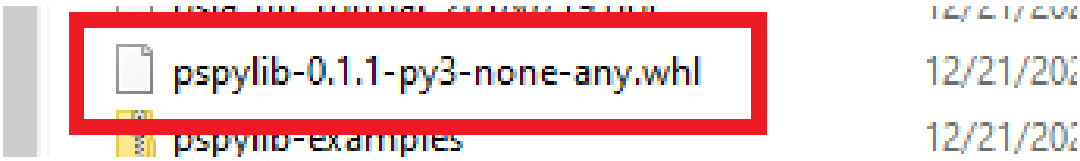


- After the installation is finished, you will see a screen like the one below. End the installation operation with the click of the 'Close' button.

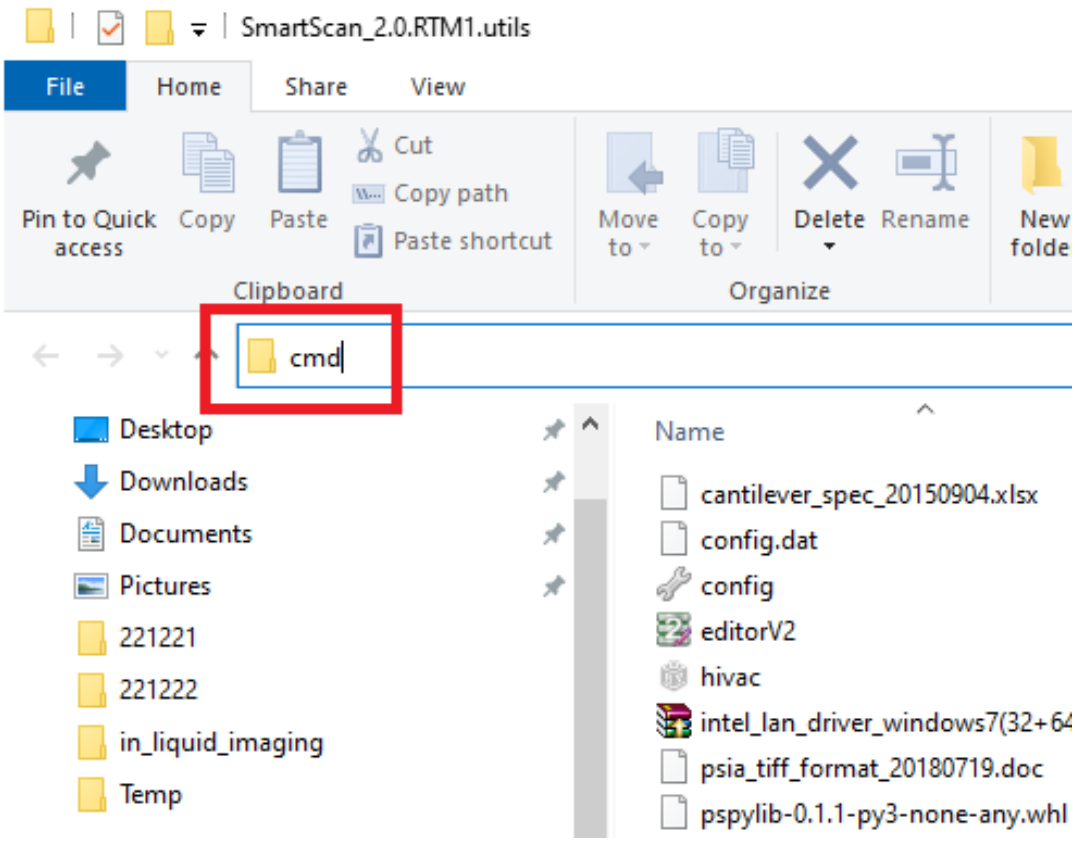


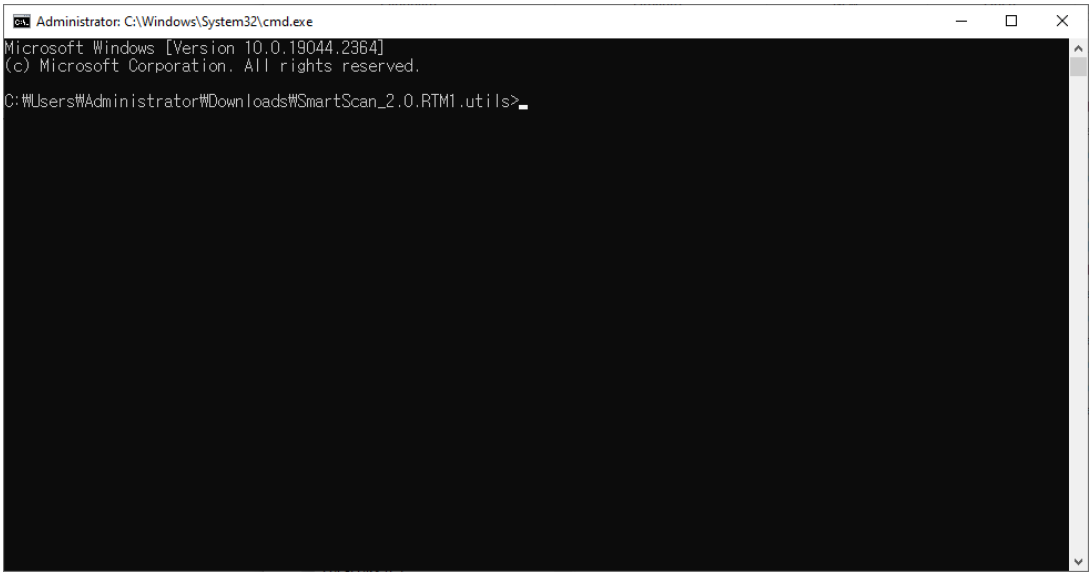
