Lightnovo

Miraspec software

User Manual

Version 001

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Contents

1. Introduction

Miraspec is a software platform developed by **Lightnovo ApS** for the control and operation of Raman spectroscopy and Raman microscopy systems. The software provides tools for instrument control, spectral acquisition, visualization, and data analysis, enabling users to perform both point spectroscopy and spatially resolved Raman measurements.

Miraspec integrates the operation of the spectrometer, laser, detector, and microscope components into a single user interface. Through this interface, users can configure measurement parameters, acquire spectra, perform spectral processing, and export results for further analysis. In microscopy configurations, the software also supports Raman mapping and image-based analysis.

The software is designed for laboratory and industrial environments where Raman spectroscopy is used for material identification, chemical analysis, and microscopic investigation. Typical applications include:

- Material characterization
- Chemical identification
- Quality control and process monitoring
- Micro-scale analysis using Raman microscopy

This manual provides guidance for installing and using the Miraspec software. It explains the software interface and describes the procedures for performing spectroscopy and microscopy measurements, analyzing the acquired data, and exporting results.

The manual is organized as follows:

- **Installation and Startup** describes system requirements and the installation process.
- **GUI Overview** introduces the main elements of the software interface.
- **Spectroscopy Mode** explains how to configure and perform Raman spectral measurements.
- **Microscopy Mode** describes imaging and Raman mapping functionality.
- **Troubleshooting** provides solutions to common problems.
- **Support and Service** lists contact information for technical assistance.

2. Safety summary

The Miraspec software is used to operate Raman spectroscopy and Raman microscopy instruments that may include lasers, optical components, and electrical equipment. Improper operation of such systems may result in personal injury or damage to the instrument. Users must follow all safety instructions provided with the hardware system.

Laser Safety

Raman instruments typically use visible or near-infrared lasers for excitation. Exposure to direct or reflected laser radiation may cause eye injury. Users must avoid looking directly into the laser beam or optical path and must follow all laser safety procedures specified for the instrument. Protective eyewear appropriate for the laser wavelength should be used where required.

Electrical Safety

The instrument should only be connected to properly grounded electrical outlets and operated according to the manufacturer’s specifications. Installation and servicing of electrical components should be performed only by qualified personnel.

Safe Operation

Before operating the system, ensure that all optical and mechanical components are properly installed and that the instrument enclosure is closed where applicable. Do not modify the instrument or operate it outside the recommended conditions.

The Miraspec software itself does not introduce additional hazards; however, it provides control over hardware components that may pose risks if used improperly. Users should familiarize themselves with the safety documentation provided with the instrument before performing measurements.

3. Installation and Startup

3.1 System requirements

The Miraspec software is designed to run on standard desktop or laptop computers used for laboratory instrumentation. The following system requirements ensure reliable operation and proper communication with the spectrometer and associated hardware.

Operating System

- Microsoft Windows 10 or Windows 11 (64-bit)

Processor

- Intel Core i5 or equivalent processor
- Intel Core i7 or higher recommended for Raman mapping and large datasets

Memory (RAM)

- Minimum: 8 GB
- Recommended: 16 GB or more for microscopy and Raman mapping applications

Storage

- Minimum: 1 GB available disk space for software installation
- Additional storage required for measurement data and Raman maps

Display

- Minimum resolution: 1920 × 1080
- Recommended: Full HD or higher resolution for optimal visualization of spectra and images

Interfaces

- USB port for spectrometer and instrument communication

Additional Software

- Latest drivers for the microscopy hardware (included with the Miraspec driver package)

User Permissions

- Administrator privileges are required for driver installation.

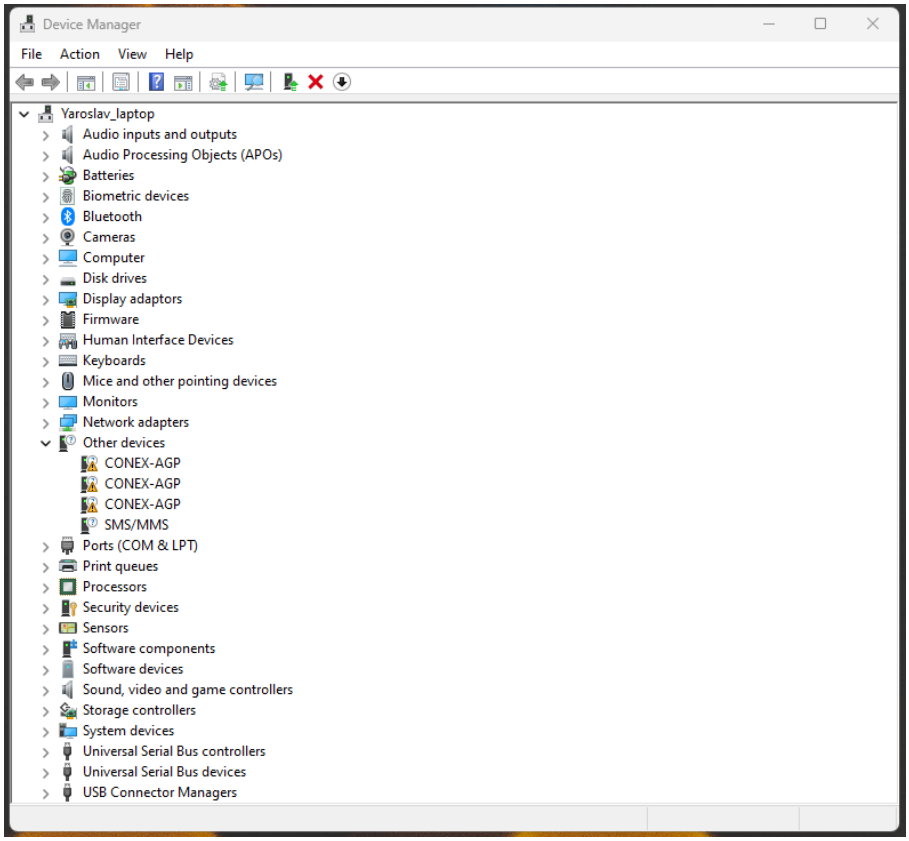
For optimal performance during large Raman mapping experiments or image processing tasks, a system with additional RAM and a modern multi-core processor is recommended.

3.2 Software installation

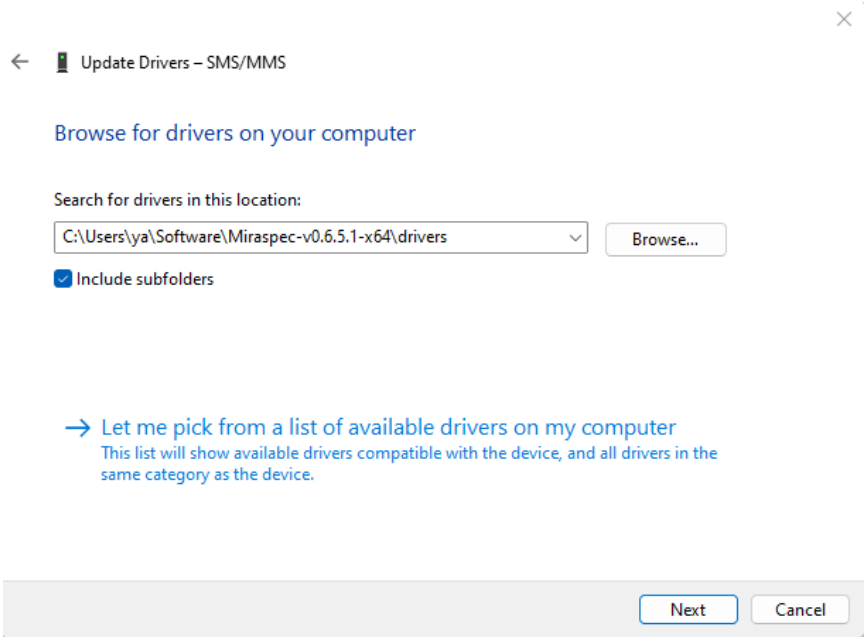
- Download the **Miraspec software** as the zip archive from Lightnovo ApS website
- Unzip the archive to a folder on your computer
- The software is installed and ready to use
- The spectrometers don’t require software drivers
- The microscopes require a software driver, please proceed to the following section to install the microscope drivers

3.3 Driver installation

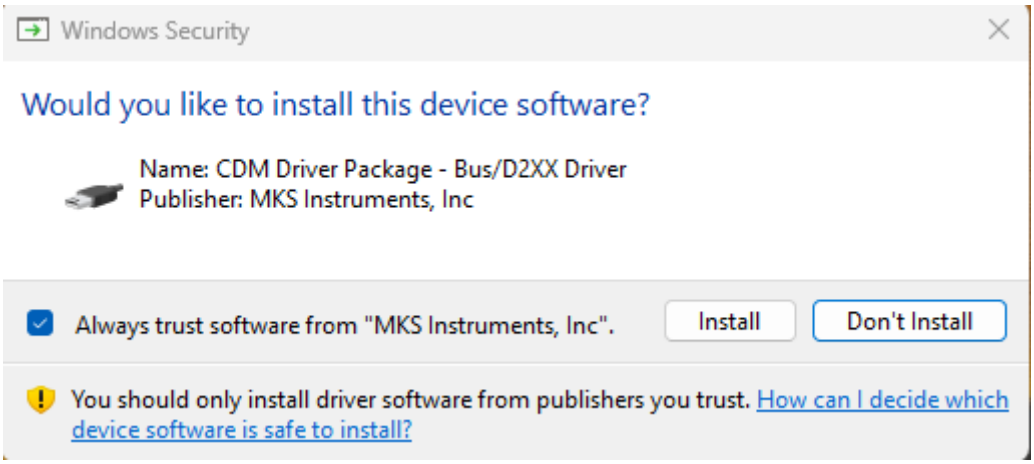
1. Go to **Device Manager/Other Devices** in Windows



2. Right click on a device and choose **Update Driver**
3. Choose **Browse** my computer for drivers
4. Choose **Miraspec/drivers** folder from your computer



5. Click **Next**
6. Approve installation by clicking **Install**

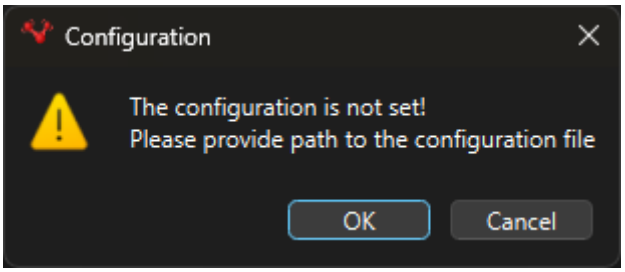


7. You should get a message that Windows has successfully updated the driver for the device
8. Repeat this procedure for each device from the Device Manager

