

Spectral Analysis User Manual

Spectrometer Software Operation Manual

Chapter 1 Introduction	4
1.1 Product Overview	4
1.2 Product Features	4
Chapter 2 Operation	6
2.1 Overview	6
2.2 Software Operation	6
2.3 Spectrometer External-triggering Operation	7
2.4 Active Trigger	7
2.5 Parameters Setting	10
2.5.1 Integral Time	10
2.5.2 Scans to Avg	12
2.5.3 Smoothness	13
2.6 Operating State Setting	14
2.7 Dimension Operating	15
2.7.1 Window Maximize	15
2.7.2 Image Adaptive	15
2.7.3 Vertical Adaptive	16
2.7.4 Zoom In and Zoom Out	17
2.7.5 Choose Zoom In	18
2.7.6 Set Coords	20
2.7.7 Move Image	20
2.8 Reticule	20
2.9 Peak	21
2.10 Data Processing	22
2.10.1 Store Dark Spectrum	23
2.10.2 Store Reference Spectrum	23

2.10.3 Display Original Spectrum.....	24
2.10.4 Mimus Dark.....	24
2.10.5 Save and subtract dark spectra.....	26
2.10.6 Superimposed spectrum.....	27
2.10.7 Absorbance Measurement.....	29
2.10.8 Transmission Measurement.....	30
2.10.9 Reflection Measurement.....	32
2.10.10 Others.....	33
2.11 Spectrum Processing.....	33
2.11.1 Overlay Activity Spectrum.....	34
2.11.2 Save Spectrum Data.....	34
2.11.3 Save the continuous spectrum data.....	37
2.11.4 Overlay Spectrum Data.....	39
2.11.5 Delete the spectral data.....	40
2.11.6 Save Spectrum Image.....	41
2.12 Facility Information.....	41
2.12.1 Facility Information.....	41
2.12.2 Facility Selection.....	42

Chapter 1 Introduction

1.1 Product Overview

This software Spectral Analysis for Fiber Optic Spectrometer is a spectroscopy software platform which based on the modular design and development. Its VC++ based which need to be operated on Windows 2000 or above. It features with easy maintainance and updating etc. This software is an easy operating, advanced acquisition and display program that provides a real-time interface to a variety of signal-processing functions.

1.2 Product Features

(1) User friendly interface

The operating window is simple and easy to handle which well matches the user's operation habits. It's also customizable upon customer's request.

(2) Several ways of data collection

During the operating, you can set the parameters (integral time, average number, evenness etc.) freely, and analyse the spectrum by setting the parameters of data collection.

(3) Control more than one devices

Control more than one devices at the same time and each USB

devices can be operated separately. During the operating the software, the spectrometer can connect with more than one USB equipments and control the USB equipment separately.

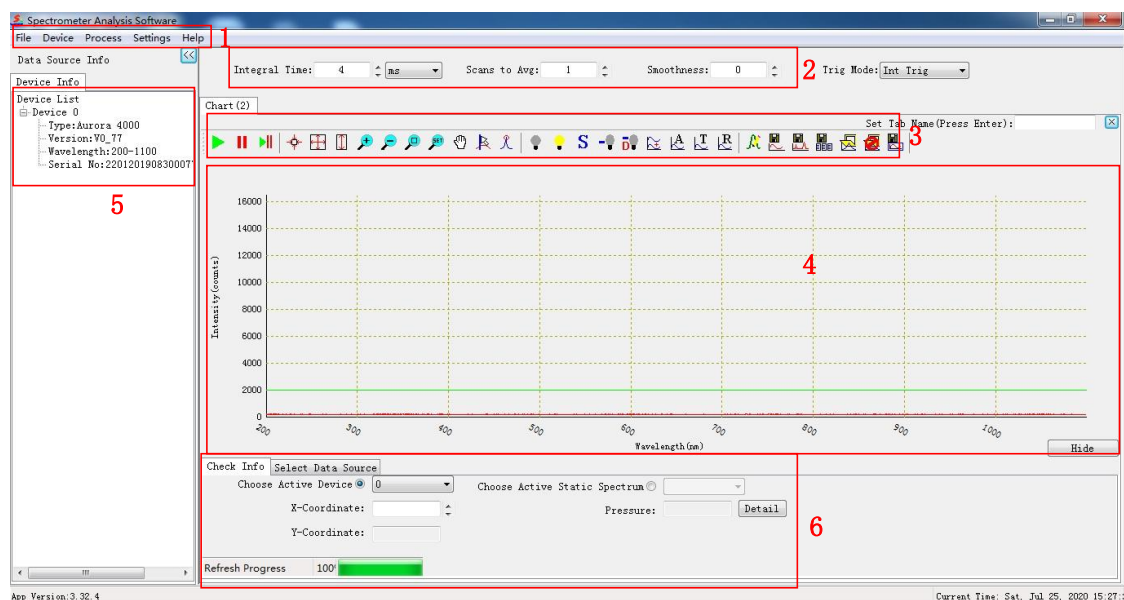
Chapter 2 Operation

2.1 Overview

This chapter is mainly to introduce the operation of this spectrometer software via the icons and buttons.

Some operating of the spectrometer is dependent on the operating of the software. For example: you need to save the dark spectrum and reference spectrum before transmission measurement, otherwise it will be error when you click the “transmission curve”. It will also be error if you deduct the dark spectrum before save the dark spectrum. The detail operating will be state in this chapter.



2.2 Software Operation



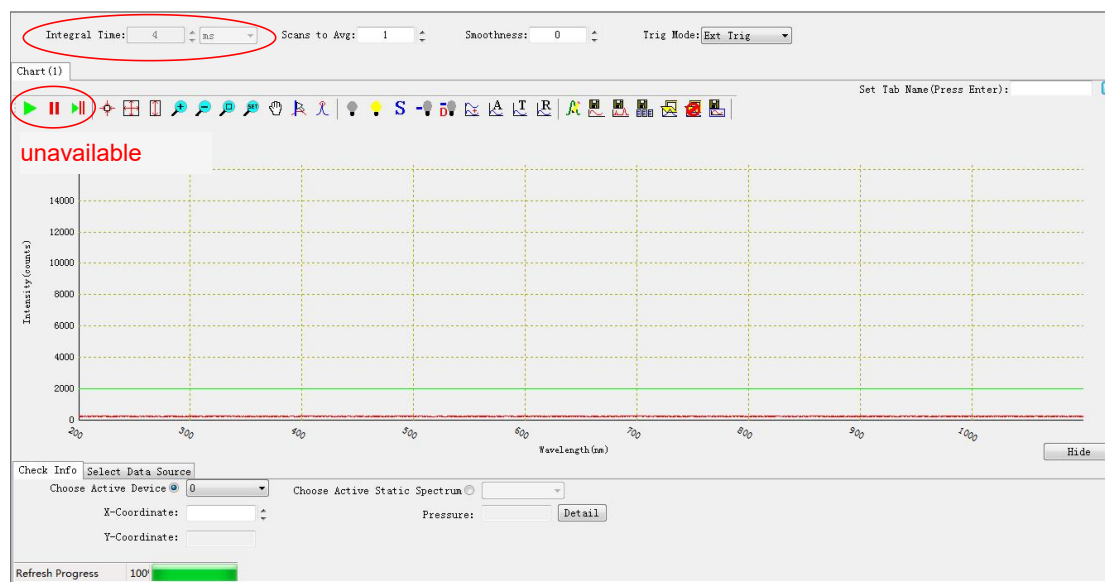
There are 6 areas of the software: 1.Menu ; 2.Parameter setting ; 3.Tool ; 4.Curve display ; 5.Information display ; 6.Status

2.3 Spectrometer External-triggering Operation

First, the spectrometer and the external- triggering box are connected with the cable, then connecting the spectrometer to the computer with a USB line. Open the software, at this time the green light on the external-triggering box is flashing and the red one is continuous on, otherwise, check the connection.

The system default is internal trigger  , that is, click on the drop-down box, select “external trigger”  , in the parameter region.

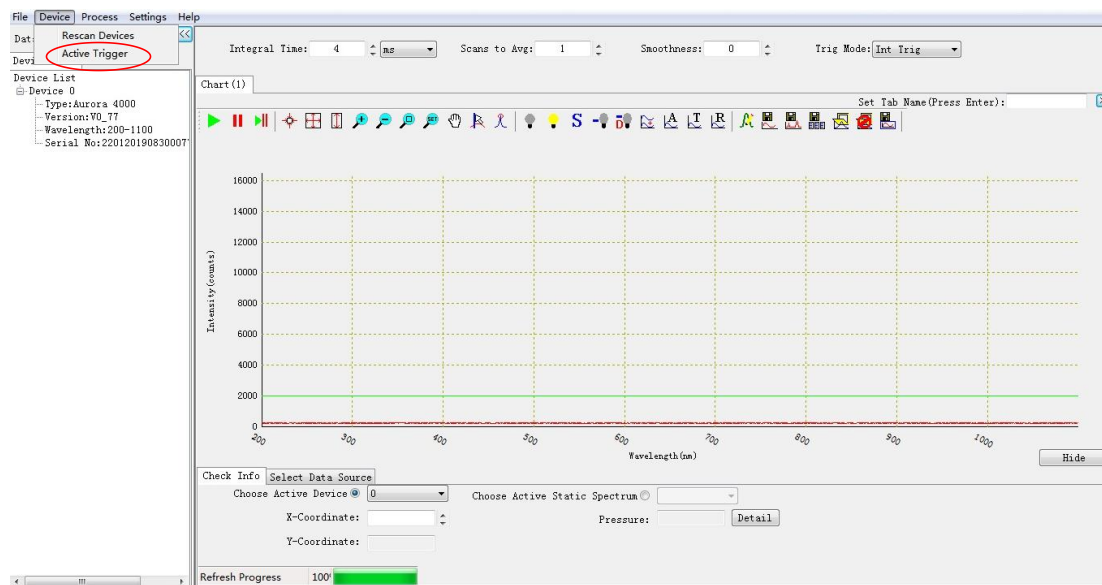
At this point, the buttons of “integration time”, “run”, “pause” and “single step” are unavailable, in the parameter region.



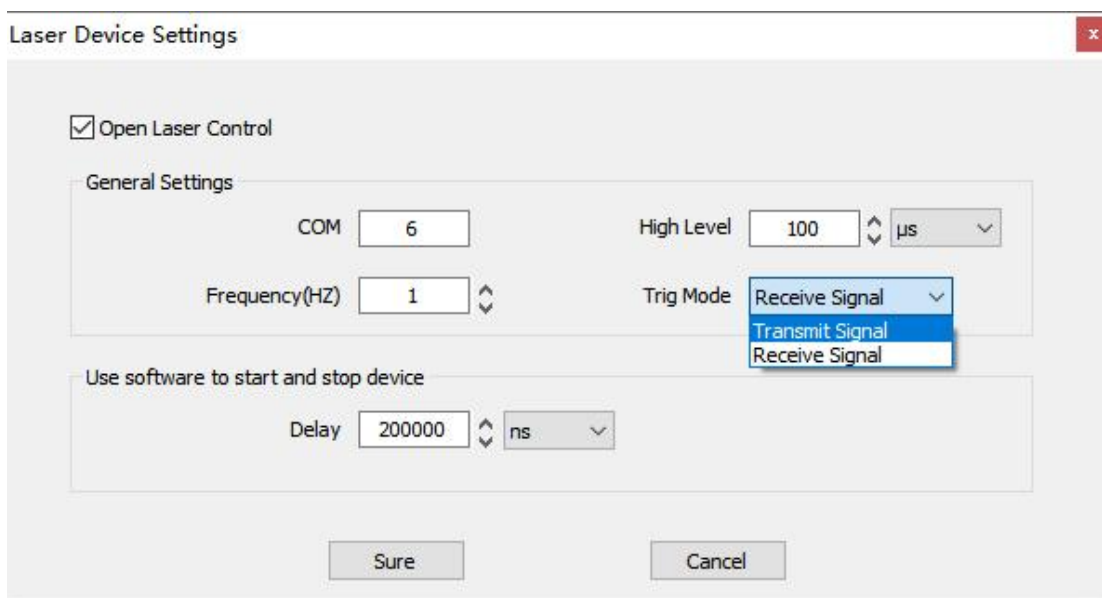
2.4 Active Trigger

In order to realize the timing control of the spectrometer and laser,

select “Active Trigger” under “ Device ” in the menu bar.