1.2 Install PSPylib

- Prepare the “pspylib-0.1.1-py3-none-any.whl"

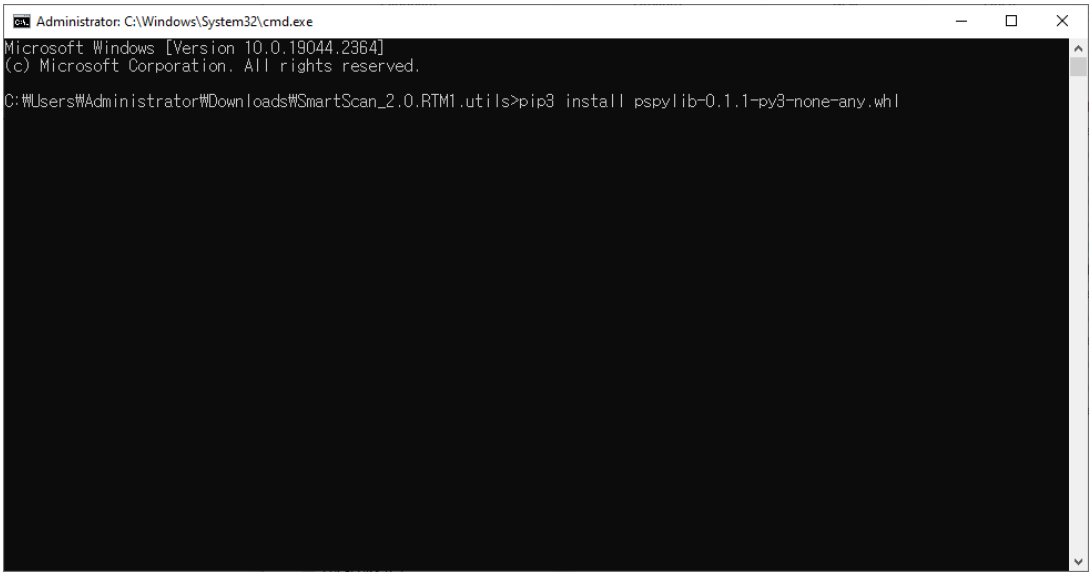


- Run the Command Prompt by typing 'cmd' in the address bar of the folder containing the pspylib-0.1.1-py3-none-any.whl file