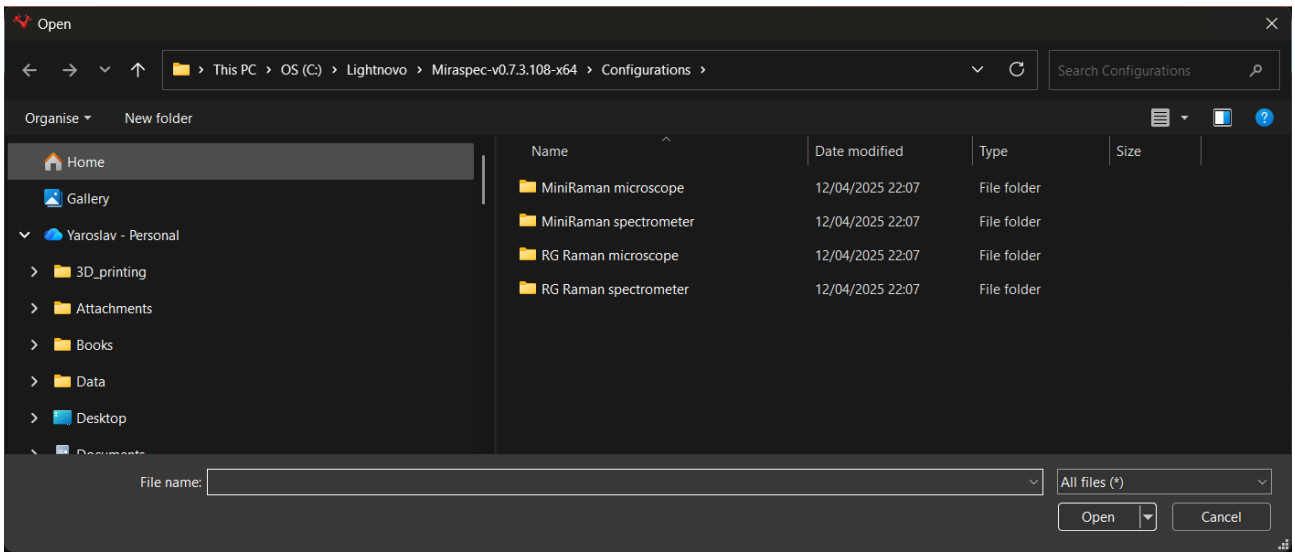
3.4 Launching Miraspec software for the first time

1. Go to the Miraspec installation folder and run **miraspec.exe** executable file.

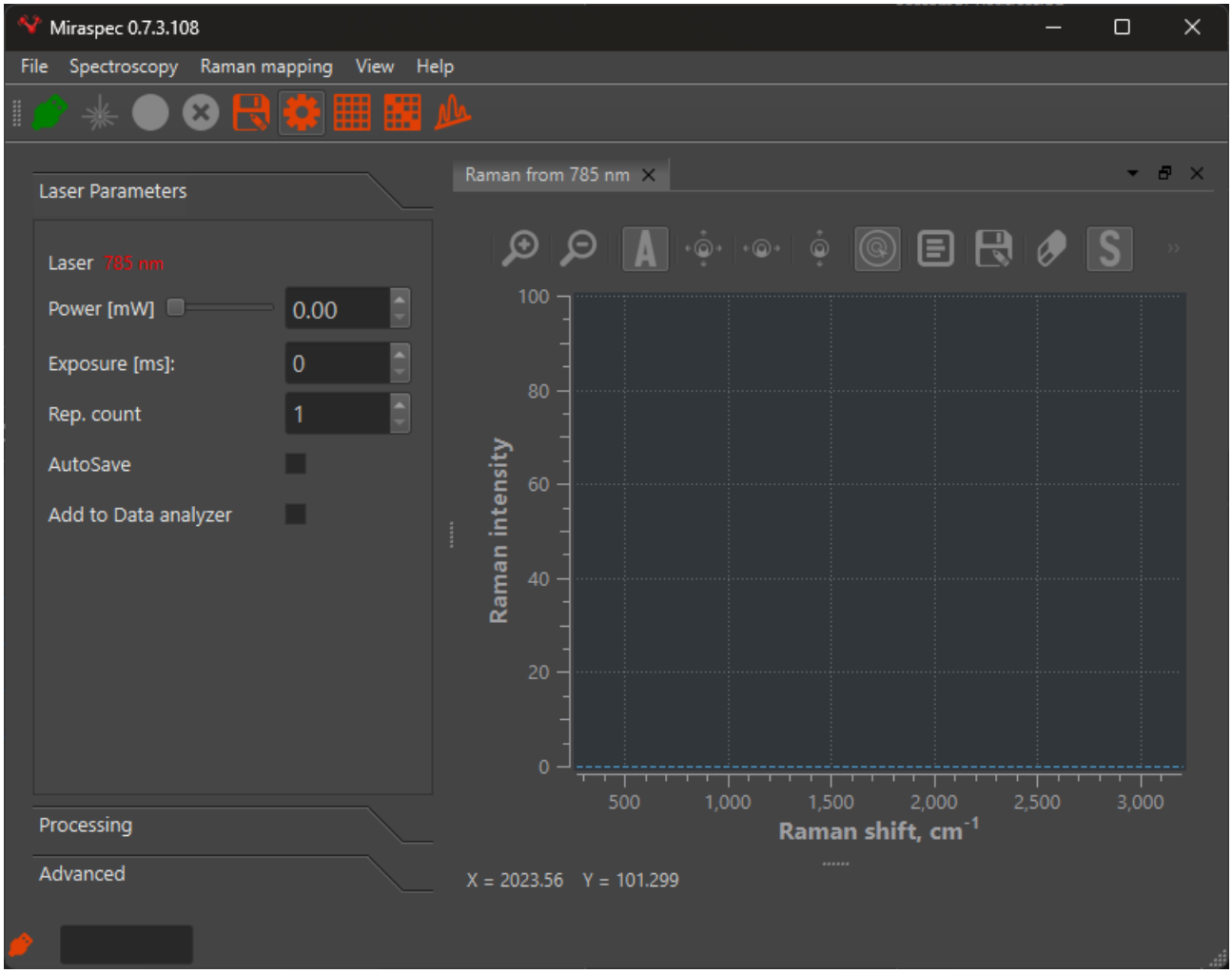
When running for the first time the prompt to choose the configuration would appear



2. Click **OK** to proceed and choose proper configuration file corresponding to the instrument you are using from the **Miraspec\Configurations** folder on your PC.

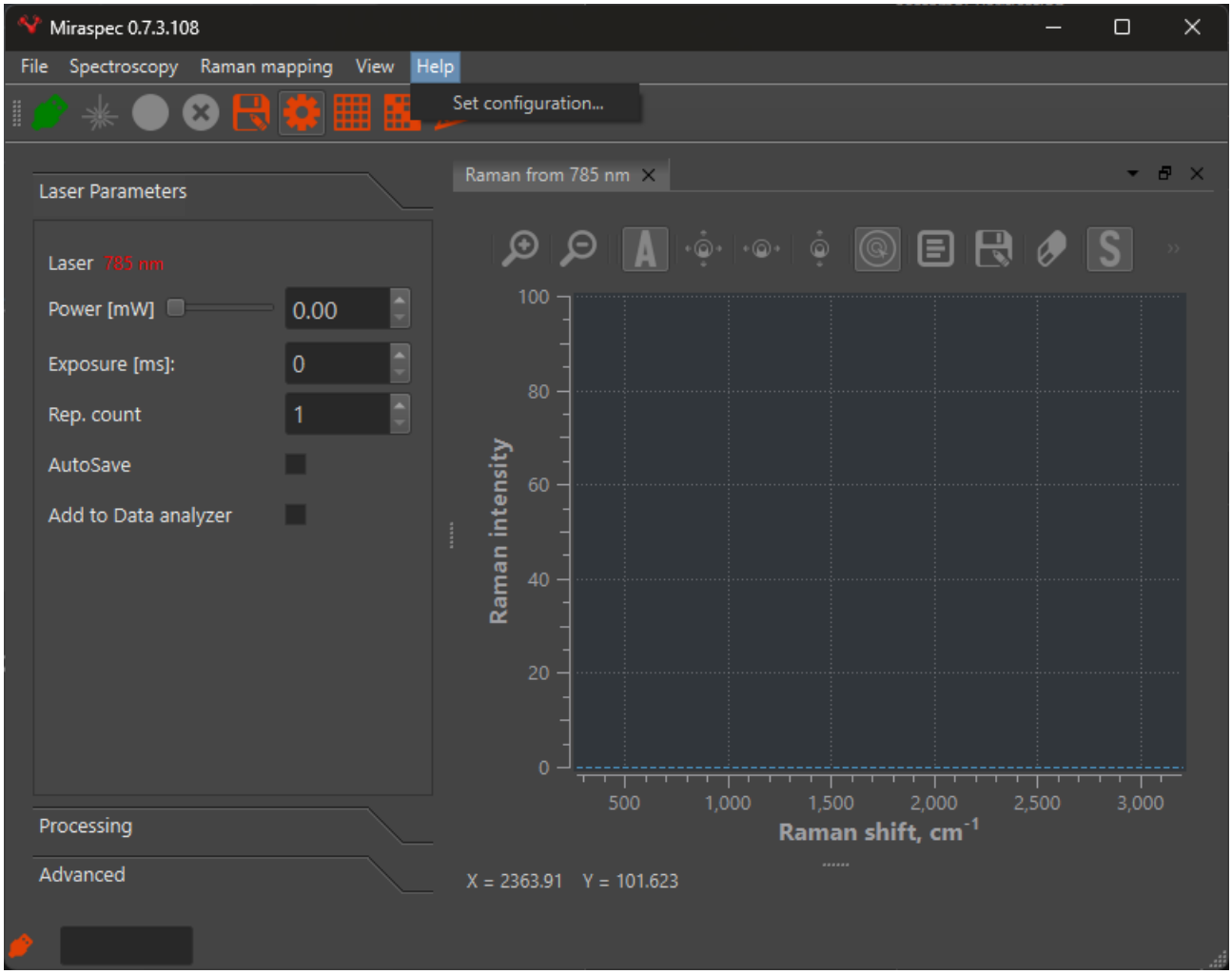


3. When the configuration is chosen the software GUI will start



Note

There is always an option to change the configuration by going to **Help -> Set Configuration** from the software menu.



4. GUI Overview

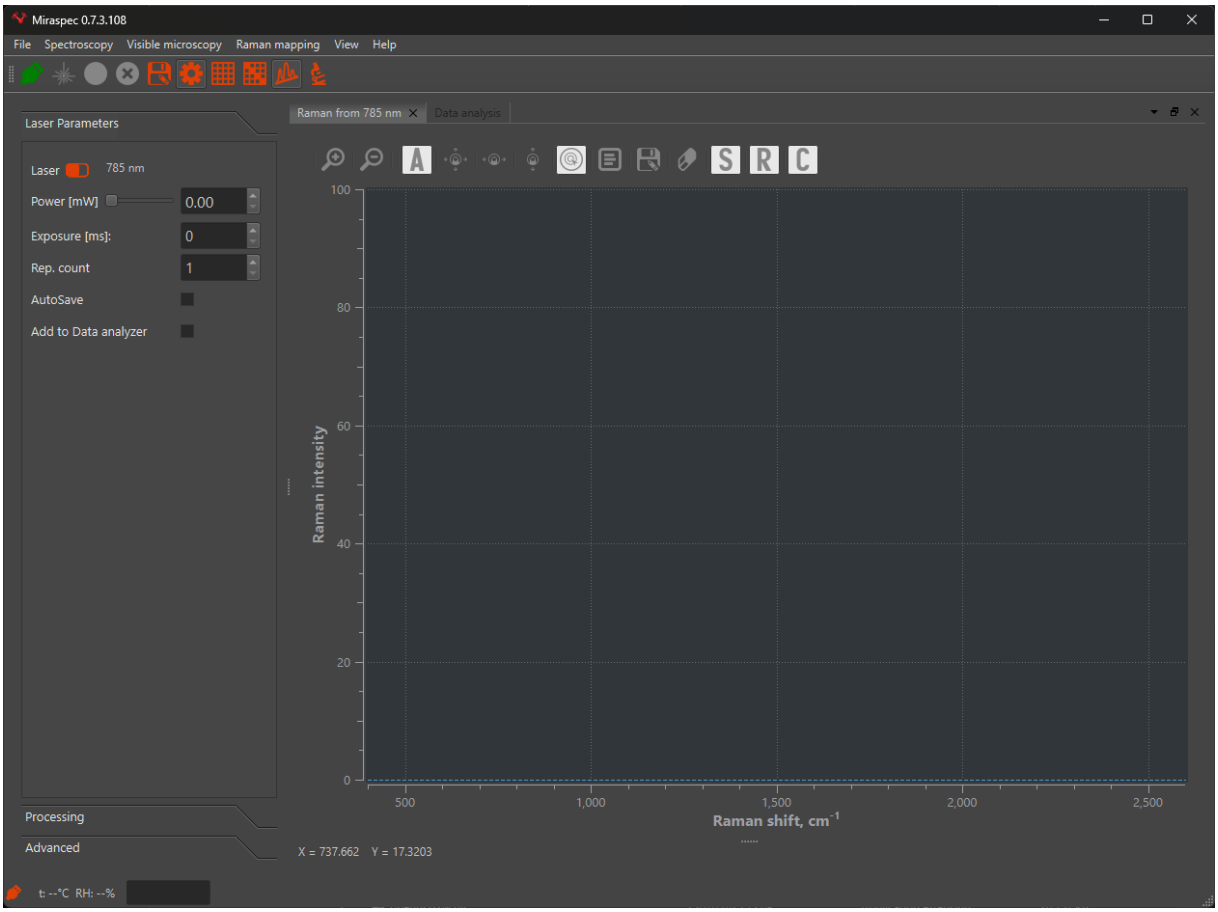


Figure 1. The GUI window.