Click “Active trigger control”, the following dialog box pops up:



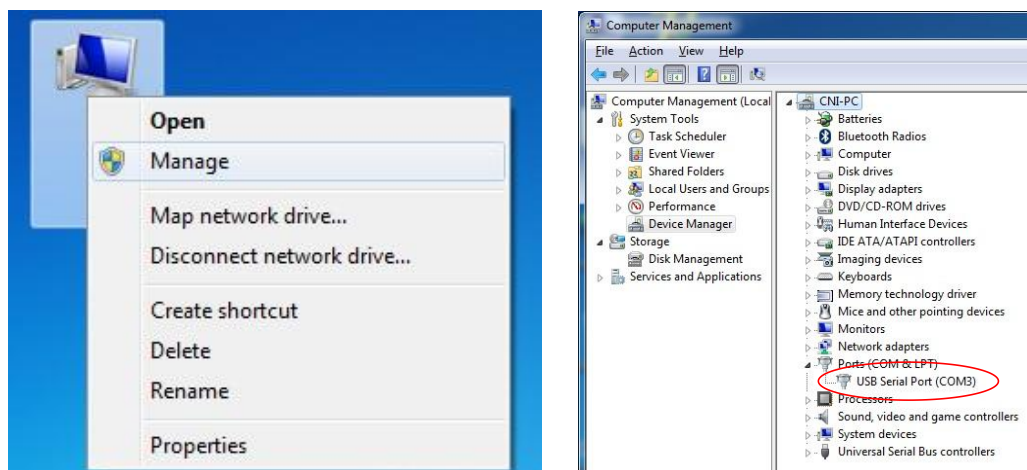
In the software, set the laser parameters, to achieve trigger box trigger state control. The details are as follows:

1. Common Settings

Serial port number (COM): The port number of the RS232-USB serial cable connecting the PC and the trigger box.

Find the serial number method: Right-click the “computer” icon,

select “management” into the “computer management”. The serial number (COM) is displayed when the port is clicked. Refer to the following figure:



High Level (μ s): width of laser trigger signal. select the appropriate trigger signal width according to the laser.

Frequency (Hz): Trigger frequency is set between 1-10Hz. It should be noted that the spectrometer integral time should be less than the trigger signal period.

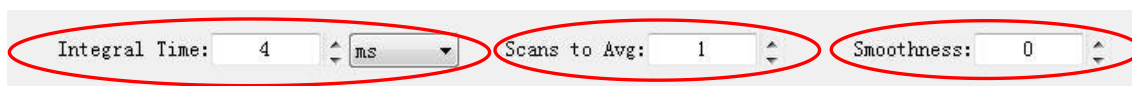
Trigger mode: select according to application. Select “Receive Signal” if the laser trigger the spectrometer to work, and “Transmit Signal” if the spectrometer is used as the signal source to trigger the laser to work.

2. Use the Software to Start and Stop the Laser

Delay Sets the acquisition spectrum. Appropriate delay can reduce the continuous spectrum of the test process.

2.5 Parameters Setting

Basic parameters include integral time, average count and smoothness; they are included in parameter region.

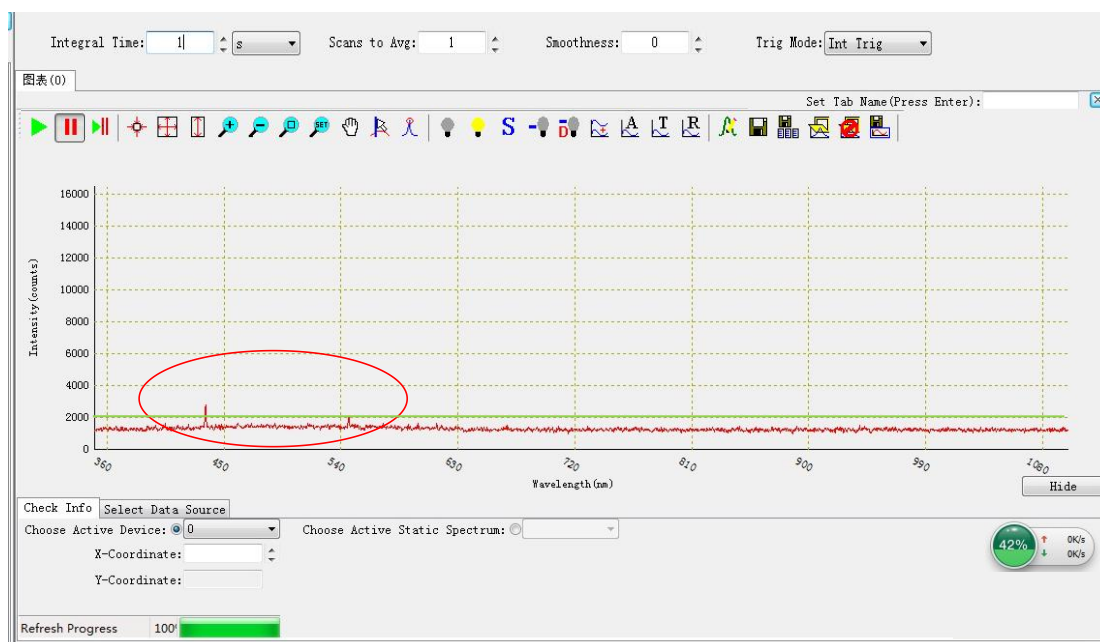


2.5.1 Integral Time

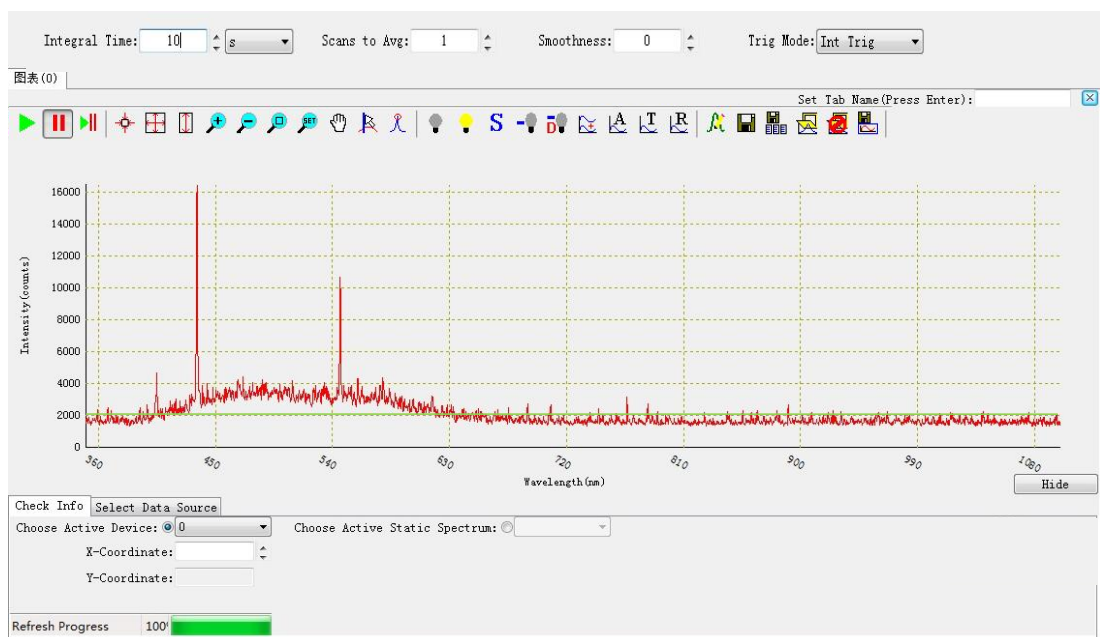
Integral time is exposure time. The higher the integral time, the more photon number is collected by CCD. If expected curve cannot be seen when the detection signal is weak, the integral time can be appropriately raised.

Integral time range is 4ms to 10s. The time unit can be selected by operator via drop-down box (millisecond and second is optional). Time can be filled in via edit box(the value should be integer), and also can be adjusted via up and down arrows on the right button, the adjusting step is integer1. The adjusting range is 4 ms to 10s; Otherwise it will be an error.

The smaller the integral time, the faster the screen curve can be refreshed. Pressing “Enter” after integral time is input, or removing the cursor, and then integral time setting is effective. Additionally, the modification of integral time is effective in next time. For example: integral time is set to 10s, after 1s, it is set to 100 ms again, 100 ms will be showed after 9s.



As picture shows, the signal is weak when the integral time is 1s.



As picture shows, signal is significantly enhanced when the integral time of 10s.

Certainly, integral time is not the bigger the better, the integral time is too much, the noise will rise and the signal may be saturated.



When the integral time is set to 2s, the noise increased significantly, the signal saturation will lead to inaccurate measurements.

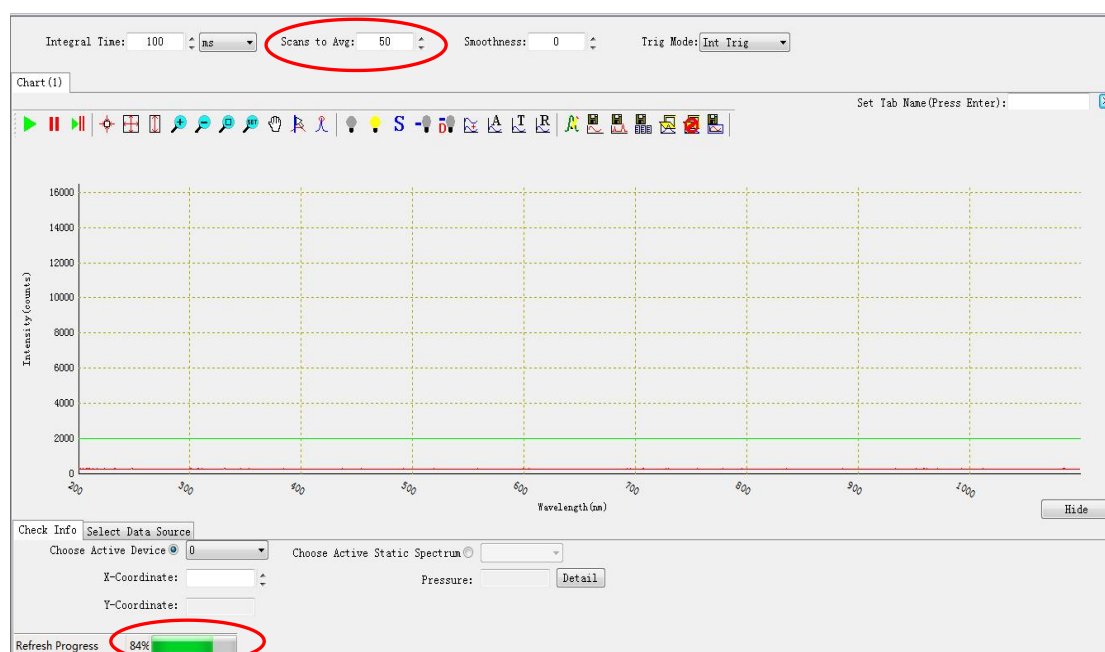
2.5.2 Scans to Avg

Set the number of discrete spectral acquisitions that are accumulated before Spectral Analysis receives a spectrum. The higher the value, the better the signal-to-noise ratio.

Average count only can be set to integer, it can be filled in via edit box, and also can be adjusted via up and down arrows on the right button, and the adjusting step is integer 1. Pressing “Enter” after average count is input, or removing the cursor, and then average count setting is effective.

Refresh progress will be prompted at the bottom right corner of interface after modification successfully. A frame will be refreshed when progress reaches 100%.

The more the average count, the smaller the image fluctuates, but image refreshed slowly. For example, integral time is set to 100ms, average time is set to 50, the image will be refreshed per 5s.



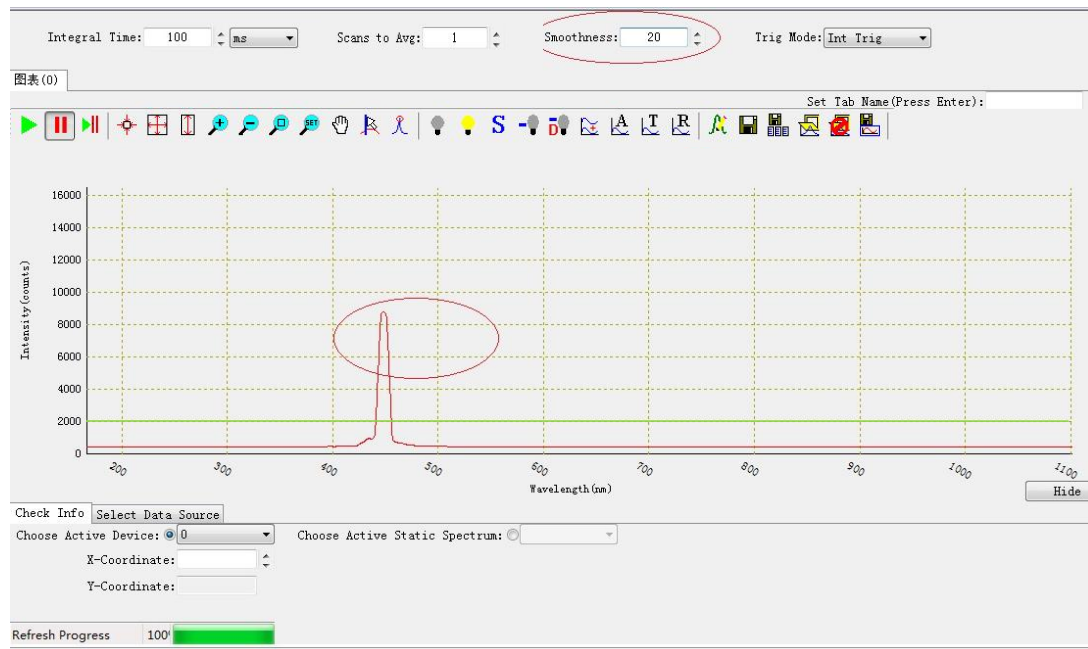
2.5.3 Smoothness

The curve fluctuates dramatically can be decreased by increasing Smoothness. Smoothness can be modified via edit box, it must be non-negative integer, and also can be adjusted via up and down arrows on the right button; The adjusting step is integer 1. Pressing “Enter” after smoothness is input, or removing the cursor, and then smoothness setting

is effective.