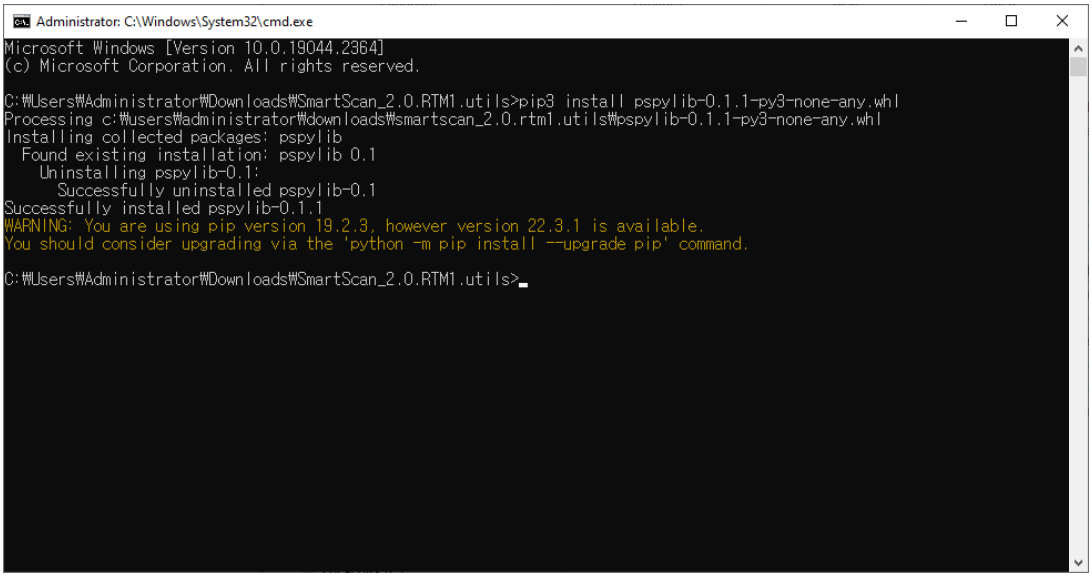




- At Command Prompt window, Type “pip3 install pspylib-0.1.1-py3-none-any.whl" to install the PSPylib



- When the installation is complete, it will be displayed as shown below



2 usage

2.1 common

- import the pspylib's tiff reader.
    - import pspylib.tiff.reader as tiffReader
- Use the TIFF Reader's load function to load the data you want.
- ASCII to String
  channelName, headMode, and other information specified in type uint16 or int16 need to be converted to text as shown below.

```
''.join(chr(c) for c in self.scanHeader['headMode'][0])
```

2.2 Scan

- Scan Header: Dictionary type
- Each element of the Scan Header: Tuple (value, type)
- Sample: scan_sample.tiff

```
# import PSPylib's Tiff Reader
import pspylib.tiff.reader as tiffReader

#Data to load information (including path, if in the same folder as the
program, just the filename.tiff)
pathScan = 'scan_sample.tiff'


# Create an instance so that you can use Tiff
ReadereaderScan = tiffReader.TiffReader()


# load the data
readerScan.load(pathScan)

# load the Scan Header
scanHeader = readerScan.data.scanHeader.scanHeader


# load the Scan Data
scanData = readerScan.data.scanData.ZData


# key('width', 'channelName', etc.) is the attachment of the following
data structure.
# Full output the Meta data
print(scanHeader)
```

```
# Output the desired information from Meta data
print(scanHeader['width'][0])
print(''.join(chr(c) for c in scanHeader['channelName'][0]))
# ouput the Data
print(scanData)
```