The **GUI window** has the following areas:

1. **Window title** showing Miraspec version as well as standard minimize, maximize and close buttons.

Figure 2. Window title.

2. **Status bar** showing the whether the device is connected, if the device is connected it will also automatically show the parameters of the device such as serial number, the version of the firmware etc.

Figure 3. Status bar.

The progress of the measurement is also shown in the status bar.

3. **Text menu** and **graphical toolbar** with buttons to connect the device, control acquisition or show/hide components.

Figure 4. Text menu and graphical toolbar.

4. **Side panel** allowing to control various settings such as Laser parameters, Processing settings as well as to control advanced settings.

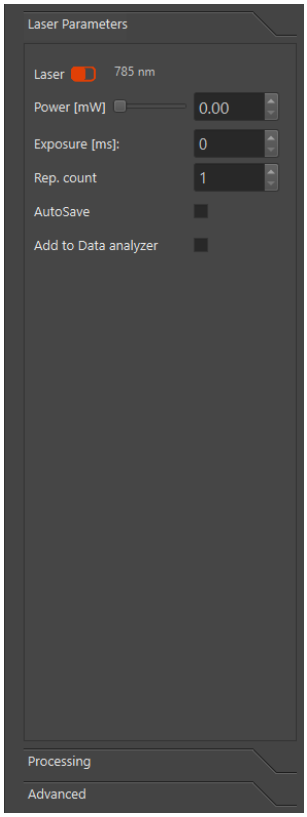


Figure 5. Side panel.

5. **The central part** of the Miraspec window is dedicated to the visualization of spectra or images depending on the selected operating mode. In spectroscopy mode, this area displays the live Raman spectrum, reference spectrum, and captured spectra. In microscopy mode, it displays the optical image of the sample and Raman maps generated during mapping experiments.

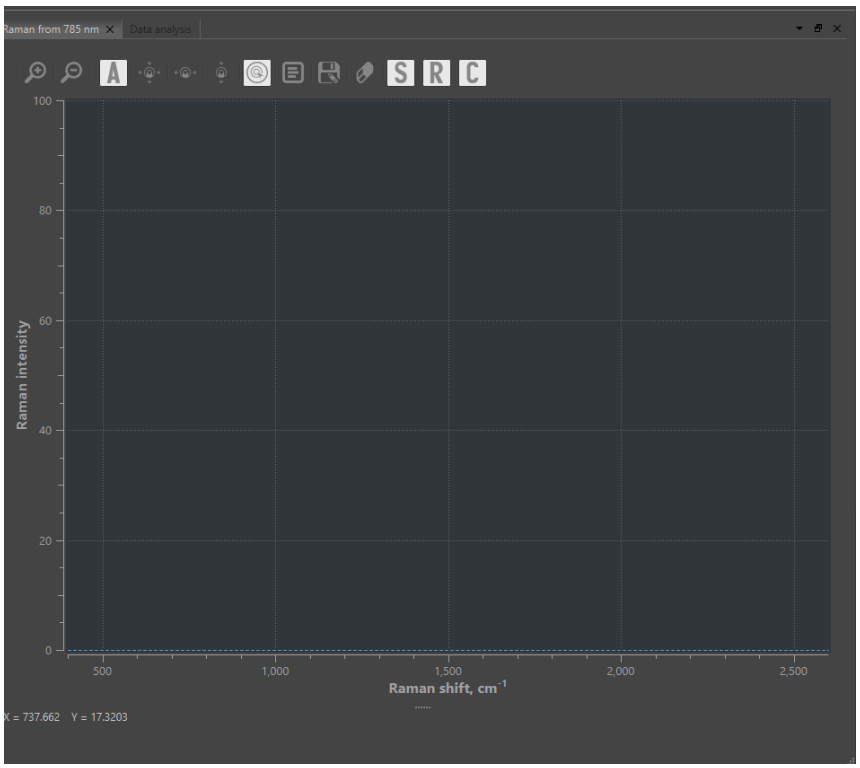


Figure 6. The central part of the Miraspec window.

The display supports interactive tools including zooming, scaling, and cursor tracking to inspect spectral features and intensity values.

GUI settings

In Miraspec software it is possible to optimize user interface based on customer preferences. Windows can be adjusted with docking widgets, see below, this is especially useful for large screens.

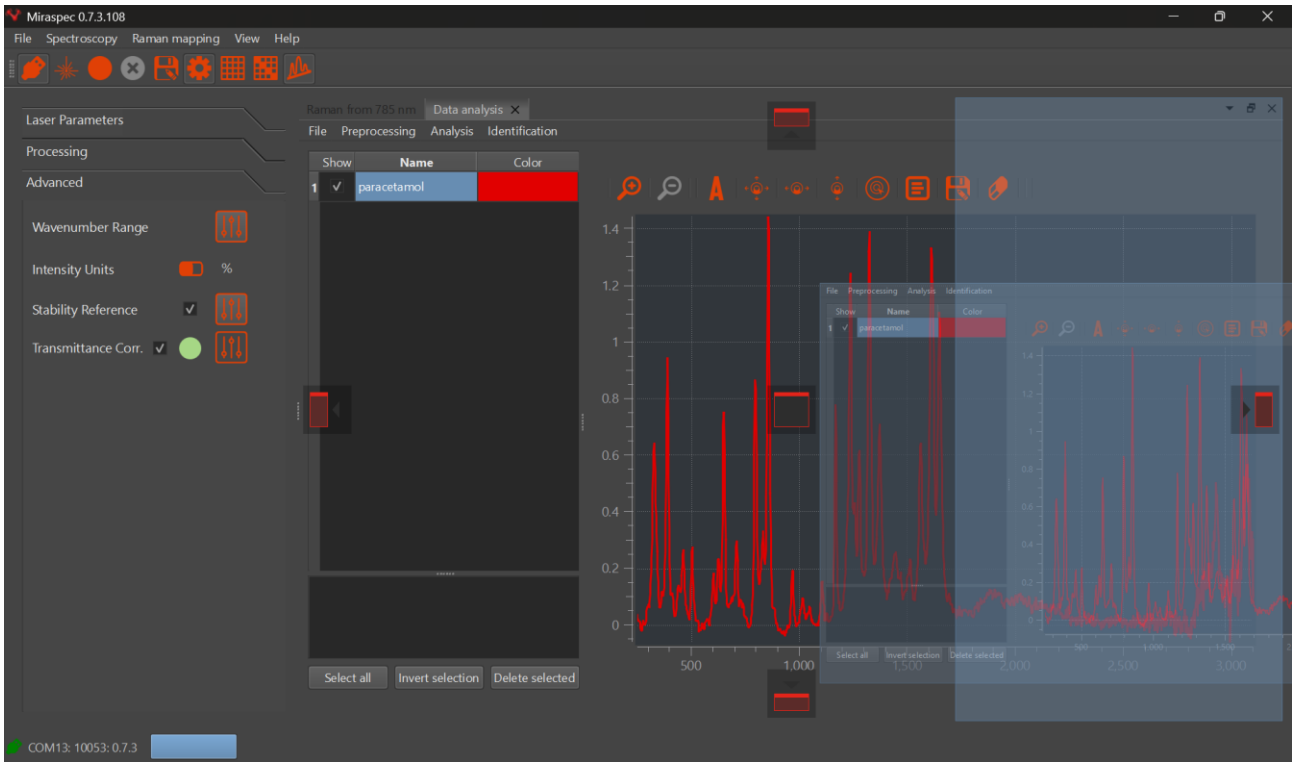


Figure 7. The process of docking windows in Miraspec software.

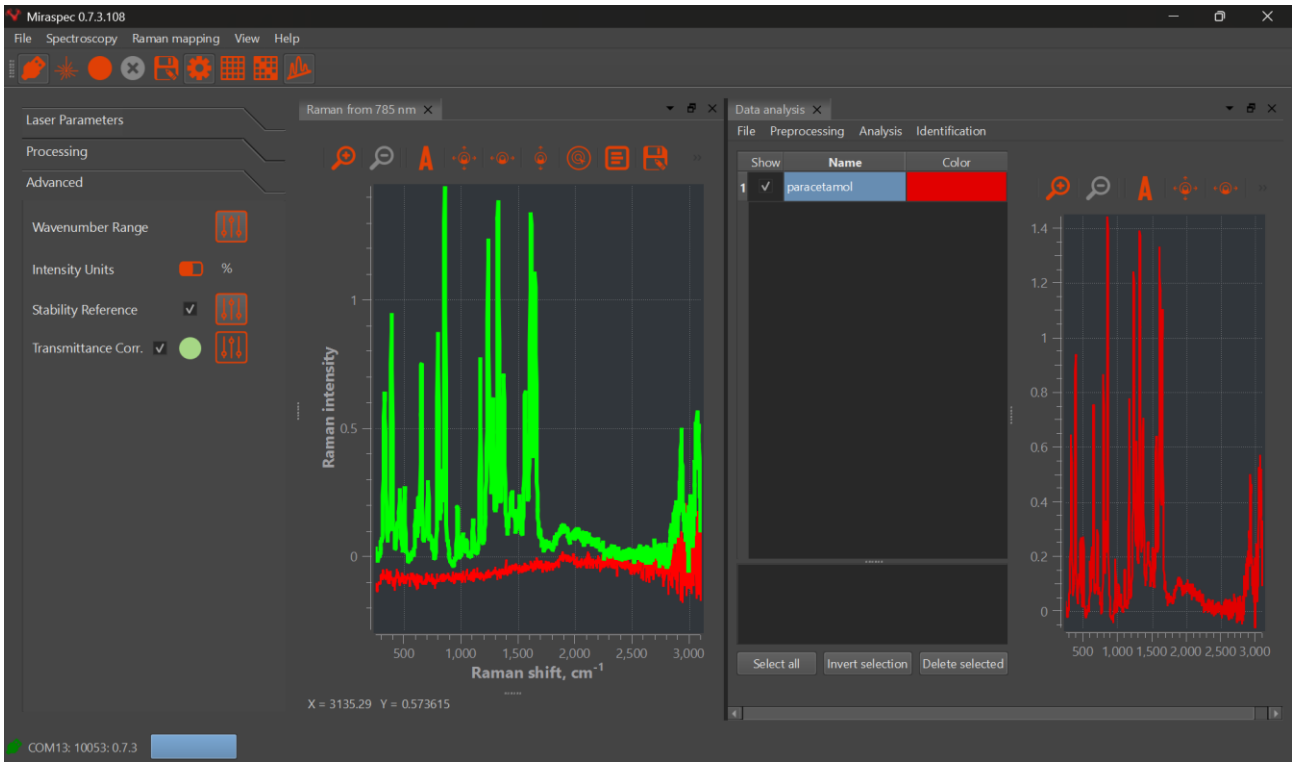
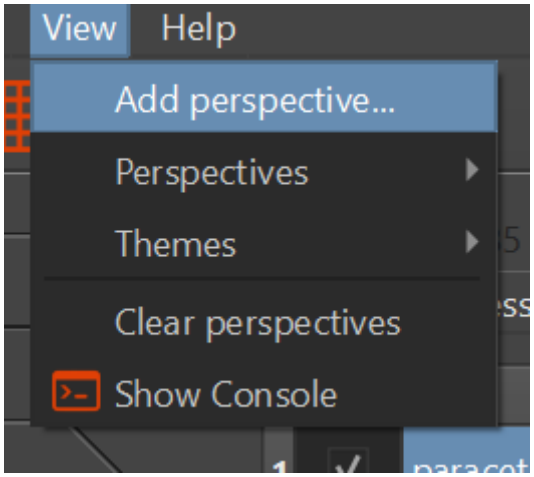