If curve smoothness is set to n, sum the values of per point of curve with n points on the left and n points on the right, the value for this point is result that $2n+1$ is divided by above sum.


The smoothness of curve can reduce noise well, but also can weaken curved feature at same time, curve may be distorted. If smoothness is set to 20, although fluctuation for curve is small, the peak of original curve is not existed.



2.6 Operating State Setting

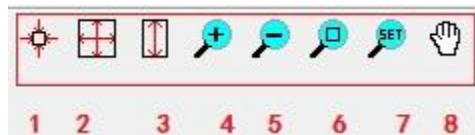


Operating state can be set in the left of the edit box.  means start scanning,  means stop scanning,  means scan once.

Operating state is defaulted when open the software, click  to

stop data capturing. At this time, curve shows captured data last time. A frame will be captured and showed when click single step run each time. If average time is set to n this time, clicking single step run, n frames data will be captured and showed after doing n times average processing.

2.7 Dimension Operating



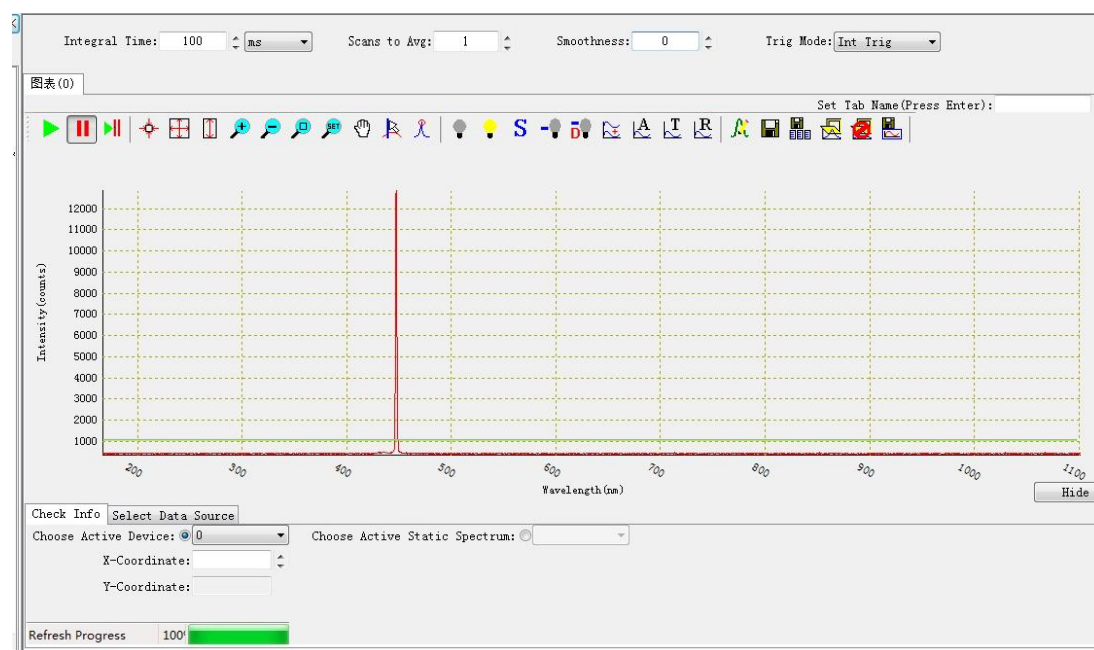
As picture shows, the red marked region is tools for dimension operating: 1.Window Maximize, 2. Image Adaptive, 3.Vertical Adaptive, 4. Zoom In , 5. Zoom Out, 6. Choose Zoom In , 7. Set Coords, 8. Move Image

2.7.1 Window Maximize

Click “Window Maximize” button, the range for axis is same with initial screen, wavelength range is 200-1100(nm), the strength is 0-16000 (counts).

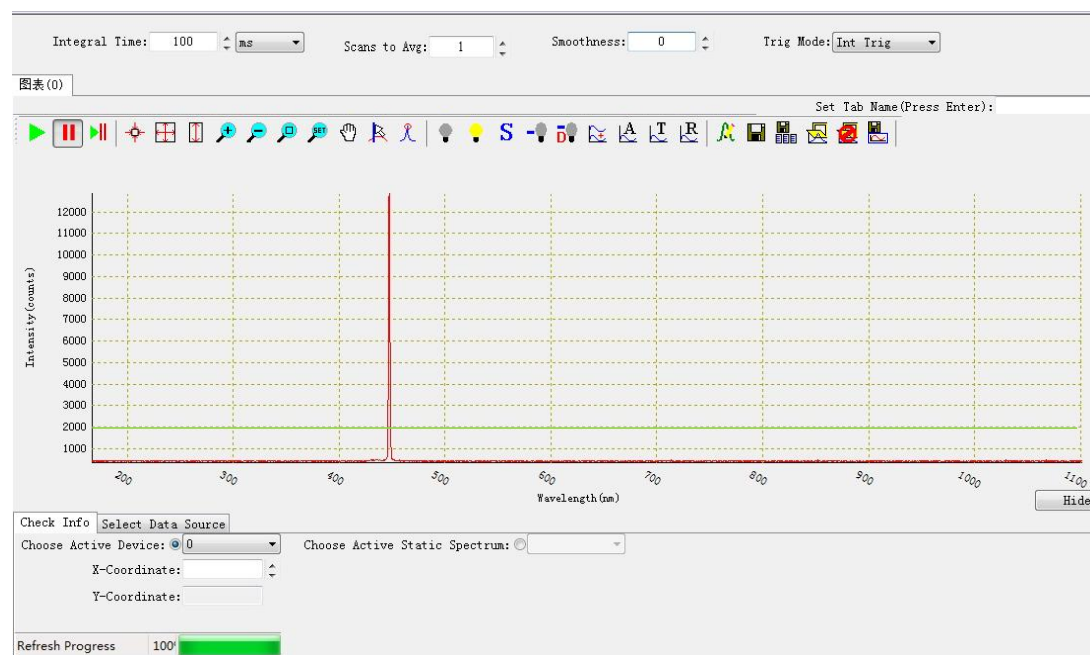
2.7.2 Image Adaptive

Click “Image Adaptive” button, the maximum and minimum value of horizontal and vertical coordinates for current frame is taken by software as coordinate axis range, completed curve can be seen this time.



2.7.3 Vertical Adaptive

The vertical adaptive is that the maximum and minimum value of the curve ordinate should be taken as maximum value and minimum value of the axis ordinate. The abscissa is not changed.



2.7.4 Zoom In and Zoom Out

Press “Zoom In” button to enlarge the image. The method of “Zoom In” is that click the area that need to be enlarged firstly. And take the area as the center axis. Press “Zoom In” button and enlarge the image.

For example, find the image as below. If you want to enlarge the area in the red circle, please click the area in red circle.

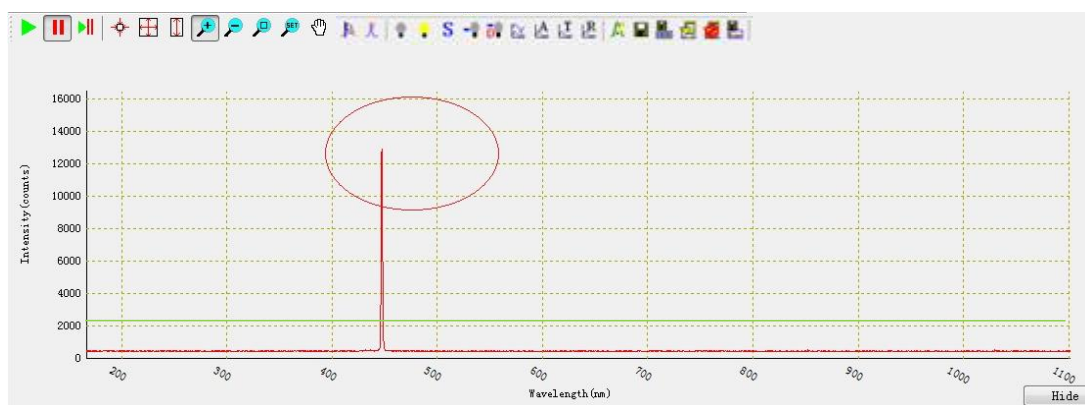
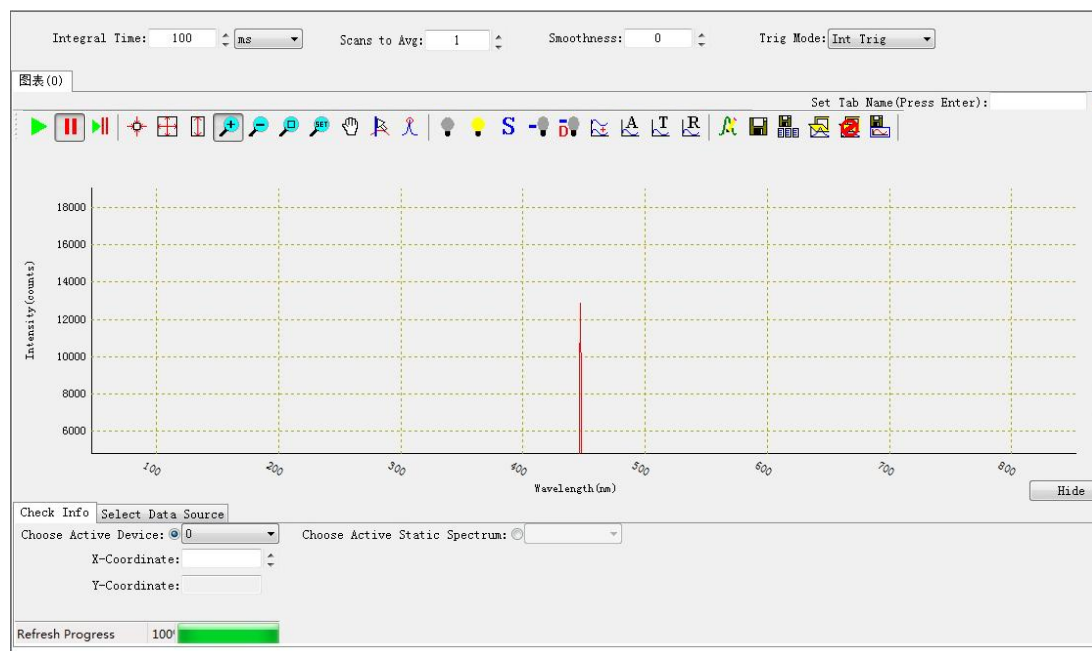


Image after enlarging is as below.

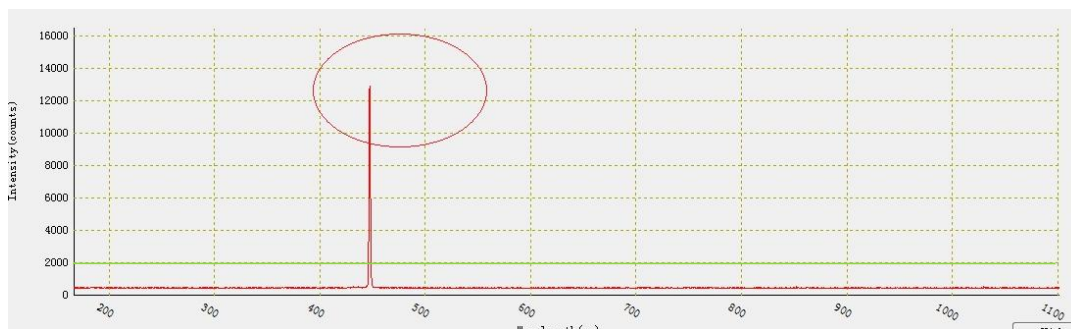


The method of zoom out is similar.

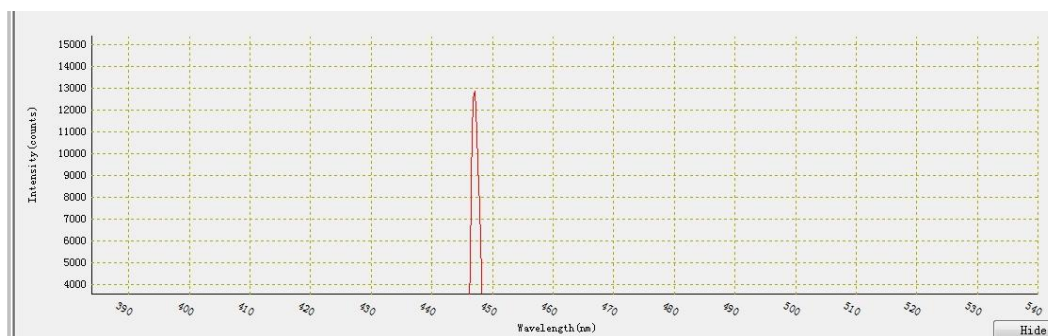
You can also use the mouse wheel to zoom in and out. Turn the mouse wheel upward one time equivalent to press “Zoom In” button one time; Turn the mouse wheel downward equivalent to press “zoom out” button one time. When you turn the mouse wheel, the position of the mouse arrow changes the center of area that need to zoom in and out.