- The result of executing the above code is as follows

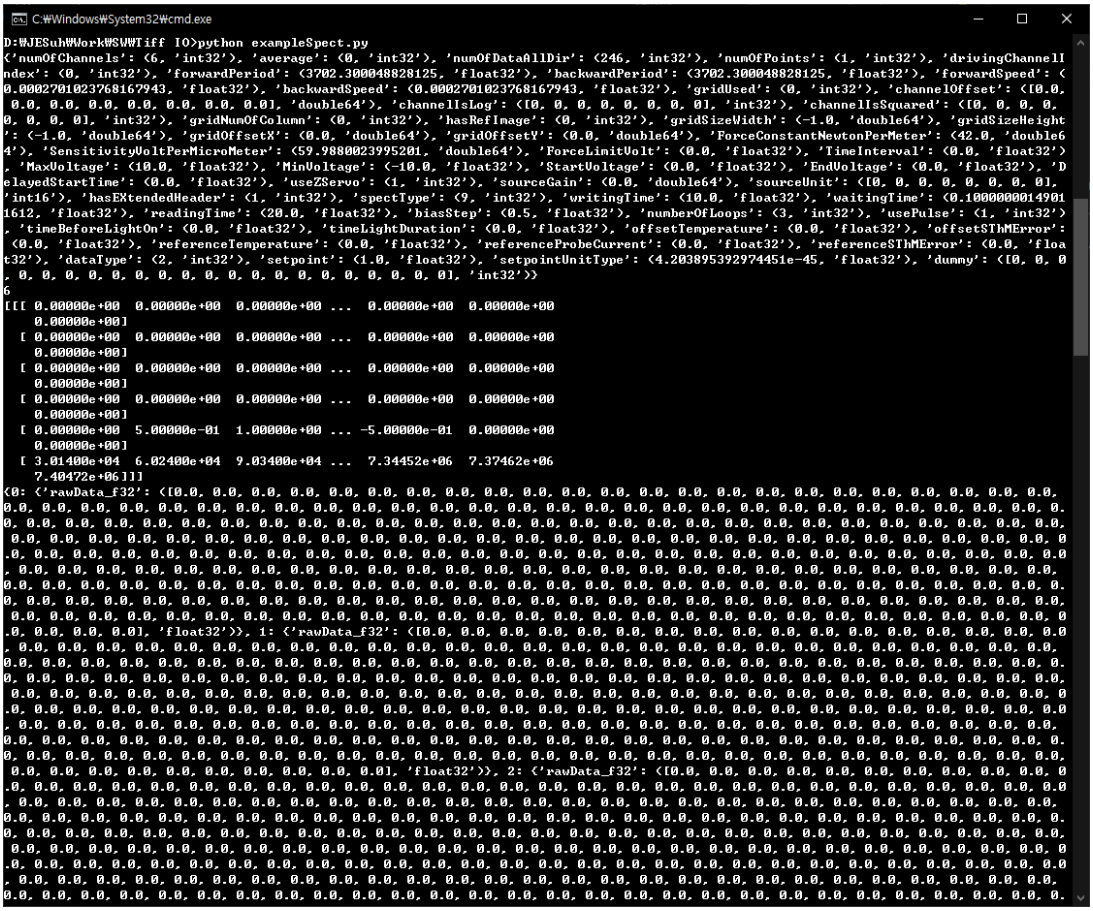
2.3 Spectroscopy

- Spect Header: Dictionary Type
- Spect Data
    - RawData: Type
    - rawDataDict: Dictionary Type
- Sample: spect_sample.tiff

```
#import the PSPylib's Tiff Reader
import pspylib.tiff.reader as tiffReader

#Data to load information (including path, if in the same folder as the program, just the filename.tiff)
pathSpect = 'spect_sample.tiff'


# Create an instance so that you can use Tiff ReadereaderScan
readerSpect = tiffReader.TiffReader()
```

```
# load the Data
 readerSpect.load(pathSpect)

# load the Spect Header
spectHeader = readerSpect.data.spectHeader.spectHeader


# load the Spect Data(ndarray type)
spectData = readerSpect.data.spectData.rawData


# load the Spect Data(Dictionary type)
spectDataDict = readerSpect.data.spectData.rawDataDict

*key is the attachment of the following data structure


# output the Meta data
print(spectHeader)


# Output the desired information from Meta data
print(spectHeader['numOfChannels'][0])


#output the Data
print(spectData)
print(spectDataDict)
```

- If you run the above code, the result will look like the following



Example code: [exampleTiffReader.py]

3 FILE INFORMATION

3.1 Scan

ScanHeader	Name	Description
	dataCategory	0 = 2d mapped image, 1 = line profile image, 2 = Spectroscopy image
	channelName	Source name of image (ex: topography, z detector, ...)
	headMode	Image mode of image (ex: CAFM, NC-AFM, MFM, ...)
	lowPassStrength	Low Pass Filter strength
	isAutoFlatten	Automatic flatten after imaging
	isAcTrack	Non-zero for Ac Track, 0 for NOT
	width	Number of pixels in the direction of width (x-axis)
	height	Number of pixels in the direction of height (y-axis)
	scanRotation	Angle of Fast direction about positive x-axis
	isSineScan	None-zero for sine scan, 0 for normal scan
	overScanRatio	Over scan rate
	isFastScanLeftToRight	Non-zero for forward, 0 for backward
	isSlowScanBottomToTop	Non-zero when scan up, 0 for scan down
	isXYSwapped	Swap fast-slow scanning directions
	scanSizeWidth	X scan size (unit: um)
	scanSizeHeight	Y scan size (unit: um)
	scanOffsetX	X offset (unit: um)
	scanOffsetY	Y offset (unit: um)
	scanRate	Scan speed in rows per second
	setpoint	Error signal set point
	setpointUnit	SetPoint Unit (one,)
	tipBias	Tip Bias Voltage
	sampleBias	Sample Bias Voltage
	dataGain	Z Data Gain
	ZScale	Z Data Scale
	ZOffset	Z Offset (unit: um)
	unit	Z Data Unit (um)
	dataMin	Minimum value of data in integer, rounds up
	dataMax	Maximum value of data in integer, rounds down