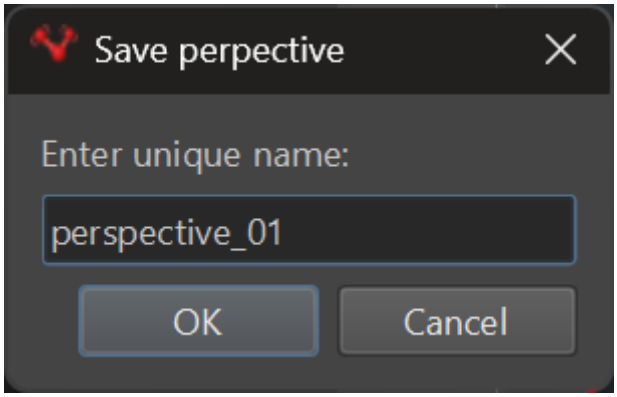
Figure 8. Docking widgets.

Each user interface can be saved, see below.

1. Adding perspective



2. Saving perspective



Saved perspective can be opened at any time later, see below.

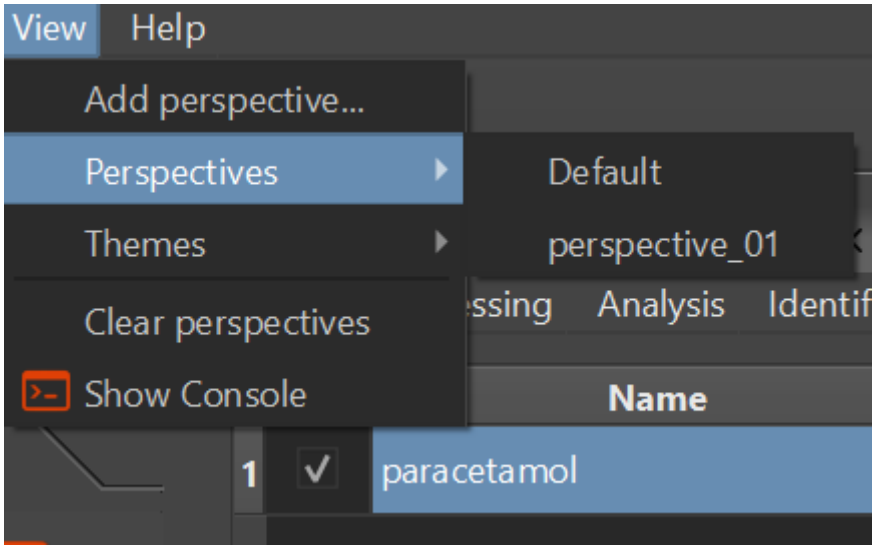


Figure 9. Saved perspective list.

5. Spectroscopy Mode

5.1 Overview

Spectroscopy Mode is used for acquiring and analyzing Raman spectra from a sample. In this mode, the Miraspec software controls the spectrometer, laser source, and detector to collect spectral data and display it in real time.

Typical workflow in spectroscopy mode consists of the following steps:

1. Connect the spectrometer to the software.
2. Enable the laser and configure acquisition parameters.
3. Observe the live spectrum of the sample.
4. Capture the spectrum using the acquisition control.
5. Process and analyze the recorded spectrum.

During acquisition, the live signal from the spectrometer is continuously displayed in the spectrum window. Users can adjust parameters such as laser power, exposure time, and number of repetitions to optimize signal quality.

Spectra can be further processed using built-in analysis tools such as smoothing, baseline correction, normalization, and spike removal.

5.2 Connection of the device

Press green connection button in the upper menu of Miraspec software window (Figure 10). The button should turn red when the device is connected (Figure 11). The status of connection including COM port, the serial number of the device, and device’s firmware version should be displayed in status bar as shown in Figure 12.

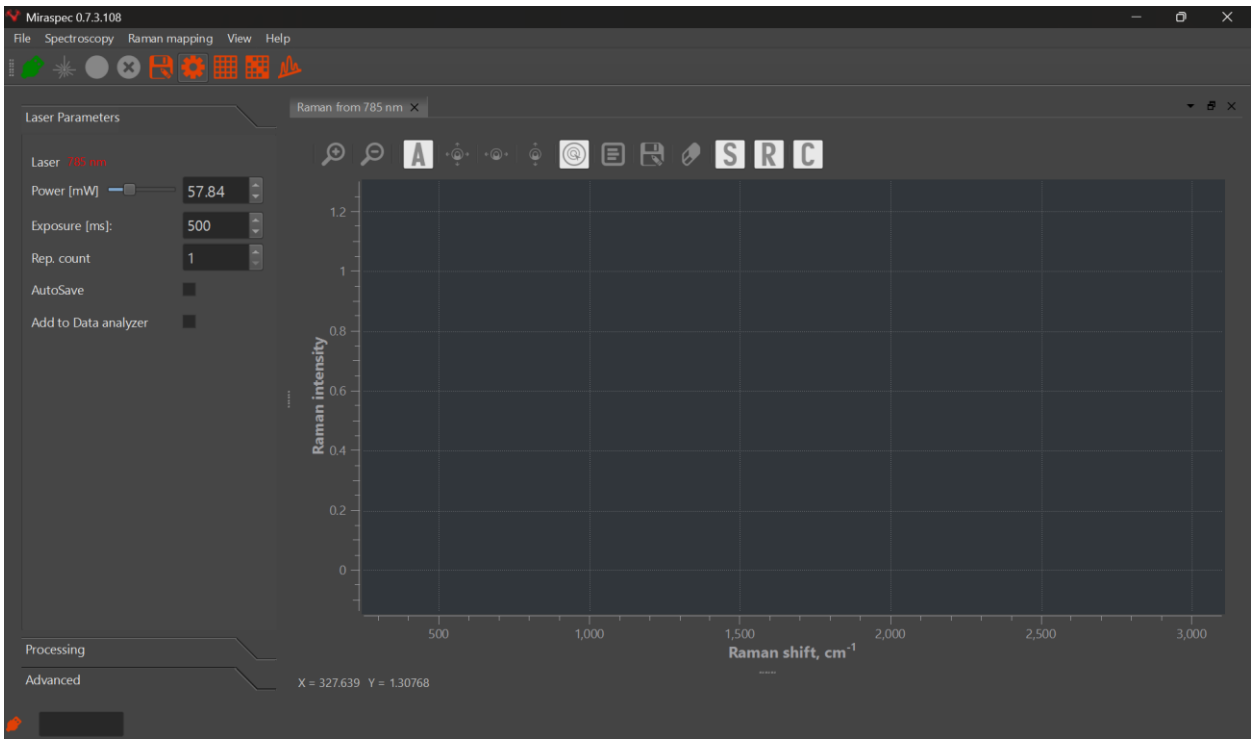


Figure 10. miniRaman spectrometer software interface; connection of devices.

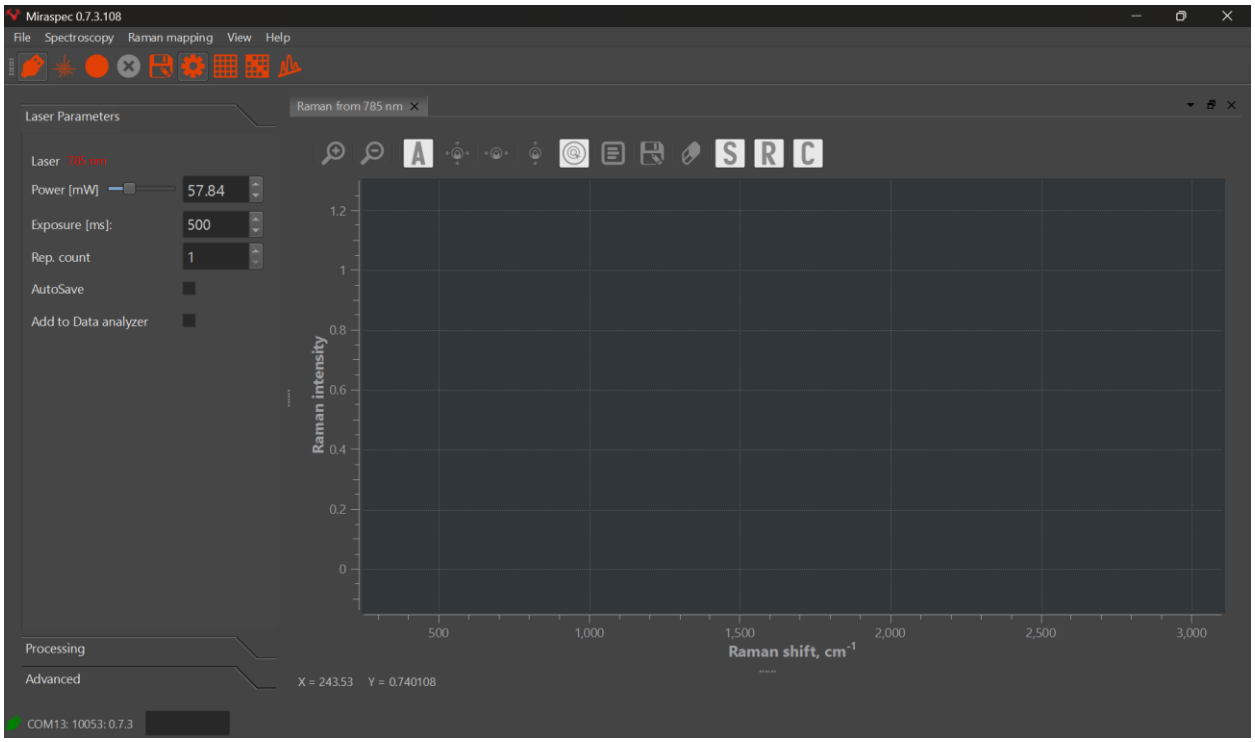


Figure 11. Connection window.

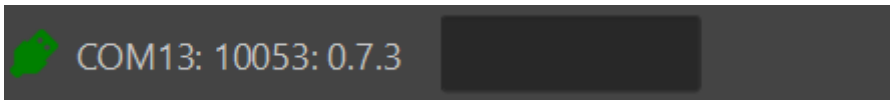


Figure 12. The status of connection in the status bar when the device is connected.

Once the device is connected, one can operate it through Miraspec software.

In order to disconnect the device click on red USB button again.

5.3 Measurement setup

Turn ON/OFF lasers

Press the red laser button from the main menu of the software, the laser button should turn green when the laser is ON. To turn the laser off press the laser ON/OFF button again, it should turn back to red when the laser is OFF.

Laser ON/OFF button when the laser is OFF

Laser ON/OFF button when the laser is ON

Measuring the Raman spectrum of the sample in real time.

Raman spectra can be visualized via Spectroscopy/Plots, see below.