2.7.5 Choose Zoom In

This tool provides more flexible function of amplification. Please click the icon 6 in the toolbar. The mouse is the state that selected area can be enlarged.



If the curve is as shown in above image, you want to enlarge area in the red rectangle. Put the mouse at the area. Hold down the left mouse button. Move the mouse. Then lift the left mouse button. The curve changes to following image.

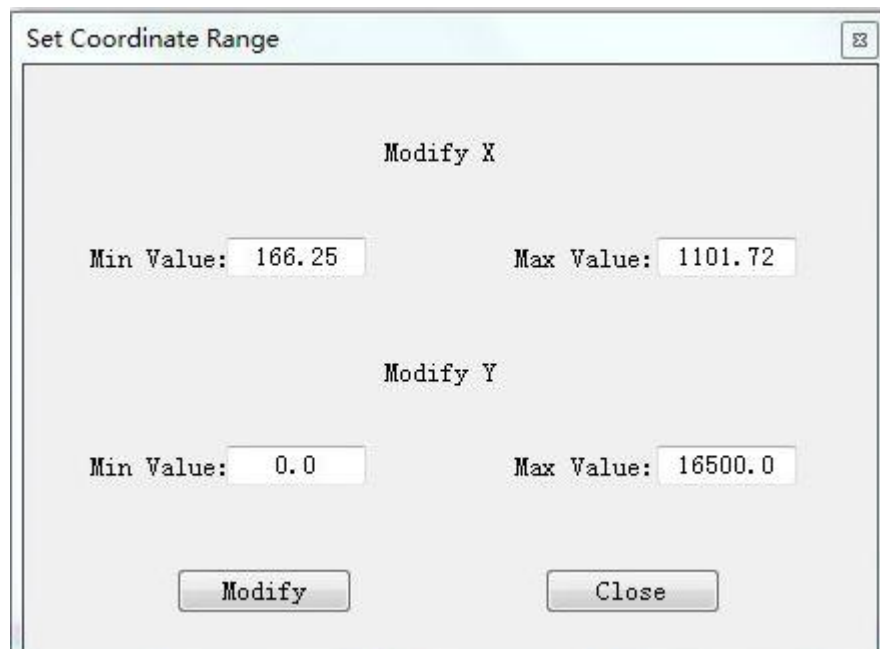


Hold down the left mouse button at any position in the image. Then move the mouse to the upper left. The curve returns to the original state before amplification.

Note: Drag the mouse to lower right corner when you want to amplification. If drag the mouse to upper left, the curve returns to the previous state. Other drag and drop method doesn't work. Guarantee a certain height and width when you drag the mouse. Or else the software will make the operation as the misoperation and it will ignore the operation.

2.7.6 Set Coords

Click “Set Coords” , appearing dialog box as below:



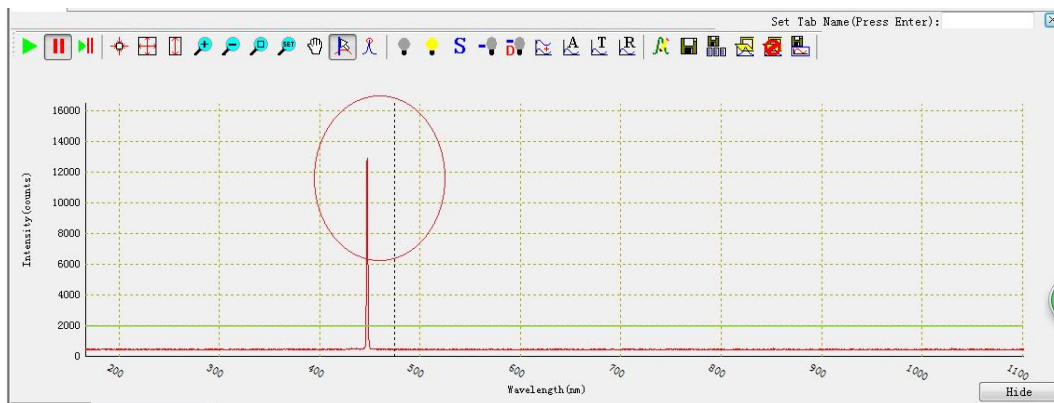
Using it, modify the coordinate range of the x-axis and y-axis.

2.7.7 Move Image

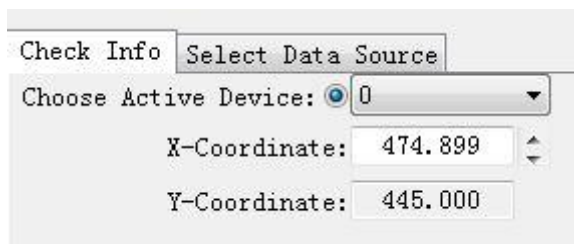
Click in the toolbar. Drag and drop functionality can be implemented.

2.8 Reticule


Press “Reticule” button. Then you can add the reticule.

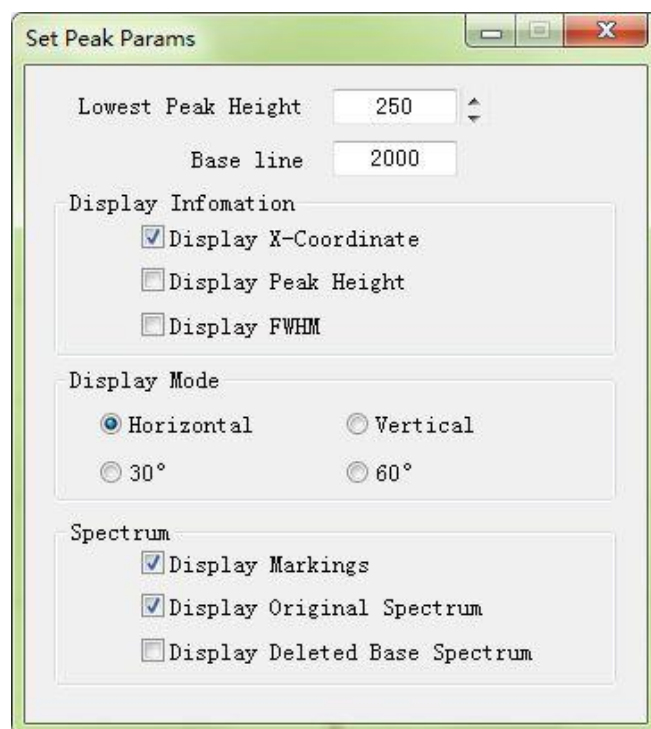


Press the left mouse button at any position. One dotted line appears. When you press the left mouse button at other position, the dotted line is moved accordingly. (Moving range is between minimum and maximum value of curvilinear abscissa). When you move the position of the dotted line, the value of intensity in below toolbar changed accordingly.

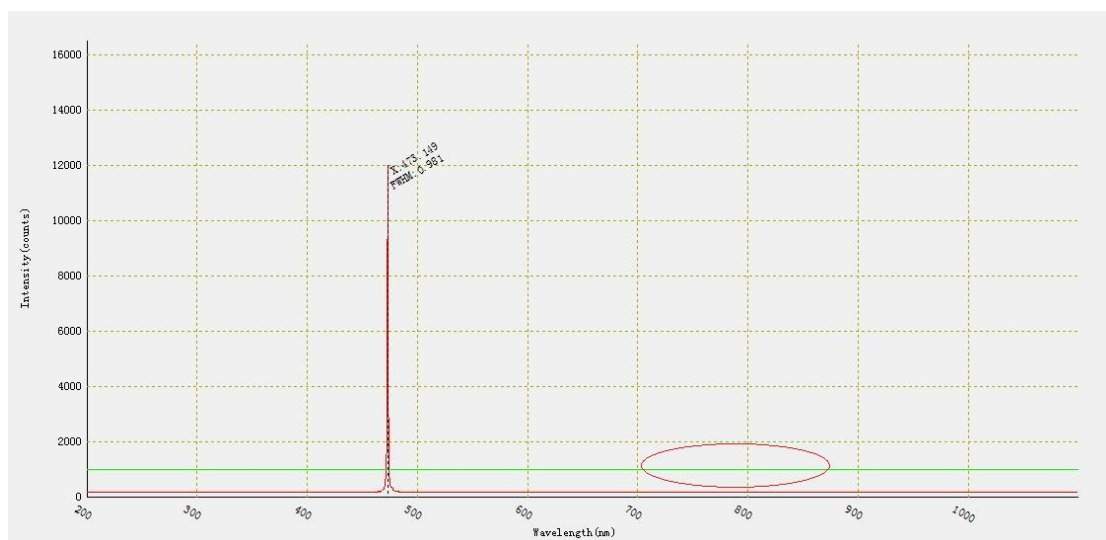


2.9 Peak

Click , appearing dialog box as below:



According to the demand, change the options, You can also change the baseline position and adjust the number of lines that you want to display information, as shown below:




2.10 Data Processing



The data processing section includes: 1. Store Dark; 2. Store Reference; 3. Display Original Spectrum; 4. Mimic Dark; 5. Save and subtract dark spectra; 6. Superimposed spectrum; 7. Absorbance; 8. Transmissivity; 9. Reflection.


Dark spectrum, also known as dark noise, in the absence of light source into the spectrometer, the spectrum will have a certain intensity, which is dark spectrum.

2.10.1 Store Dark Spectrum

Click the button  in the toolbar to save the dark spectrum. Dark spectrum will be recorded in memory for subsequent calculation and processing use.

You can load the dark spectrum by opening the file, this will be described in detail in the subsequent file operations.

2.10.2 Store Reference Spectrum


Save a selected spectrum by click  as the reference spectrum, which was referenced when test absorbance, transmission and reflectivity.

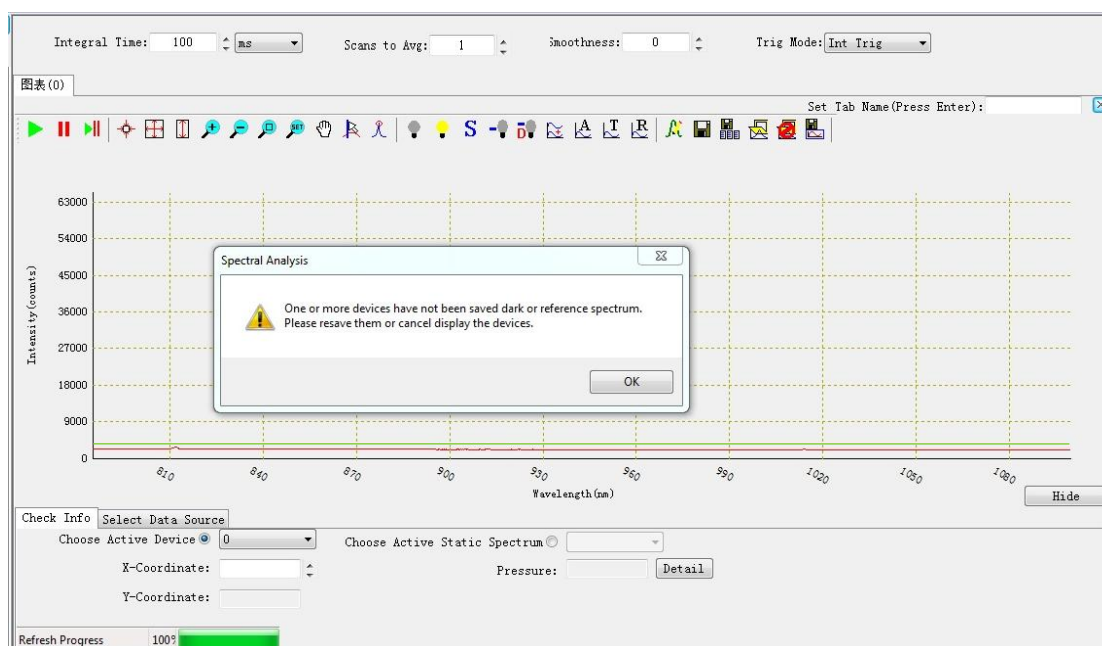
The reference spectrum also can be loaded by open a new file, which will be detailed illustrated as following chapters.

2.10.3 Display Original Spectrum

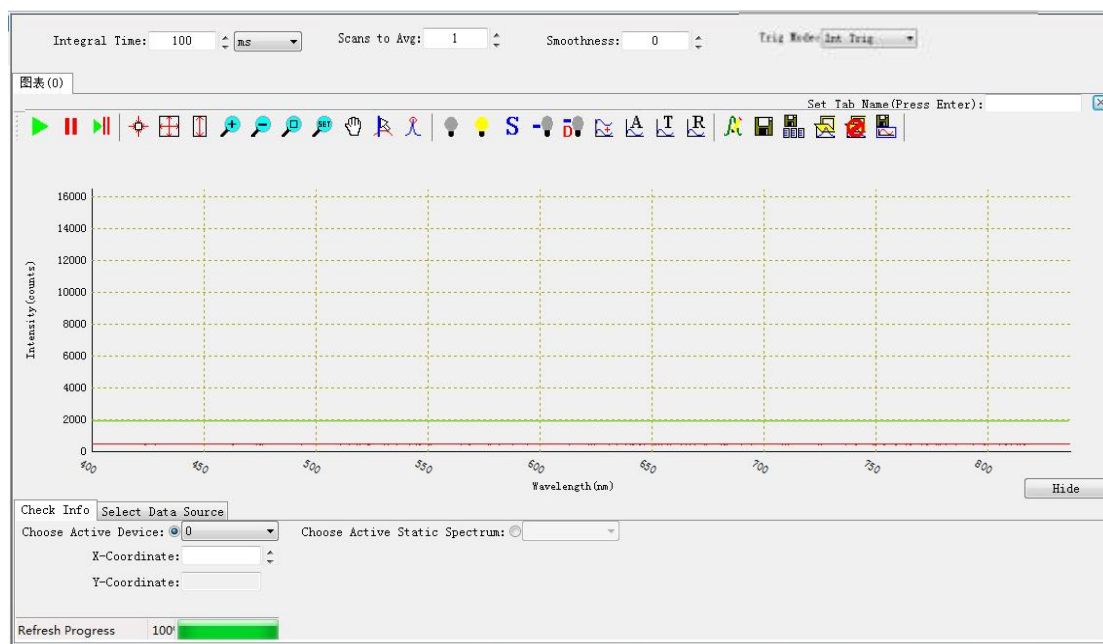
Click , then return to original image.