ScanHeader	Name	Description
	dataAverage	Mean value of data
	compression	Not used
	isLogScale	Non-zero for Log Scale, 0 for NOT
	isSquared	Non-zero for Squared, 0 for NOT
	zServoGain	Z Servo Gain
	zScannerRange	Z Scanner Range
	xyVoltageMode	XY Voltage mode
	zVoltageMode	Z Voltage mode
	xyServoMode	XY Servo mode
	dataType	0 = 16bit short, 1 = 32bit int, 2 = 32bit float
	numOfPddRegionX	Not used
	numOfPddRegionY	Not used
	ncmAmplitude	NCM Amplitude
	ncmFrequency	NCM Selected Frequency in Hz
	headRotation	Not Used
	cantileverName	Cantilever Name
	ncmDrivePercent	NCM Drive % (range = 0~100)
	intensityFactor	(A+B) / (reference Intensity)
	headTilting	Not used
	logAmpOffset	Not used
	tipSampleDistance	Distance between tip and sample
	zServoNcGain	Z servo gain
	zServoPGain	With servo P gain
	zServoIGain	With servo I gain
	isTapping	Non-zero for Tapping, 0 for NOT Tapping
	dataMinV2	Minimum value of data
	dataMaxV2	Maximum value of data
	stageX	Not used
	stageY	Not used
	sampleX	Not used
	sampleY	Not used
	imageQualityIndex	Image quality
ScanData	ZData	Scan data

3.2 Spectroscopy

SpectHeader	**Name**	**Description**
	name	Source name of image
	unit	Data unit
	gain	Data gain
	isXAxis	Non-zero for X Axis source, 0 for NOT
	isYAxis	Non-zero for Y Axis source, 0 for NOT
	numOfChannels	Number Of Spect Sources
	average	Mean value of data
	numOfDataAllDir	Data in a line
	numOfPoints	Number of data points (x,y)'s
	drivingChannelIndex	Driving source index
	forwardPeriod	DAQ Time per point/2 (sec)
	backwardPeriod	DAQ Time per point/2(sec)
	forwardSpeed	Driving Source Unit / sec
	backwardSpeed	Driving Source Unit / sec
	gridUsed	Non-zero for Volume image, 0 for NOT
	channelOffset	Sources offset
	channelIsLog	Non-zero for data in log scale, 0 for NOT
	channelIsSquared	Non-zero for data squared, 0 for NOT
	gridNumOfColumn	Number of Spect Points Per X
	hasRefImage	Has Reference image if the value is Non-zero
	gridSizeWidth	X ScanSize
	gridSizeHeight	and ScanSize
	gridOffsetX	X Offset
	gridOffsetY	& Offset
	F/D Spectroscopy Information	
	ForceConstantNewtonPerMeter	Force Constant (unit: N/m)
	It's a long way from the 1980s.	Sensitivity (V/um)
	ForceLimitVolt	Force Limit Voltage
	TimeInterval	Time Interval

SpectHeader	Name	Description
	I/V Spectroscopy Information	
	MaxVoltage	Max Voltage
	MinVoltage	Min Voltage
	StartVoltage	Start Voltage
	EndVoltage	End Voltage
	DelayedStartTime	Delayed Start Time
	useZServo	Non-zero for use Z Servo, 0 for NOT
	sourceGain	Data Gain
	source_unit	Unit of Source
	hasEXtendedHeader	Non-zero for use Extended Header, 0 for NOT
	spectType	Refer to Appendix A. Spectroscopy Type
	P/E Spectroscopy Information	
	writingTime	Writing time
	waitingTime	Waiting time
	readingTime	Reading time
	biasStep	Bias step
	numberOfLoops	Loop counts
	usePulse	Non-zero for use Pulse, 0 for NOT
	timeBeforeLightOn	Light On Delay
	timeLightDuration	Light Duration
	Photo-current Information	
	resetLevel	Reset level
	resetDuration	Reset duration
	operationLevel	Operation level
	operationDuration	Operation duration
	timeBeforeReset	Time before reset
	timeAfterReset	Time after reset
	timeBeforeLightOn	Light On Delay
	timeLightDuration	Light Duration
	TA Information	
	offsetTemperature	Offset temperature
	offsetSThMError	Offset SThM error
	referenceTemperature	Reference temperature

SpectHeader	**Name**	**Description**
	referenceProbeCurrent	Reference Probe Current
	referenceSThMError	Reference SThM error
	dataType	0 = 16bit short, 1 = 32bit int, 2 = 32bit float
	Setpoint	Error signal set point
	setpointUnitType	SetPoint unit (one,)
SpectData	rawData	Spectroscopy data (ndarray)
	rawDataDict	Spectroscopy data (dictionary)