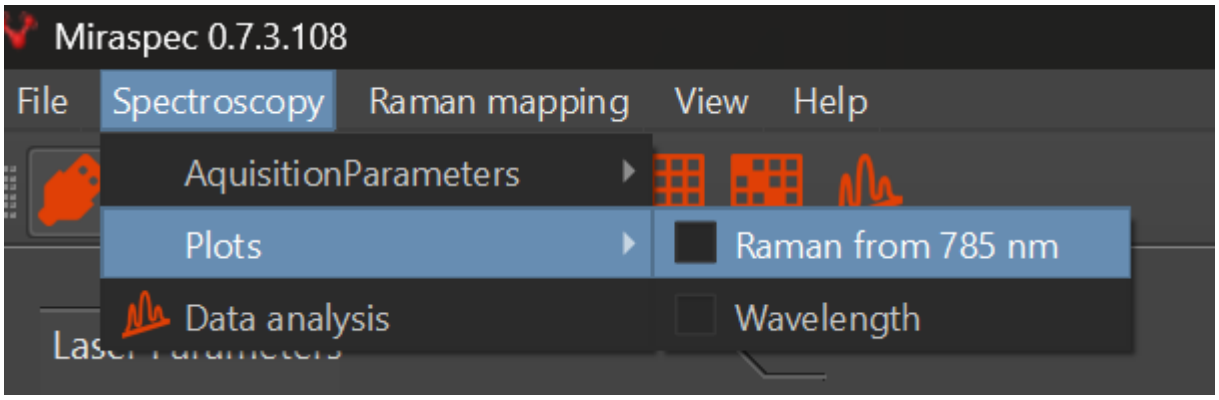


Figure 13. Visualization of Raman spectra obtained via excitation at 785 nm.

Visualizing the Raman spectrum of the sample in real time.

Raman spectra can be visualized via Spectroscopy/Plots, see below.

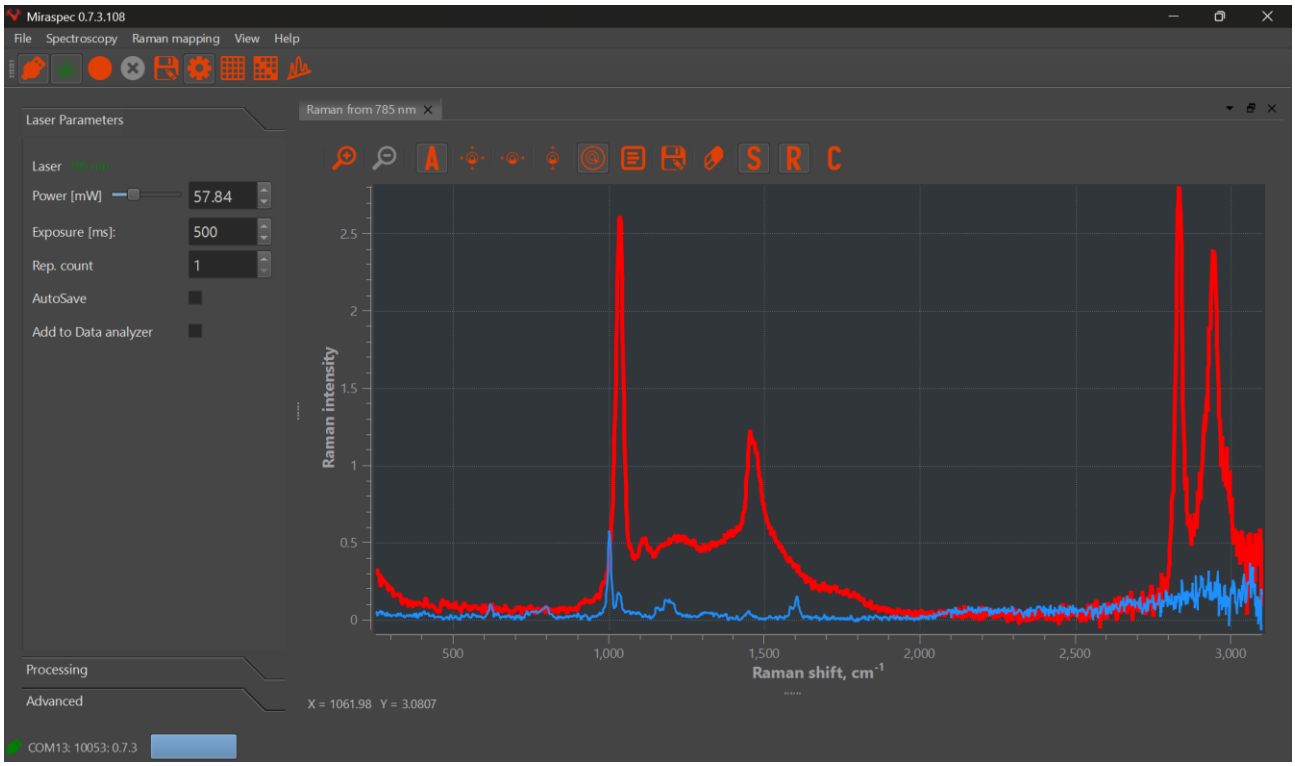


Figure 14. Live spectra of signal channel - methanol (red) and inbuilt reference sample – polystyrene (blue).

5.4 Running measurements

The acquisition settings can be controlled from the laser parameters tab (laser power, exposure time, repetitions count), there is also an option to automatically add spectrum to data analyzer.

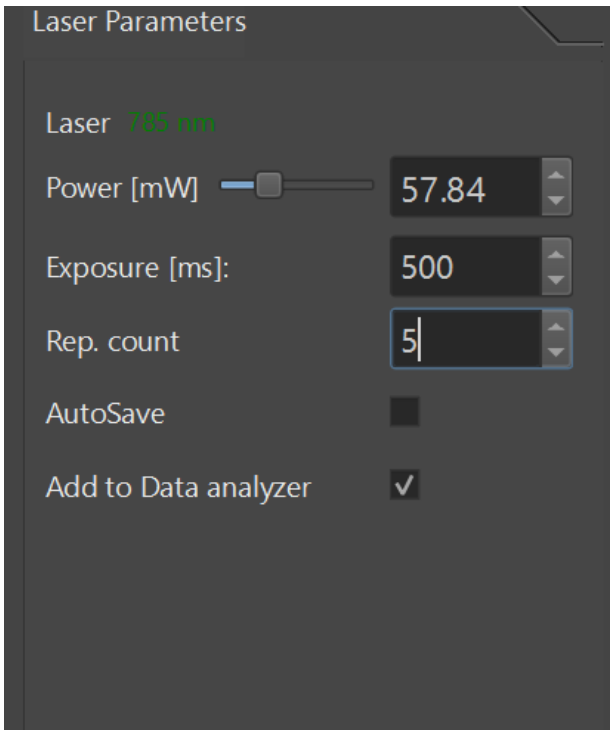


Figure 15. Laser parameters settings tab.

The Miraspec software also allows to record the background and then automatically subtract it from the measurement. The background should be recorded under the same settings as the measurement and with the laser ON. The background should be collected with the same probe but without the sample in the optical path.

Go to the Processing tab, click on the red button under Bg. Correction

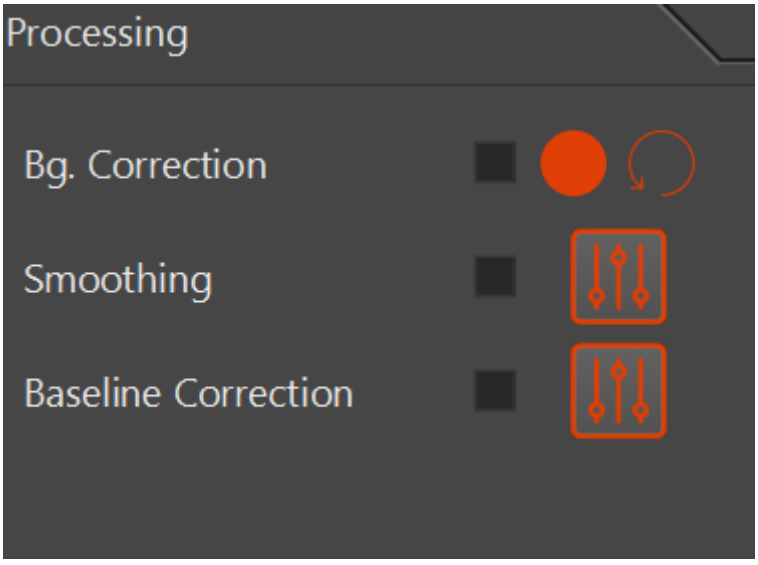


Figure 16. Processing tab.

When the background is acquired, the button should turn green:

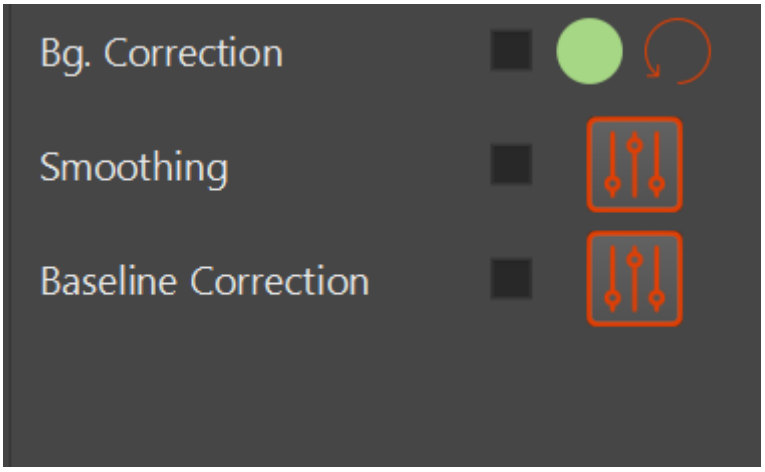


Figure 17. Processing tab with background correction captured.

Apply Bg. Correction by selecting the tick box under Bg. Correction.

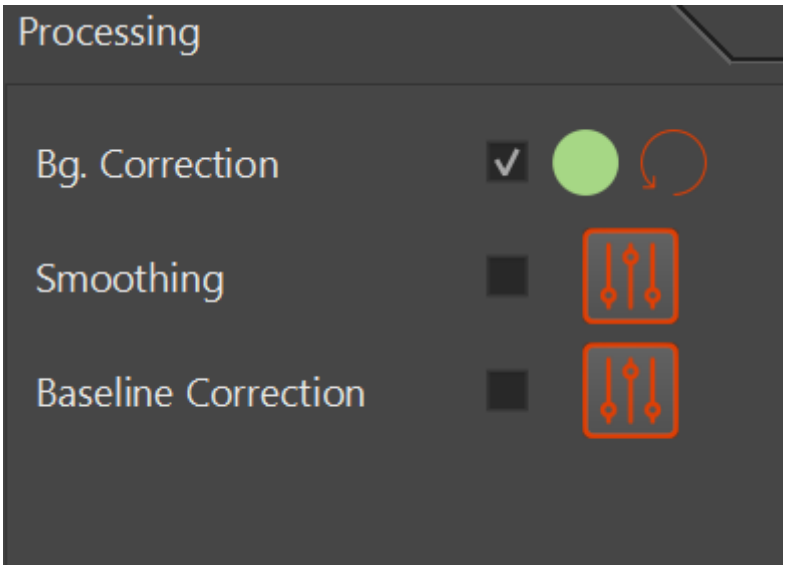


Figure 18. Processing tab with background correction captured and applied.

Now the background correction is applied automatically.

There is also a tab with advanced settings.