2.10.4 Mimus Dark

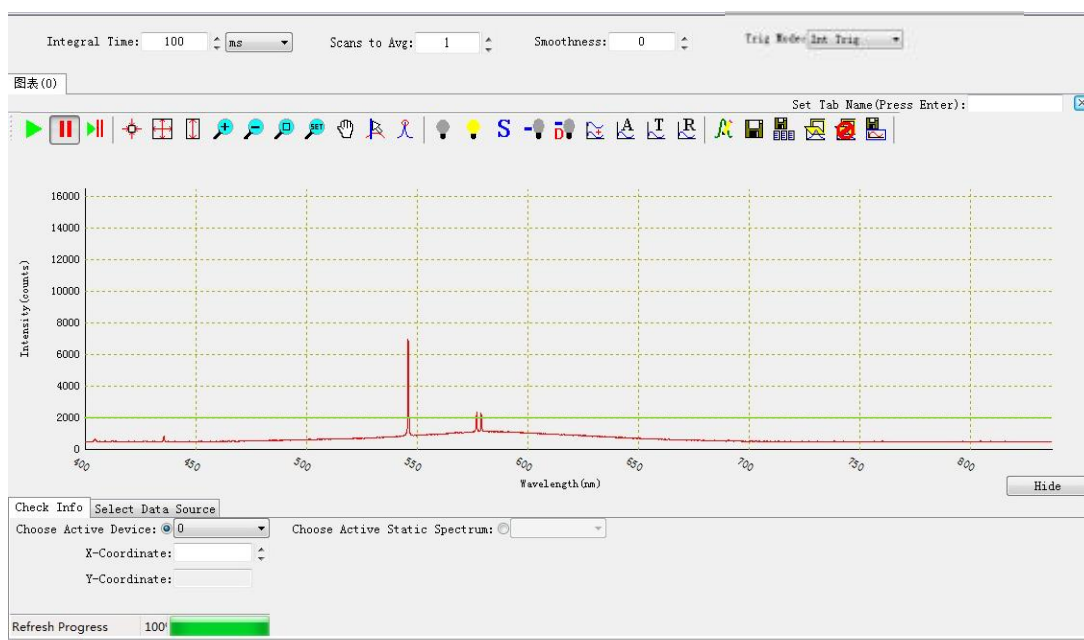
Click the button 4  in the toolbar, the collected data point-by-point minus the dark spectrum has been saved. You must saved the dark spectrum before dark spectrum operation, otherwise it will prompt an error. As shown below:



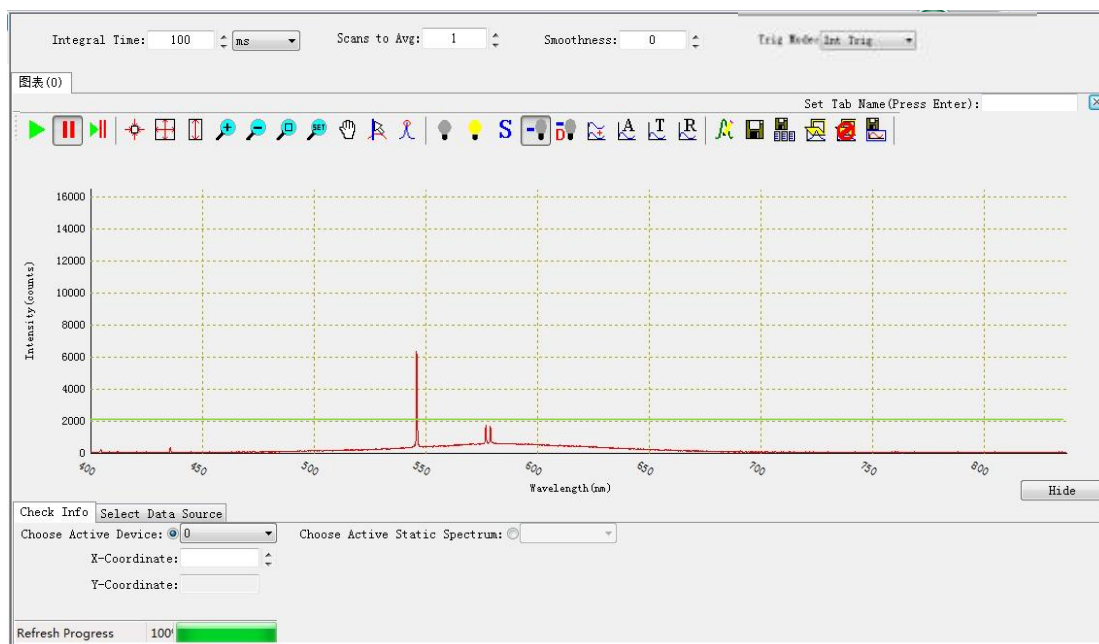
The following figure shows save the dark spectrum without any incident light.



The following figure shows save the dark spectrum under the incident light.






The curve after deducting dark spectrum as shown below:

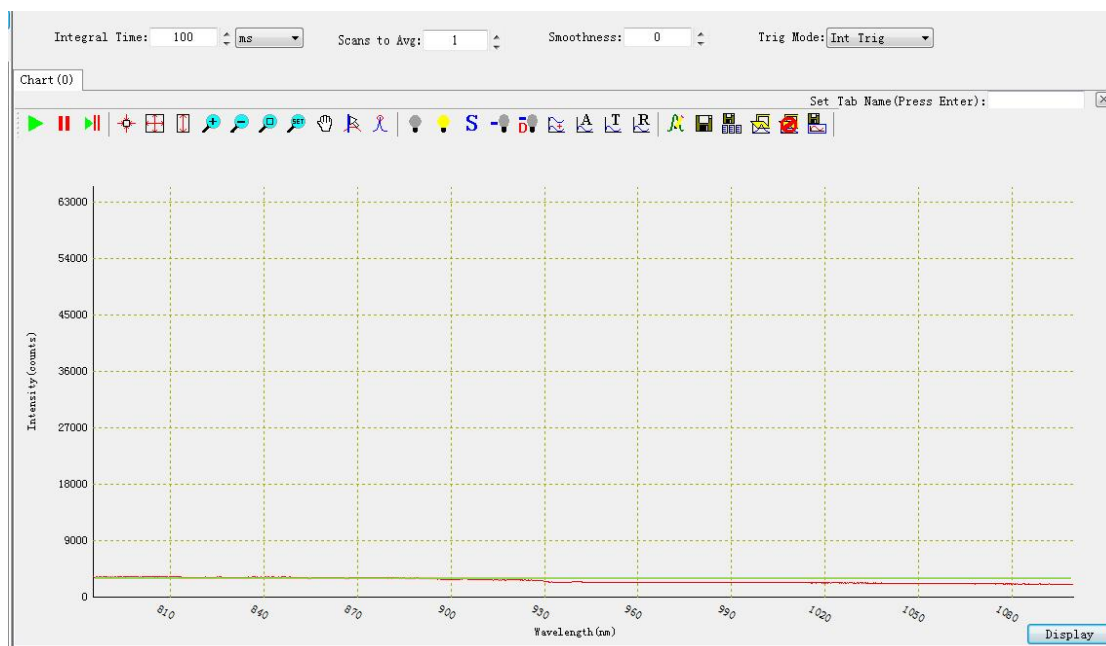


At present the deducting dark spectrum icon is in pressed state, it will recovery to not deduct the dark current state via clicking the icon again.

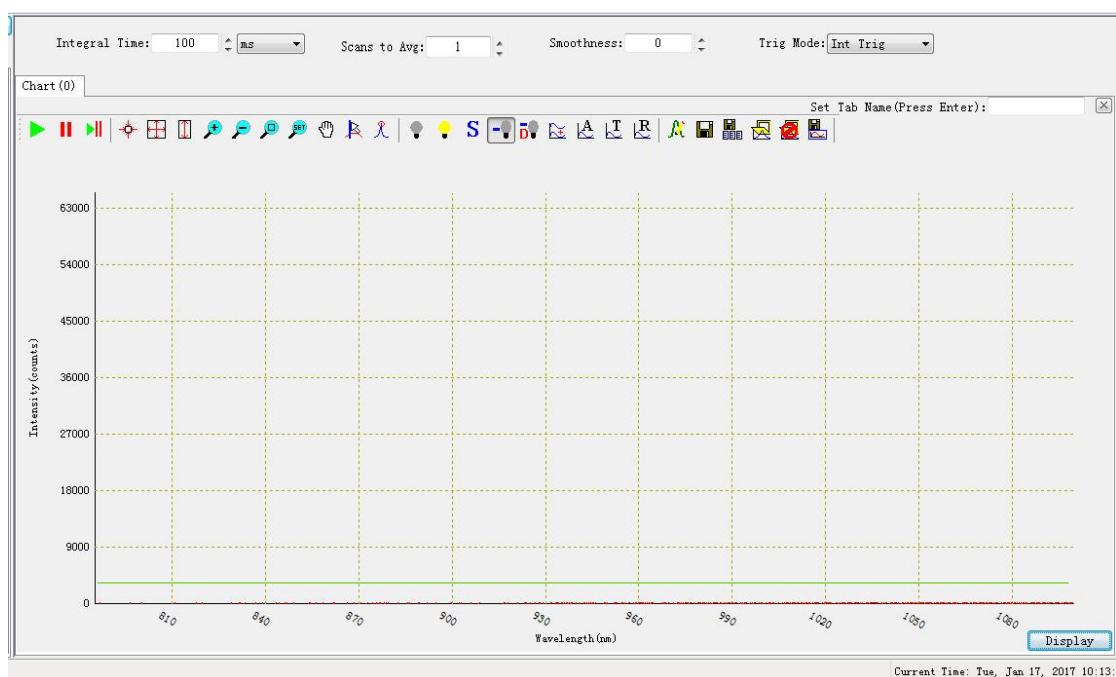
2.10.5 Save and subtract dark spectra


Click the button , at this time, the button  is pressed in the state, you can directly save and subtract dark spectrum.

Without any incident light, click the button  as shown below:



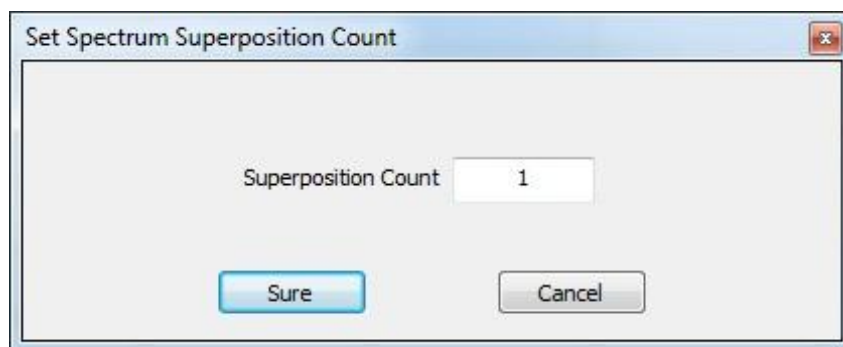
Click the button  as shown below:




In the state without deducting the dark spectrum, click the button  to recover.

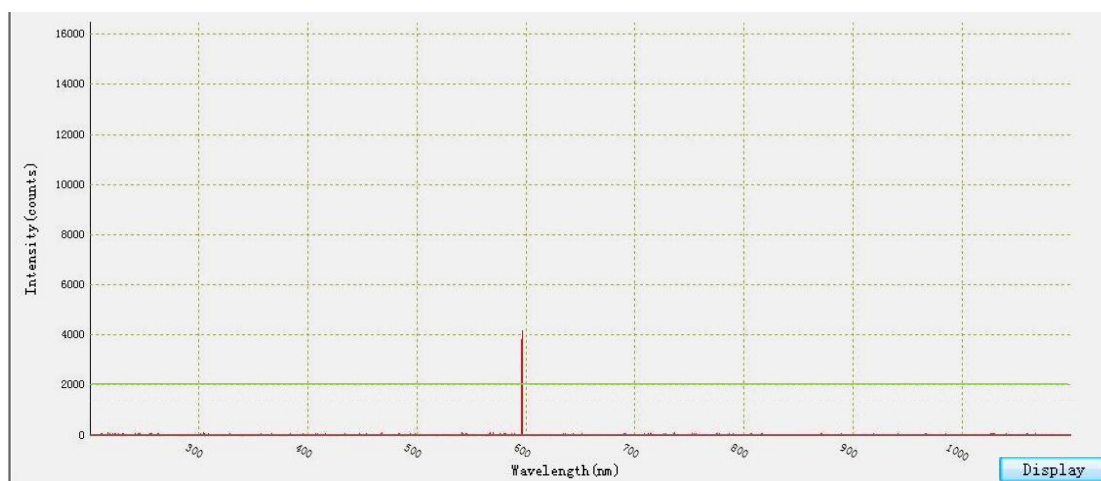
2.10.6 Superimposed spectrum

Click the button , the following dialog box appears:

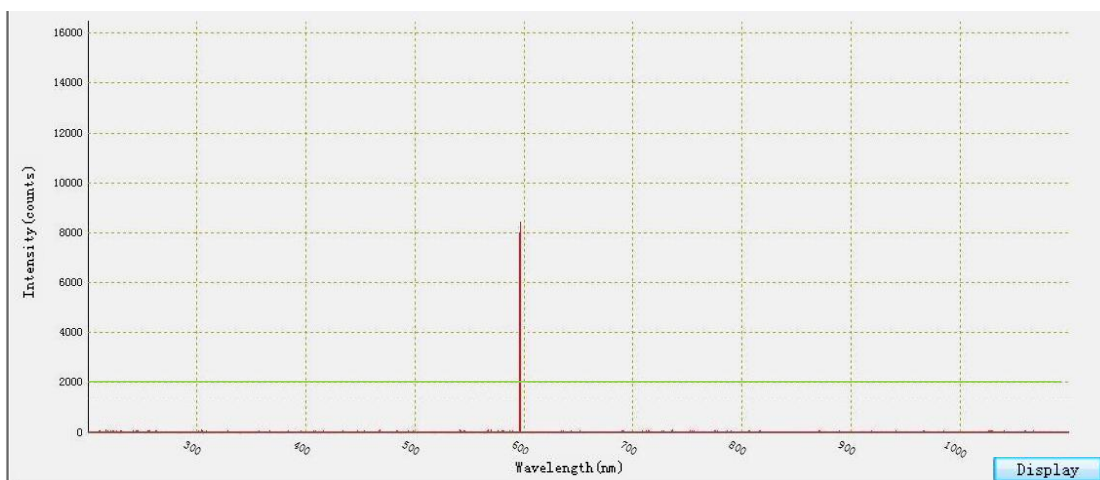


According to the demand, fill in the number of superposition n , and then click the button  in the dialog box. The relative intensity of the final spectrum is n times the original spectrum intensity.


For example, when the number of superimpositions is "1", the original spectrum is as follows:



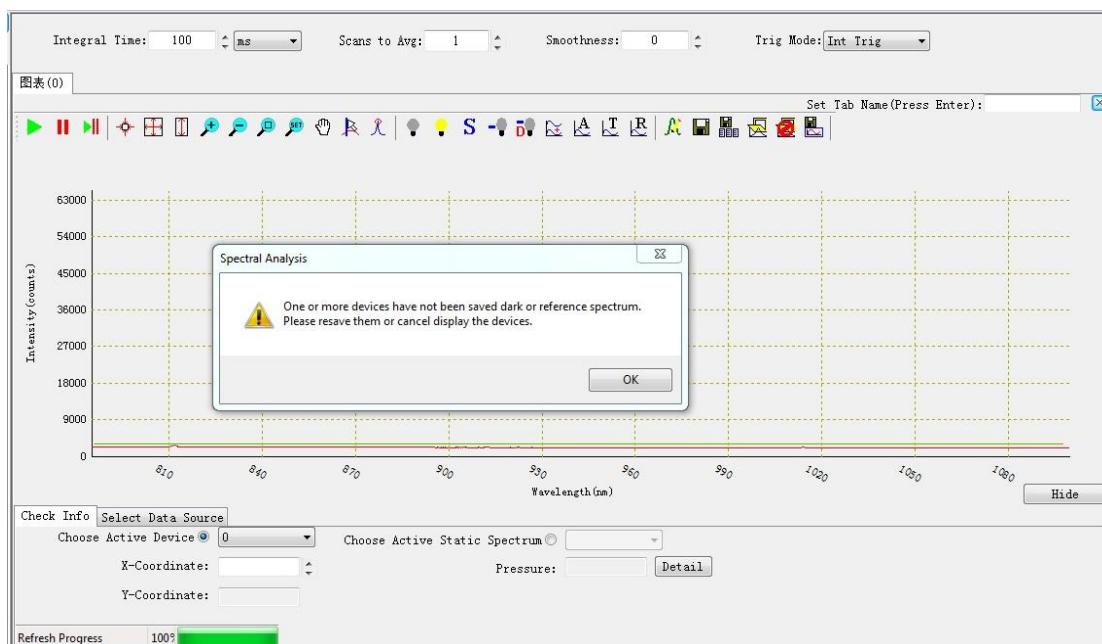
When the number of superimpositions is "2", the original spectrum is as follows:



2.10.7 Absorbance Measurement

Taking an absorbance measurement is by clicking  under tool bar. Dark spectrum and reference spectrum should be saved prior to calculate absorbance, otherwise software shown error.

Below graph shows when the reference spectrum was not saved.



Every pixel absorbance calculated via following formula.

$$A_{\lambda} = -\log_{10} \left(\frac{S_{\lambda} - D_{\lambda}}{R_{\lambda} - D_{\lambda}} \right)$$

Among:

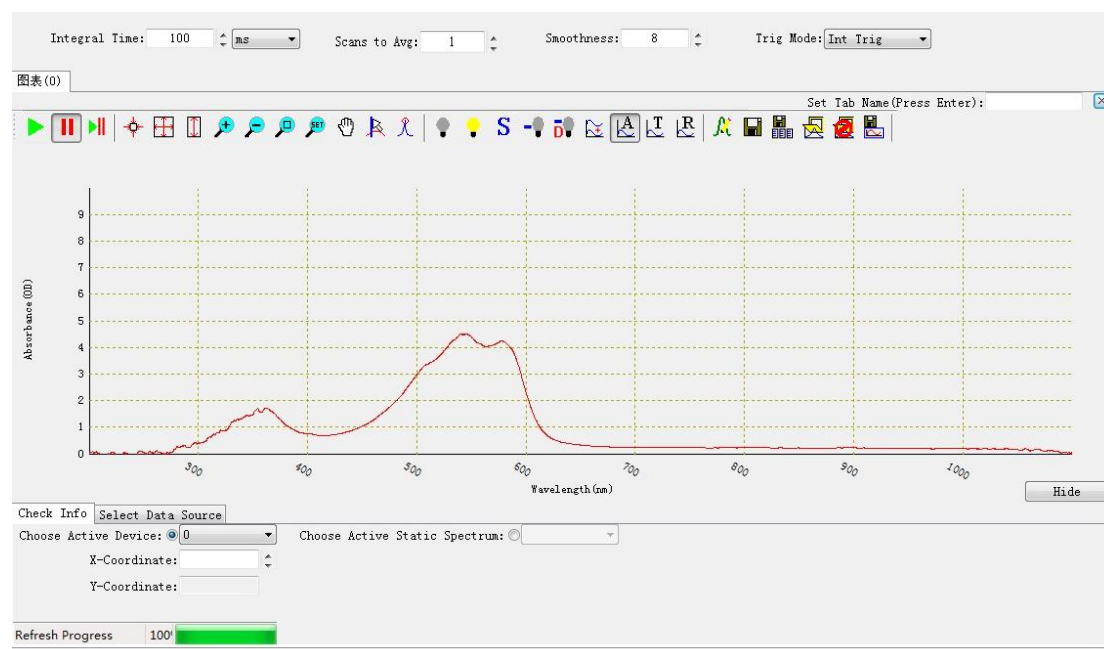
A_{λ} = The absorbance at λ wavelength

R_{λ} = The reference spectrum intensity at λ wavelength

D_{λ} = The dark spectrum intensity at λ wavelength

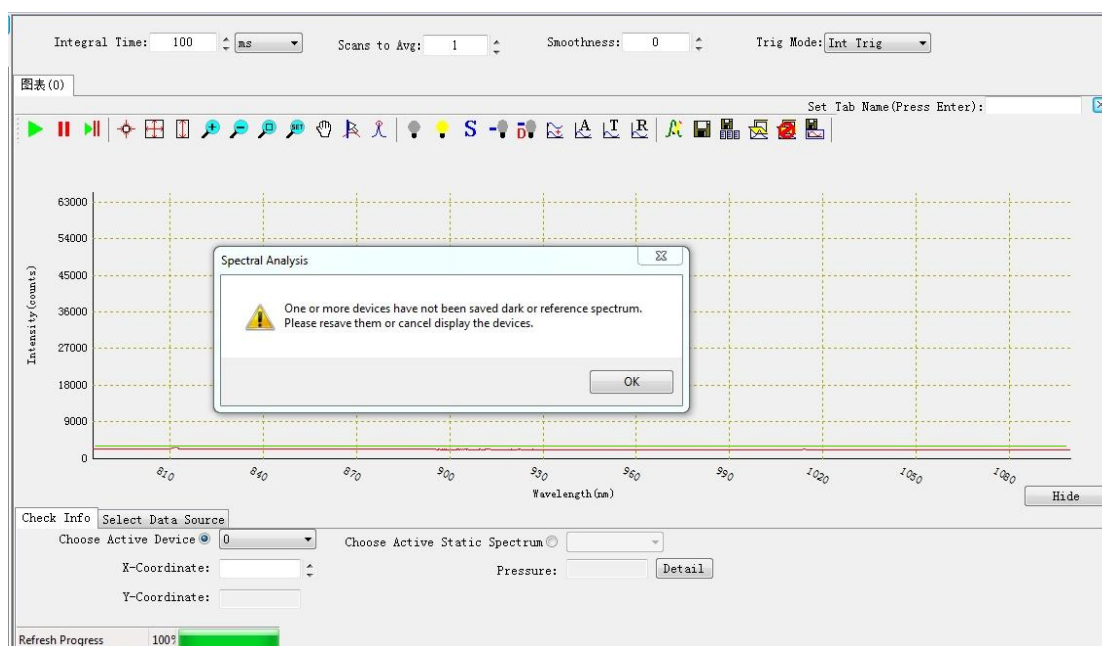
S_{λ} = Sampling laser source intensity at λ wavelength

Below diagram shows absorbance curve of certain reference spectrum.



2.10.8 Transmission Measurement

Transmission curve shown by clicking under toolbar. A dark spectrum and reference spectrum should be saved prior to calculate transmission, otherwise software prompts error.



Every pixel transmission calculated via following formula.

$$T_{\lambda} = \left(\frac{S_{\lambda} - D_{\lambda}}{R_{\lambda} - D_{\lambda}} \right) \times 100\%$$

Among:

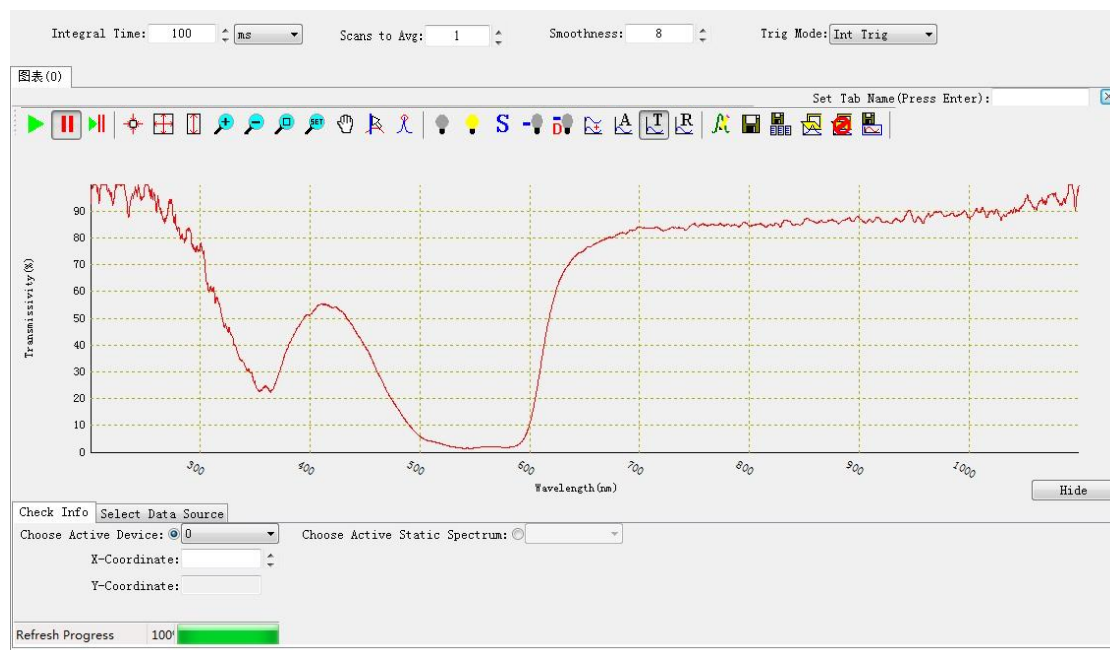
T_{λ} = The transmission at λ wavelength

R_{λ} = The reference spectrum intensity at λ wavelength


D_{λ} = The dark spectrum intensity at λ wavelength

S_{λ} = Sampling laser source intensity at λ wavelength

elow graph is the transmission curve of certain reference spectrum.