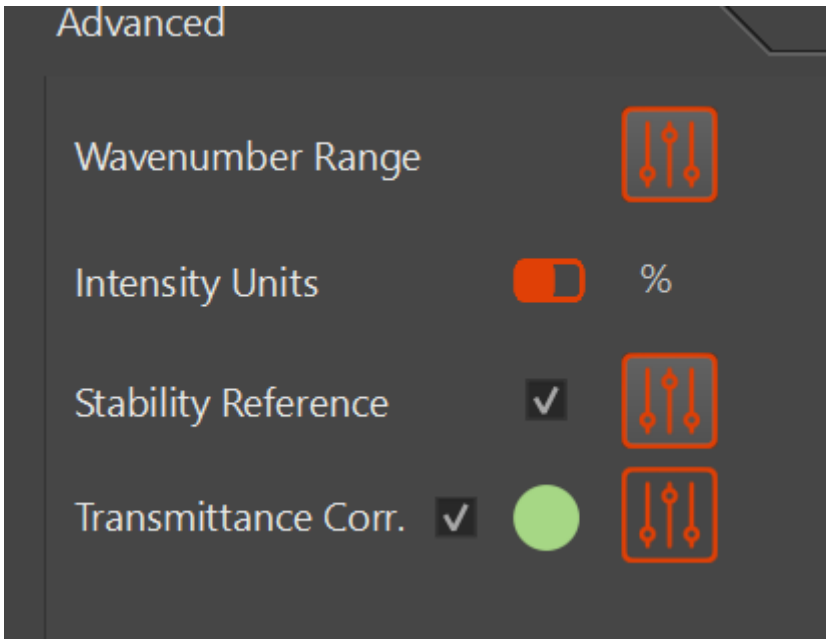


Figure 19. Advanced settings tab.

Here, the wavenumber range can be limited, if necessary, intensity units switched to counts from percent, stability reference can be adjusted, as well as transmission correction switched off. The advanced settings are for advanced users and Lightnovo service personnel. The advanced settings should be adjusted with caution and only by advanced users who clearly understand what they are doing and accept all the risks and responsibilities.

In order to record the measurement, click on the red round button from the main menu.

Figure 20. Main menu icons with the red round button used for capturing the spectra.

While the spectrum is being acquired, the integrated spectrum is shown in grey.

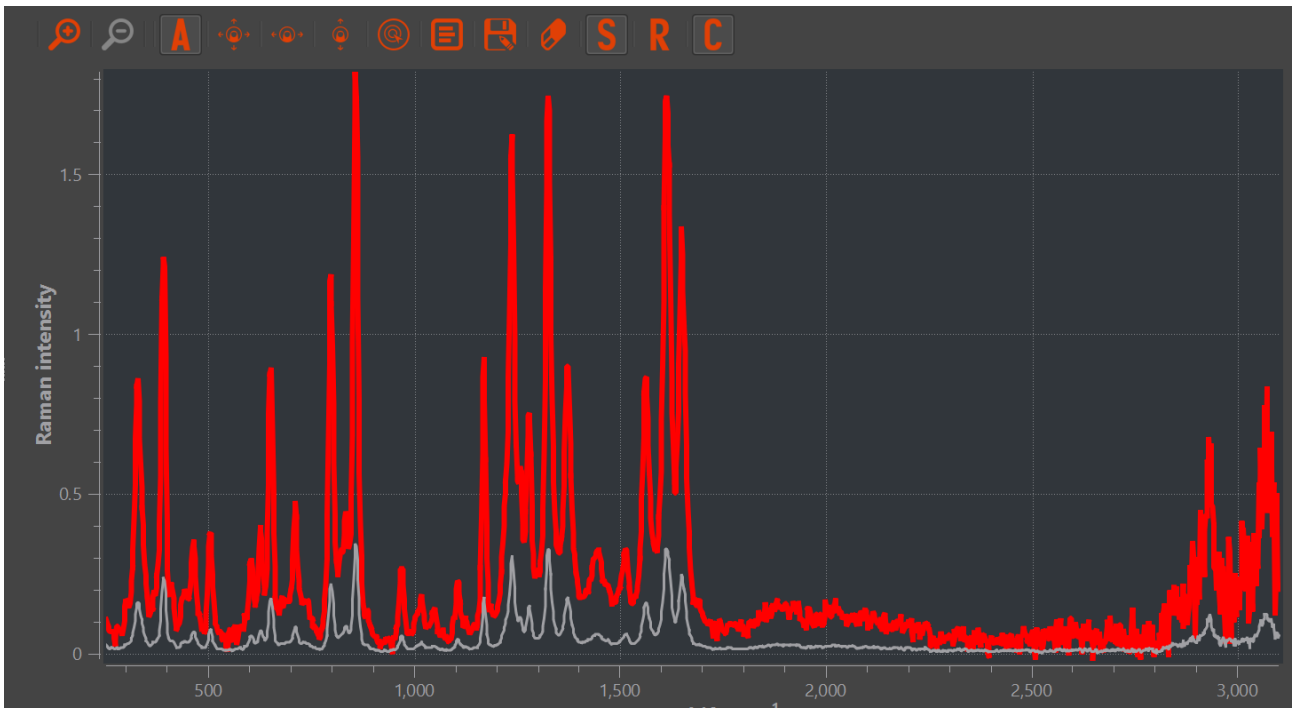


Figure 21. Paracetamol spectrum being captured -grey and live spectrum - red.

When the acquisition is completed, the captured spectrum is shown in green:

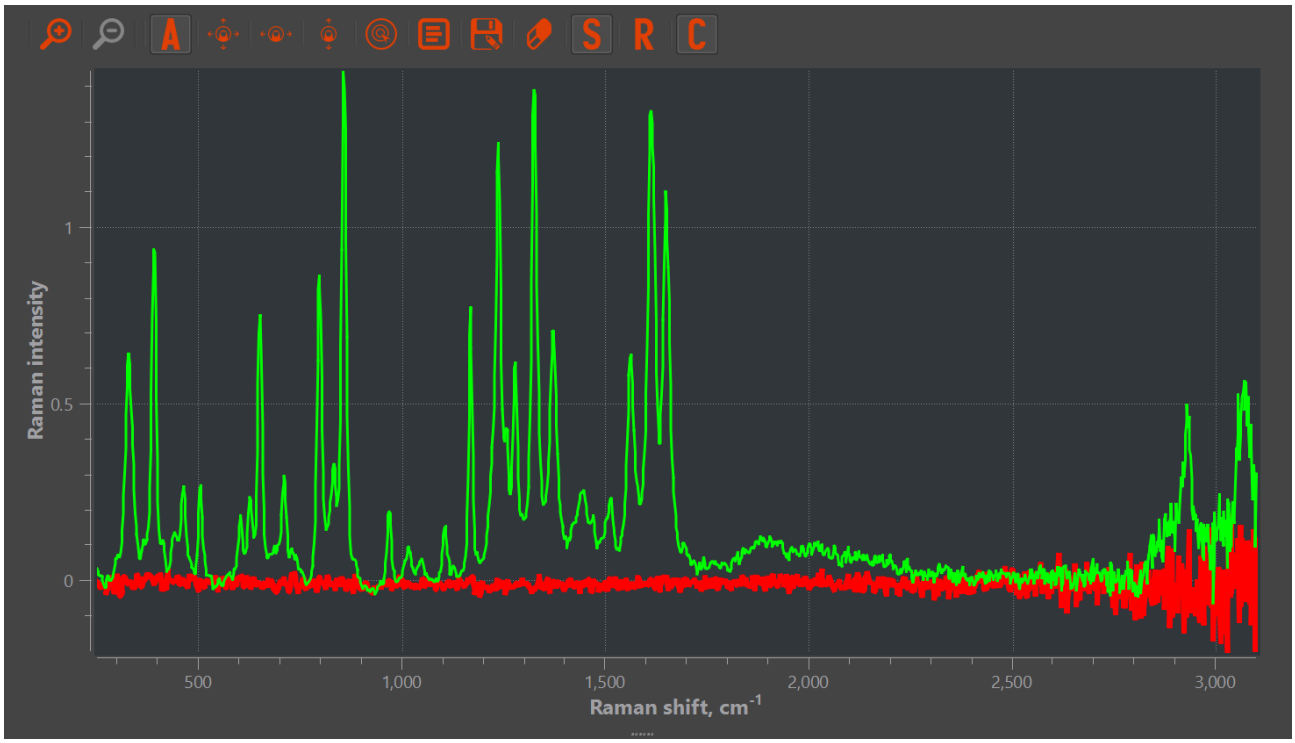


Figure 22. Captured paracetamol spectrum – green and live spectrum – red (sample removed).

Upon completion of acquisition, if the add to data analyzer option was enabled, there is a pop up window prompting to name the sample, there is also an option to save to selected folder, as well as to add tags. Enter the proper information and click OK.

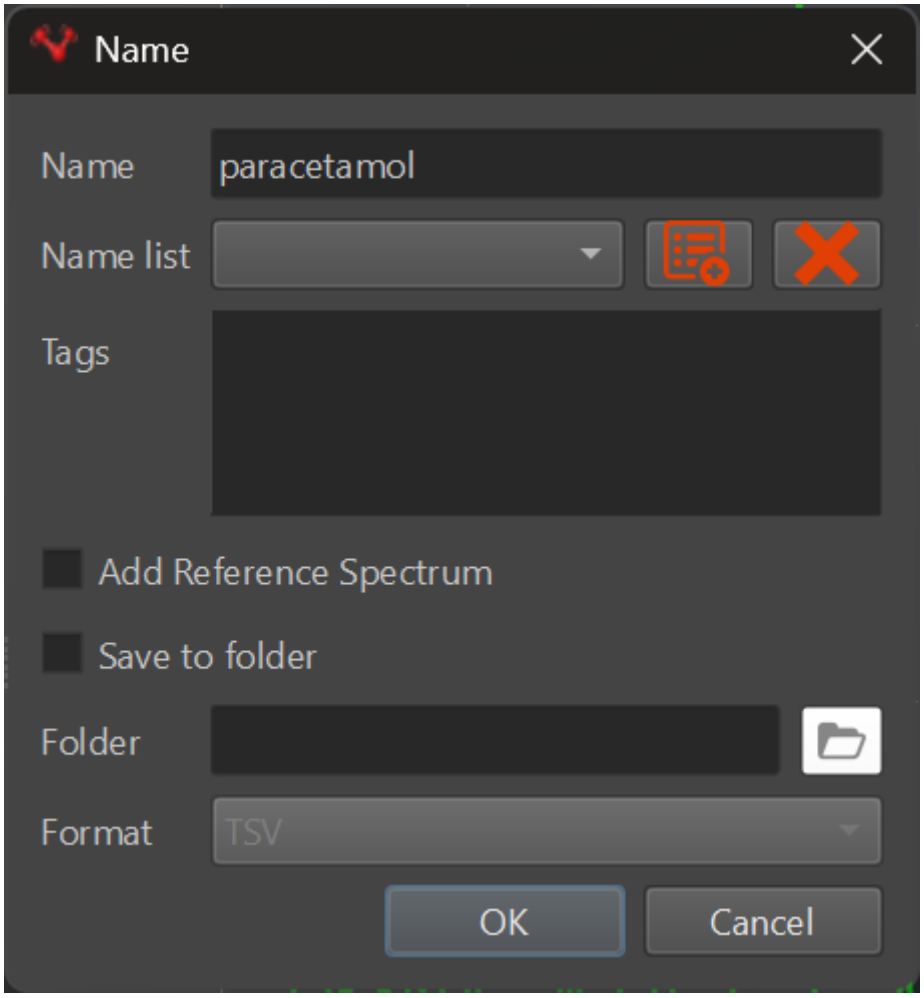


Figure 23. Name spectrum prompt window.

Additionally, there are the following tools in the spectral acquisition window:

Figure 24. Tools of data acquisition spectral window.

Zoom in, zoom out, automatic scaling, fit to window, fit horizontally, fit vertically, show tracer lines (to track X and Y coordinates), show legend, save figure as .png, erase the screen, show and hide spectra (s- signal, r- reference, c - captured)

5.5 Spectral analysis

You can go to data analyzer by clicking on the red button from the main menu showing the spectrum

Figure 25. Main menu with the data analyzer icon (showing spectra).

Data analyzer window looks as follows:

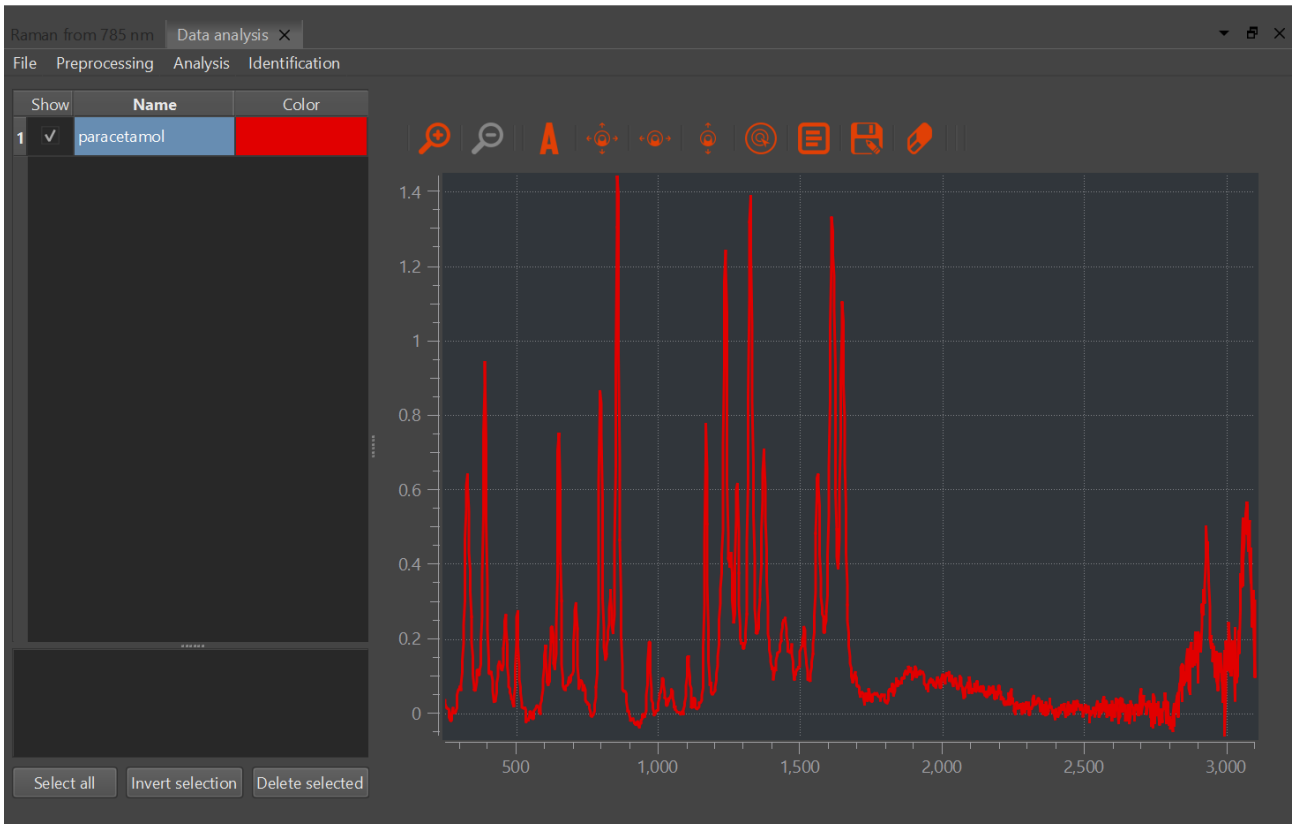


Figure 26. Data analyzer window.

There is a toolbar menu with the tools: Zoom in, zoom out, automatic scaling, fit to window, fit horizontally, fit vertically, show tracer lines (to track X and Y coordinates), show legend, save figure as .png, erase the screen. There is also a side panel where the spectral names are shown, the spectra can be hidden from the graph by unselecting them in the panel.

File menu of the data analyzer allows to save current spectrum, save selected spectra, as well as open spectral files:

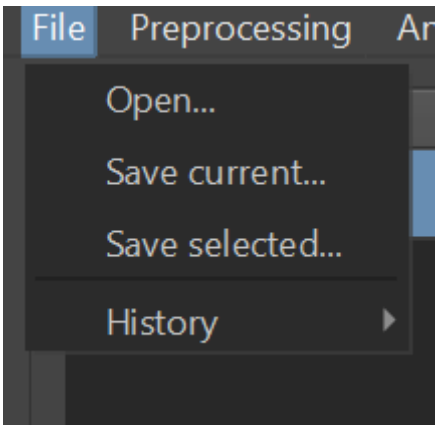


Figure 27. Data analyzer file menu.

In the data analyzer there are following options of data preprocessing in the preprocessing menu:

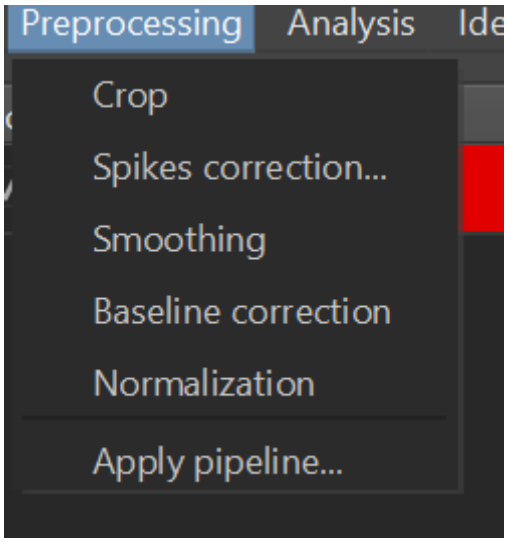


Figure 28. Data analysis preprocessing menu.

Crop spectral range, correct for spikes, perform smoothing, perform baseline correction, as well as perform normalization.

5.6 Exporting spectra

Miraspec allows users to export acquired spectra for documentation or further analysis in external software.

Spectra can be exported from the **Data Analyzer** window using the **File** menu.

The following export options are available:

- **Save current spectrum** – saves the currently displayed spectrum
- **Save selected spectra** – saves one or more selected spectra
- **Export figure** – saves the spectrum plot as an image

Supported export formats include:

- **TSV, TXT, JDX formats** for numerical spectral data
- **PNG format** for graphical spectrum images

CSV files can be imported into common data analysis software such as MATLAB, Python, Excel, or other spectroscopy analysis tools.

It is recommended to include relevant metadata such as sample name, acquisition parameters, and measurement conditions when saving spectral data.

6. Microscopy Mode

6.1 Overview

Microscopy Mode is used for Raman microscopy measurements and spatially resolved Raman mapping of samples. In this mode, the software integrates control of the spectrometer with the optical microscope and motorized stages.

The microscopy workflow typically includes the following steps:

1. Connect the microscope and spectrometer.
2. Focus on the sample using the visible microscopy view.
3. Select the region of interest on the sample.
4. Configure Raman acquisition parameters.
5. Perform Raman mapping of the selected area.
6. Analyze the resulting spectral maps.

The visible microscopy interface allows the user to navigate the sample surface, adjust focus, and select measurement areas. The motorized stage enables automated scanning of the sample to acquire spectra at multiple spatial locations.

The acquired spectral data can then be visualized as Raman intensity maps or processed using multivariate analysis methods such as PCA.

6.2 Connection of the device

Press green “Connect” button in the top menu of the software

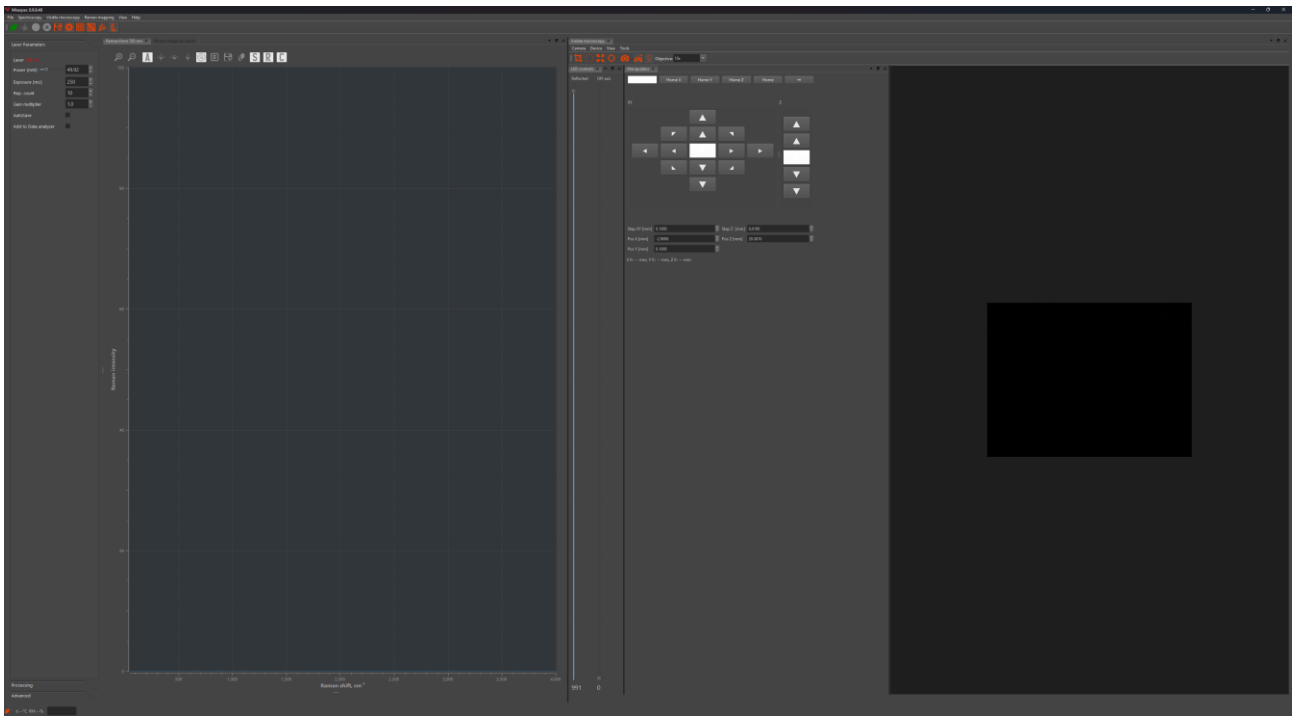


Figure 29. RG Raman microscope software interface; connection of accessories.

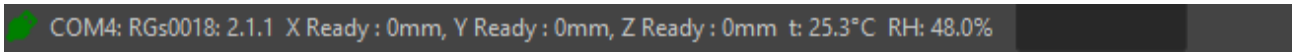
The status bar should be updated when the device is connected

It contains COM port number, serial number of the device, firmware version, the status of the stages and the temperature and humidity inside the device.