2.10.9 Reflection Measurement

Reflection curve shown by clicking  under toolbar. A dark spectrum and reference spectrum should be saved prior to calculate reflection, otherwise software prompts error.

Every pixel reflection calculated via following formula.

$$T_{\lambda} = \left(\frac{S_{\lambda} - D_{\lambda}}{R_{\lambda} - D_{\lambda}} \right) \times 100\%$$

Among:

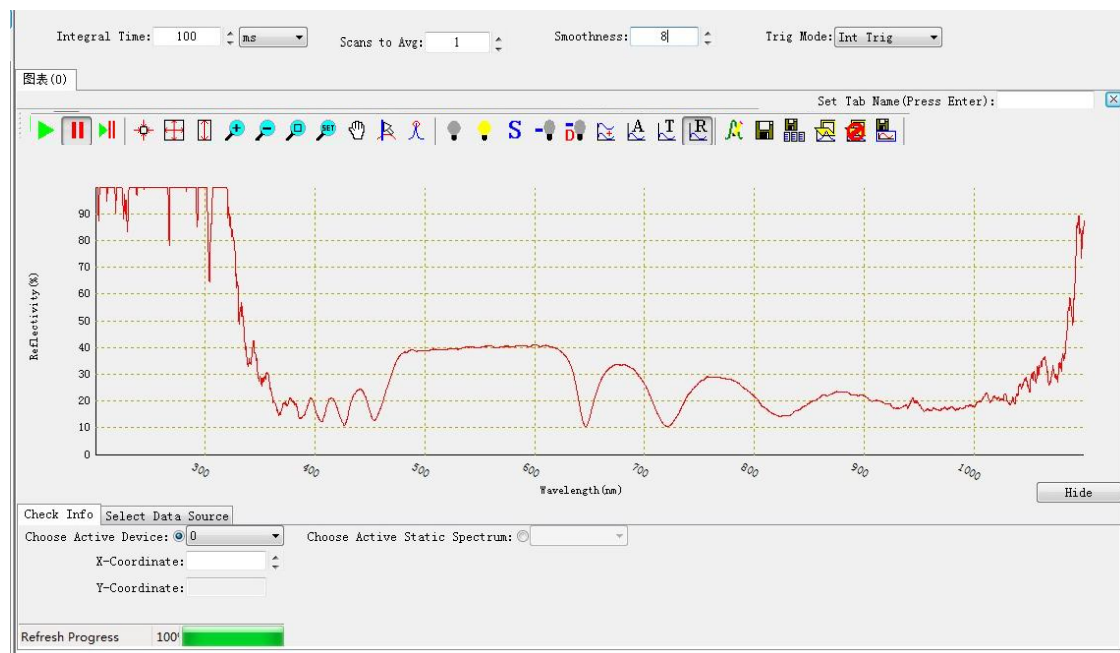
T_{λ} = The reflection at λ wavelength.

R_{λ} = The reference spectrum intensity at λ wavelength.

D_{λ} = The dark spectrum intensity at λ wavelength.

S_{λ} = Sampling laser source intensity at λ wavelength

Below graph shows a reflectivity curve of certain reference spectrum.



2.10.10 Others

Click the absorbance button (transmission or reflection) firstly, meanwhile raise the reference spectrum button to recover from the state of absorbance. The original curve shown when raise deducted dark spectrum button.

There are certain requirements when operating data processing buttons. Such as dark spectrum should be saved prior to deduct the dark spectrum. Dark spectrum and reference spectrum should be saved prior to check absorbance (transmission and reflection).


2.11 Spectrum Processing

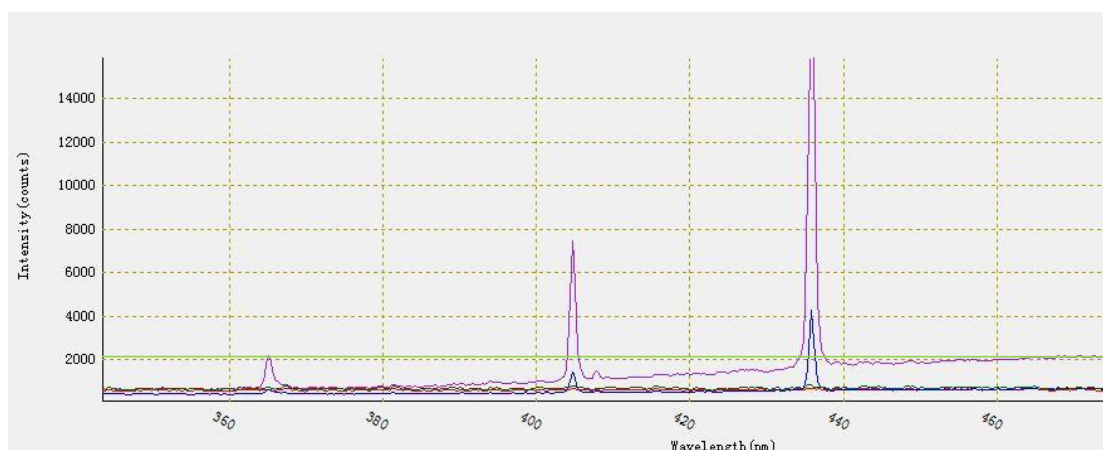


The spectrum processing section includes: 1. Overlay Activity

Spectrum; 2. Save Spectrum Data; 3. Save the continuous spectrum data; 4. Overlay Spectrum Data; 5. Delete Spectrum Data; 6. Save Spectrum Image.

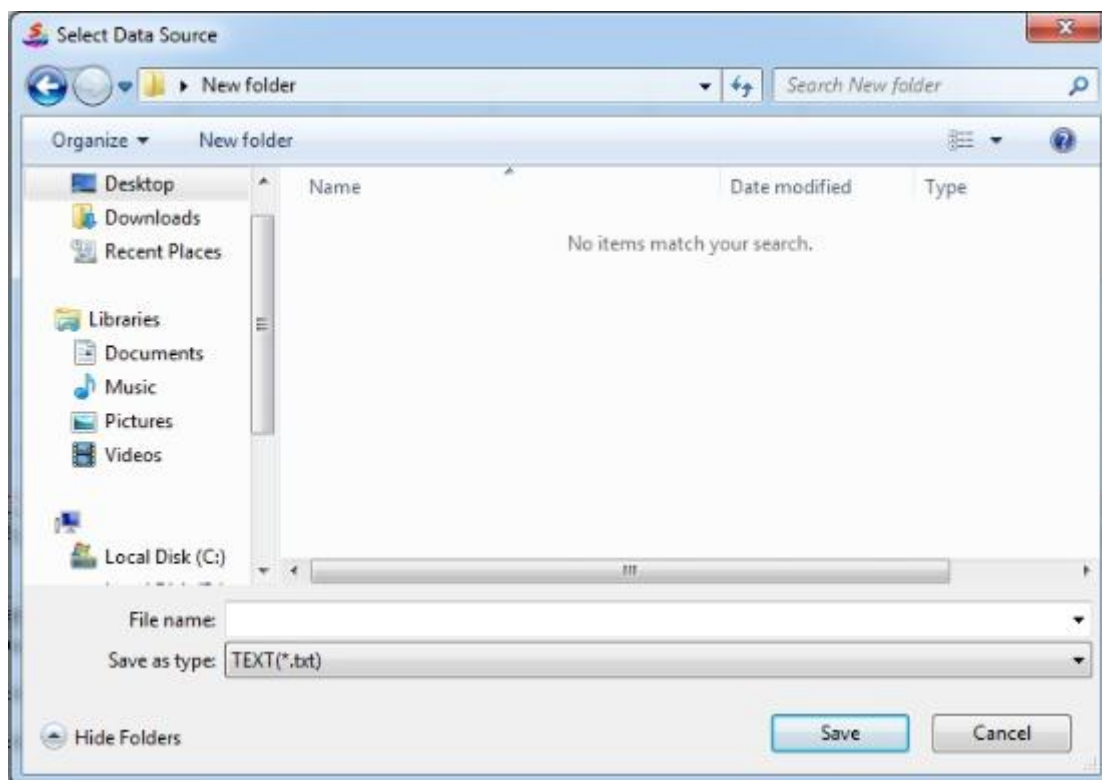
2.11.1 Overlay Activity Spectrum

Click , active static spectrum will be still. You can compare spectra. As shown below.



2.11.2 Save Spectrum Data

Click  button in toolbar, Pop up the below dialog box:



Select the save path, name the file, and click “Save” button. The saved file will exist in the selected folder.

Open the file in text mode to view the detail data.

Spectrometer Data

EN

Saving Time: Thu, Aug 07, 2014 09:57:16

Device Name: Aurora 4000

Version Info: V3_19

Serial Number: 220120140315031902001100

Integral Time (μ s): 100

Avg Count: 1

Smoothness: 0

Data Type: (0,0)Wavelength-Original Spectrum

X-Axis Unit: nm

Y-Axis Unit: counts

Pixel Count: 3512

Reserve0:250

Other Description:

+++++Begin Spectral Data+++++

200.112 362.000

200.382 367.000

200.651 362.000

200.920 362.000

201.190 355.000

201.459 358.000

201.728 357.000

201.998 361.000

202.267 363.000


202.536 363.000

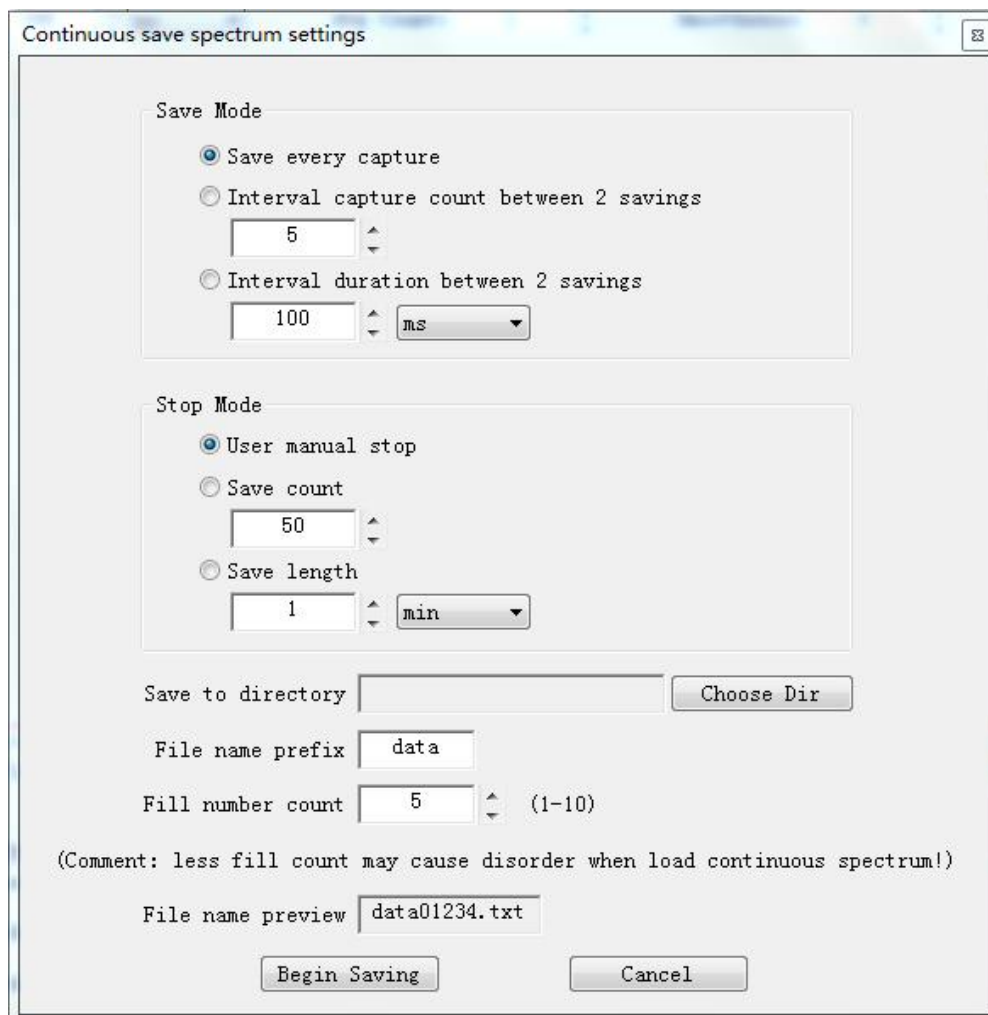
202.806 360.000

203.075 360.000

203.344 359.000

2.11.3 Save the continuous spectrum data

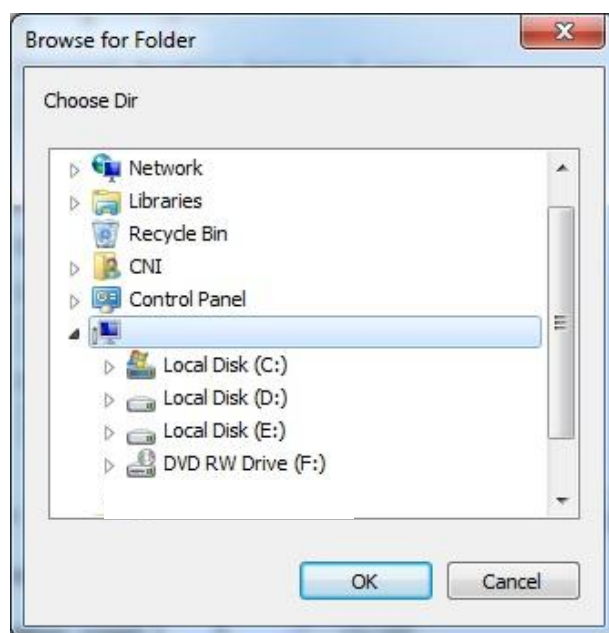
Click the button , the following dialog box pops up, the user can choose in the dialog box as needed.



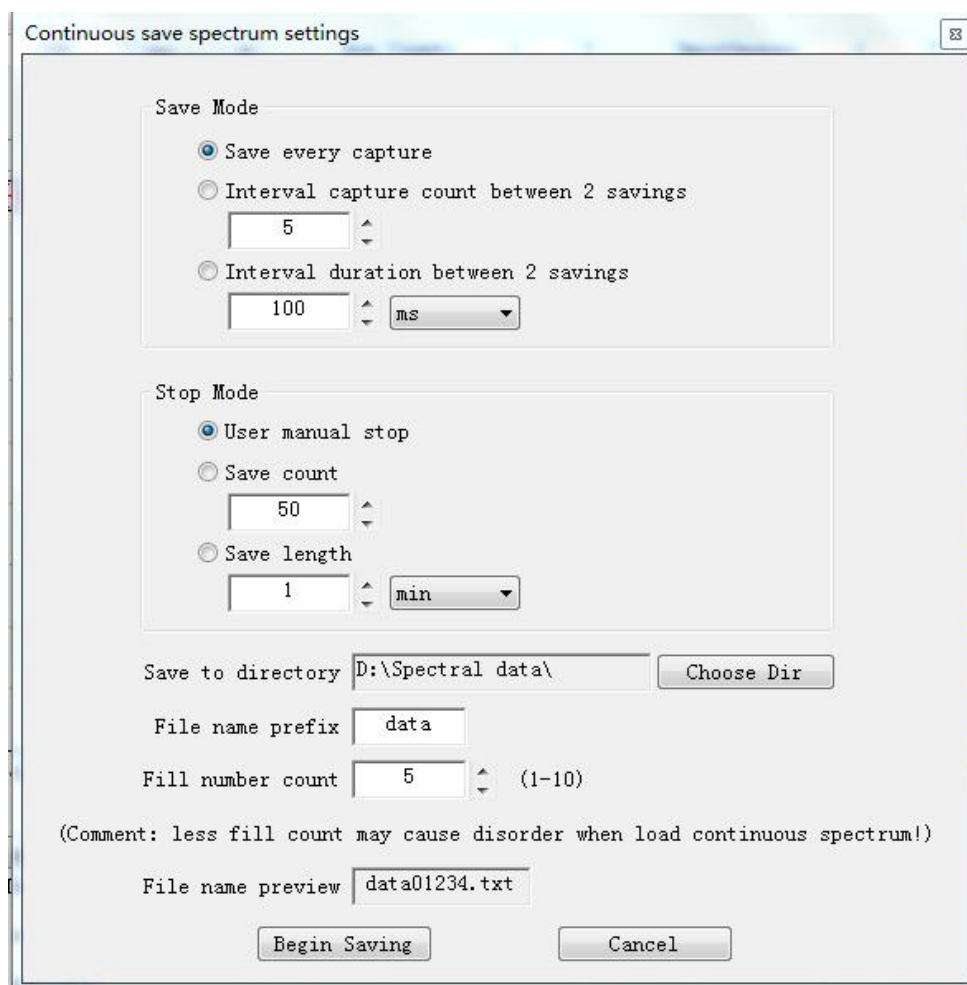
The dialog box titled "Continuous save spectrum settings" contains the following controls:




- Save Mode**
 - ☒ Save every capture
 - ☐ Interval capture count between 2 savings
 - Value: 5
 - ☐ Interval duration between 2 savings
 - Value: 100
 - Unit: ms
- Stop Mode**
 - ☒ User manual stop
 - ☐ Save count
 - Value: 50
 - ☐ Save length
 - Value: 1
 - Unit: min
- Save to directory**: [Text field] Choose Dir
- File name prefix**: data
- Fill number count**: 5 (1-10)
- (Comment: less fill count may cause disorder when load continuous spectrum!)
- File name preview**: data01234.txt
- Begin Saving Cancel

In the dialog box, click the button Choose Dir, the following dialog box pops up, you can select the desired save directory:

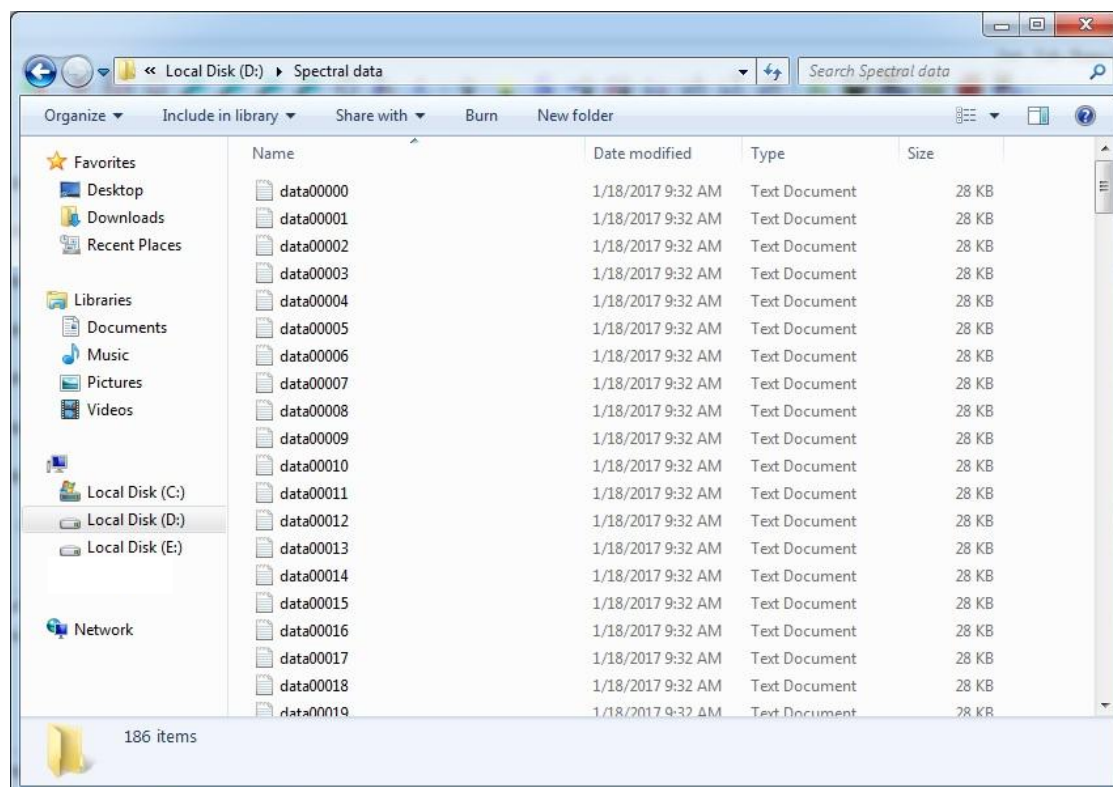


Select the save directory, click  the button as shown below:




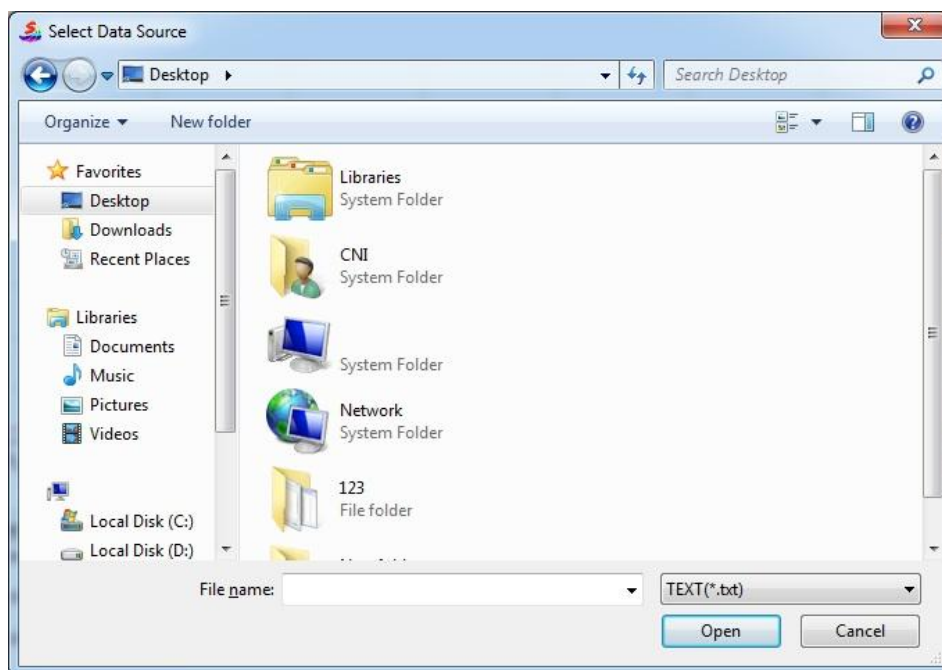
Click the button , the software “save continuous spectral data” button to press the state: . Click the "Save Continuous Spectrum Data" button again, the user will stop the saving manually. Or to save the user's reservation number and save time, then save the automatic stop. When you stop the save, the software “save continuous spectral data” button for the pop-up state: .

At this point, open the saved directory, you can see to save the data, as shown below:

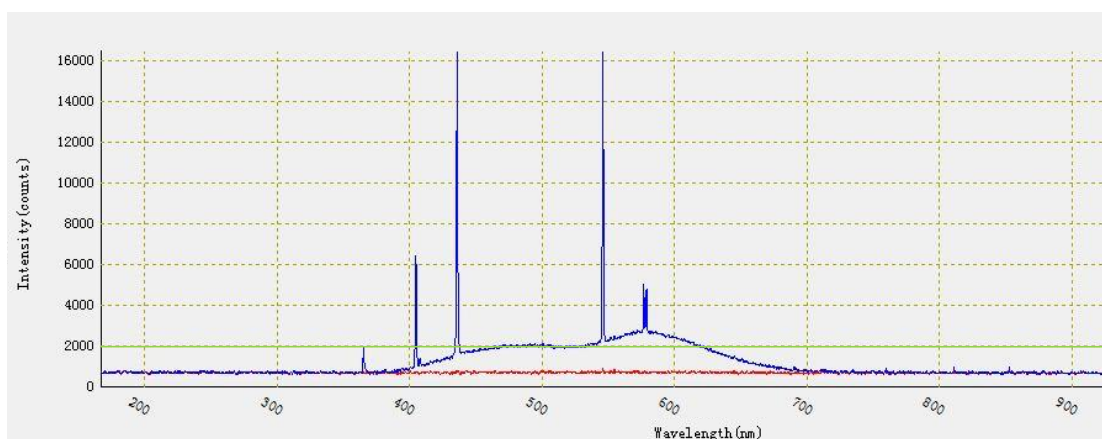


2.11.4 Overlay Spectrum Data

Click , appearing dialog box as below:

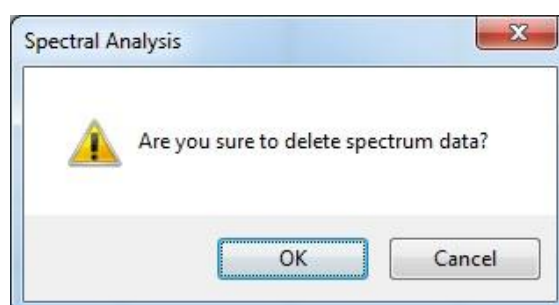


You can open the file with text form, as shown below:




2.11.5 Delete the spectral data

Click the button , the following dialog box pops up:



Click the button  to remove the superimposed spectrum.

2.11.6 Save Spectrum Image

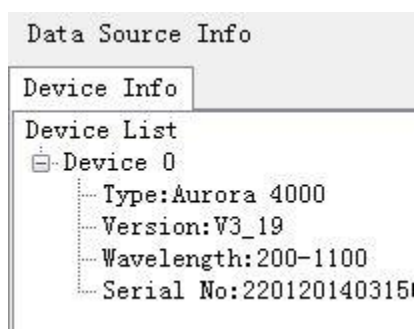
Click  button in toolbar, select the save path, name the file, and click “Save” button. The saved file will exist in the selected folder. Pop up the below dialog box:



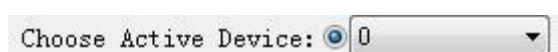
2.12 Facility Information

2.12.1 Facility Information

All spectrometer information shown by clicking facility information (default) under left information area.



The current running facility number can be checked in left the bottom facility information .



As shown, currently selected is facility 0.

2.12.2 Facility Selection

According to left facility information, current data shown after select facility number on left bottom drop-down box.