Calibration of the motorized stage

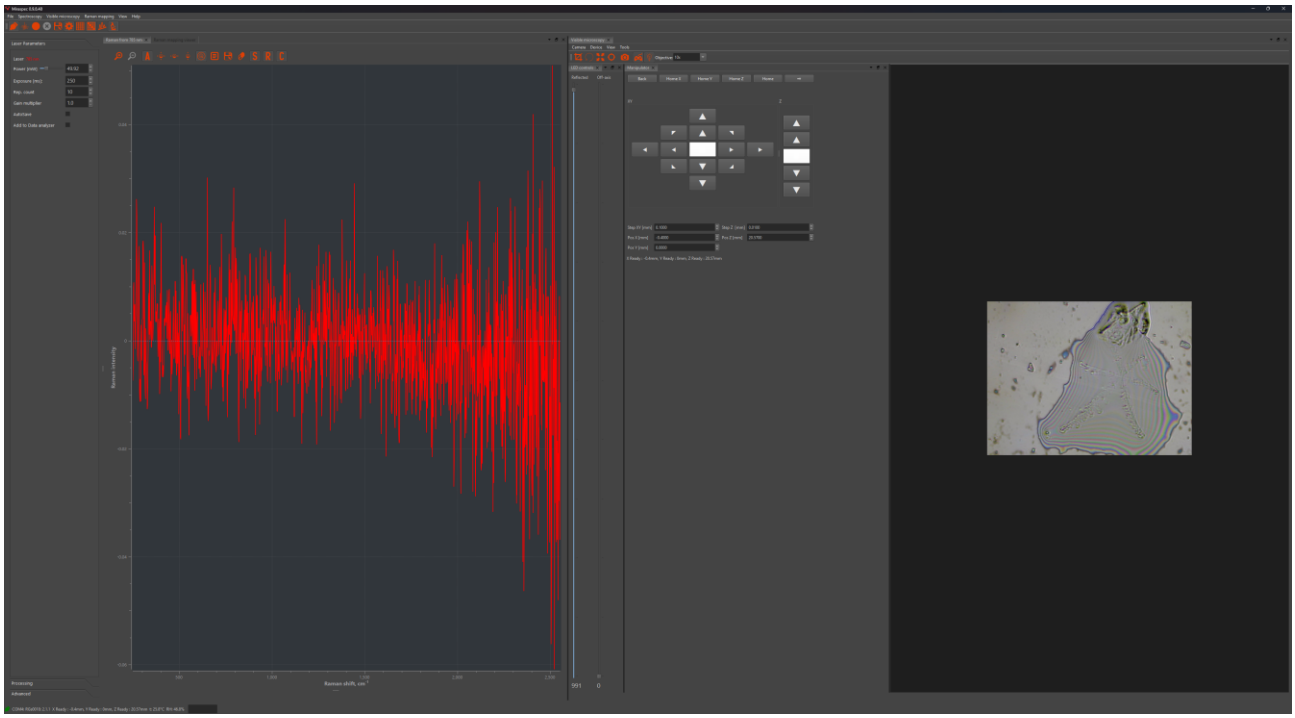
Press home button in the visible microscopy window. The stages should move to the limit switches position and then go to home position.

Upon homing if everything is done properly the status of the stages should not be highlighted in red anymore.



6.3 Imaging setup

1. Focusing on the sample.
2. Turn the Reflected LED ON till maximum intensity.
3. Go to visible microscopy sub window. Visible microscopy from main menu -> visible microscopy.
4. Place the sample under the microscope objective. Focus by setting proper steps in step Z and obtain the sharp image of the sample



Turn ON/OFF lasers

1. Press laser ON button in the top menu of the software.
2. Live spectrum should automatically be updated

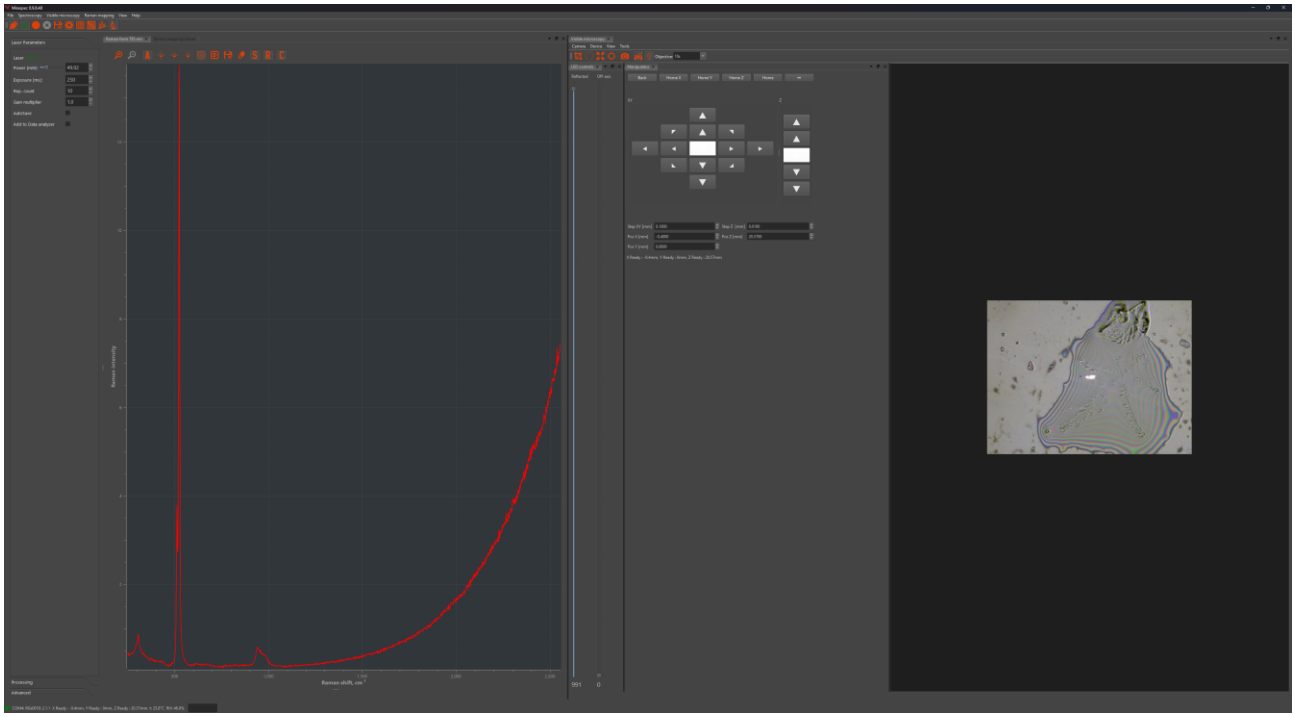
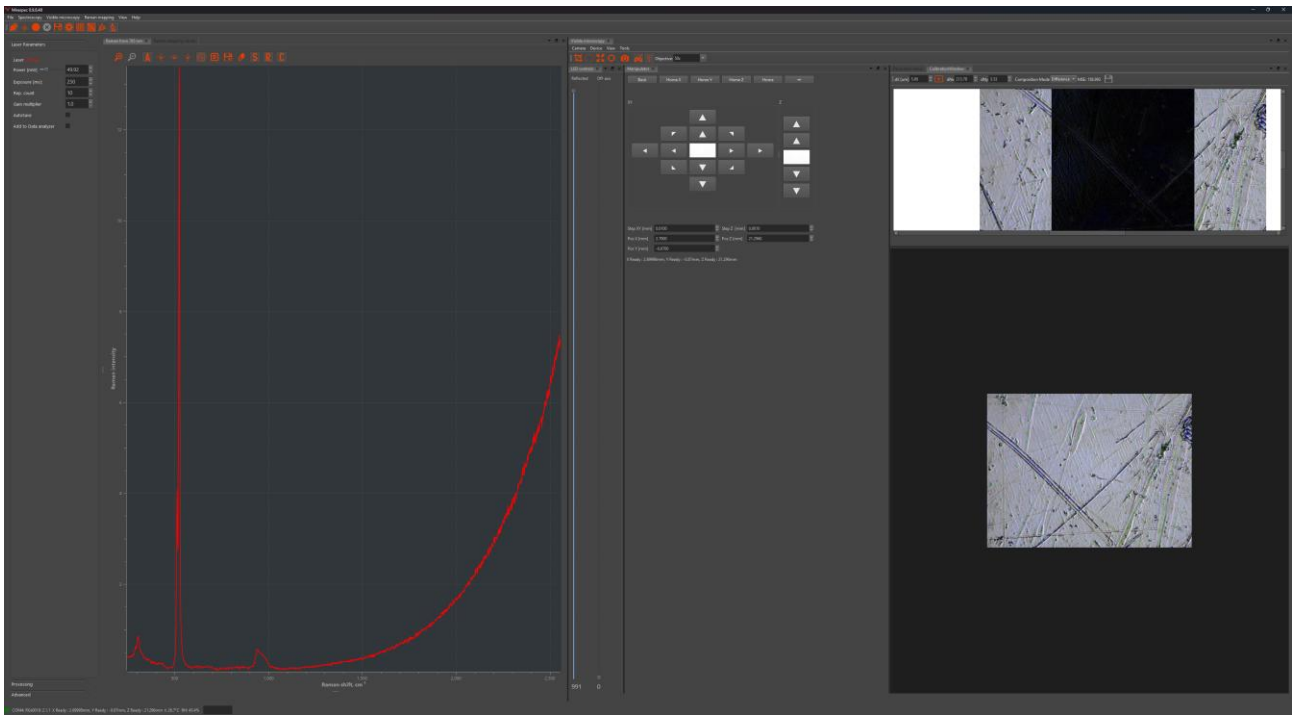


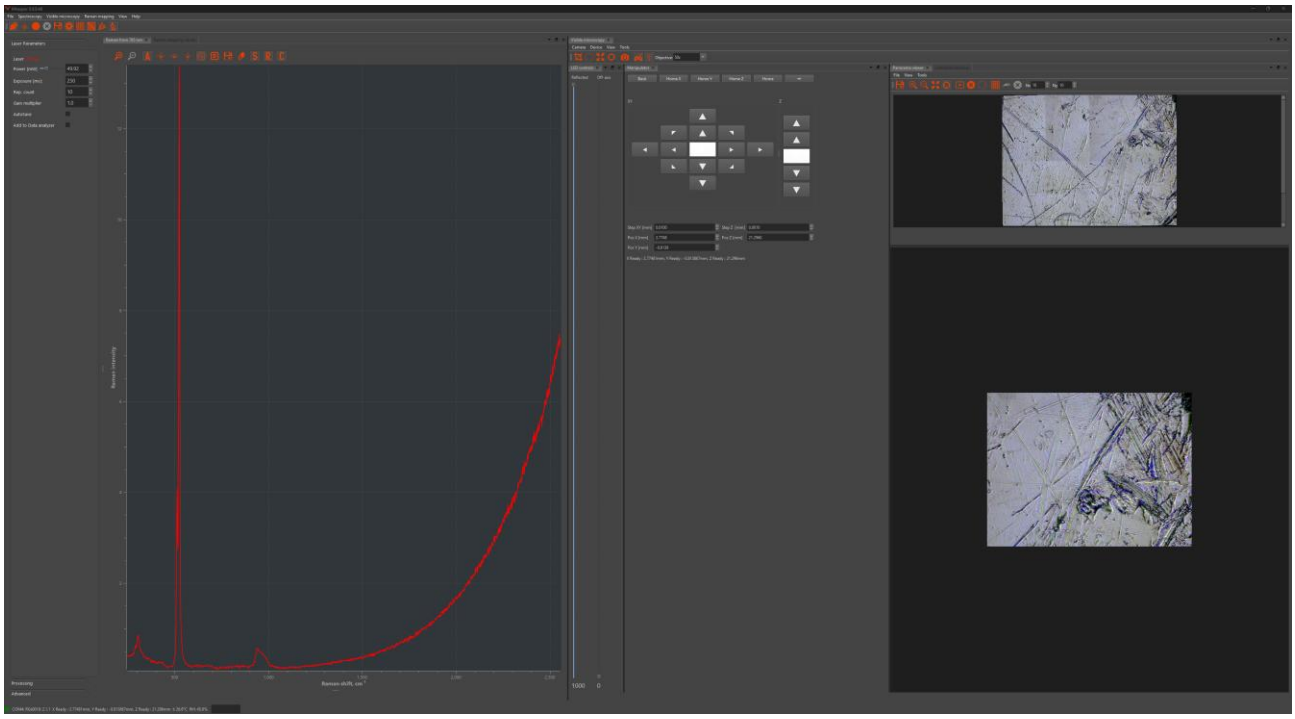
Figure 30. Switch on/off laser.

Panorama viewer calibration

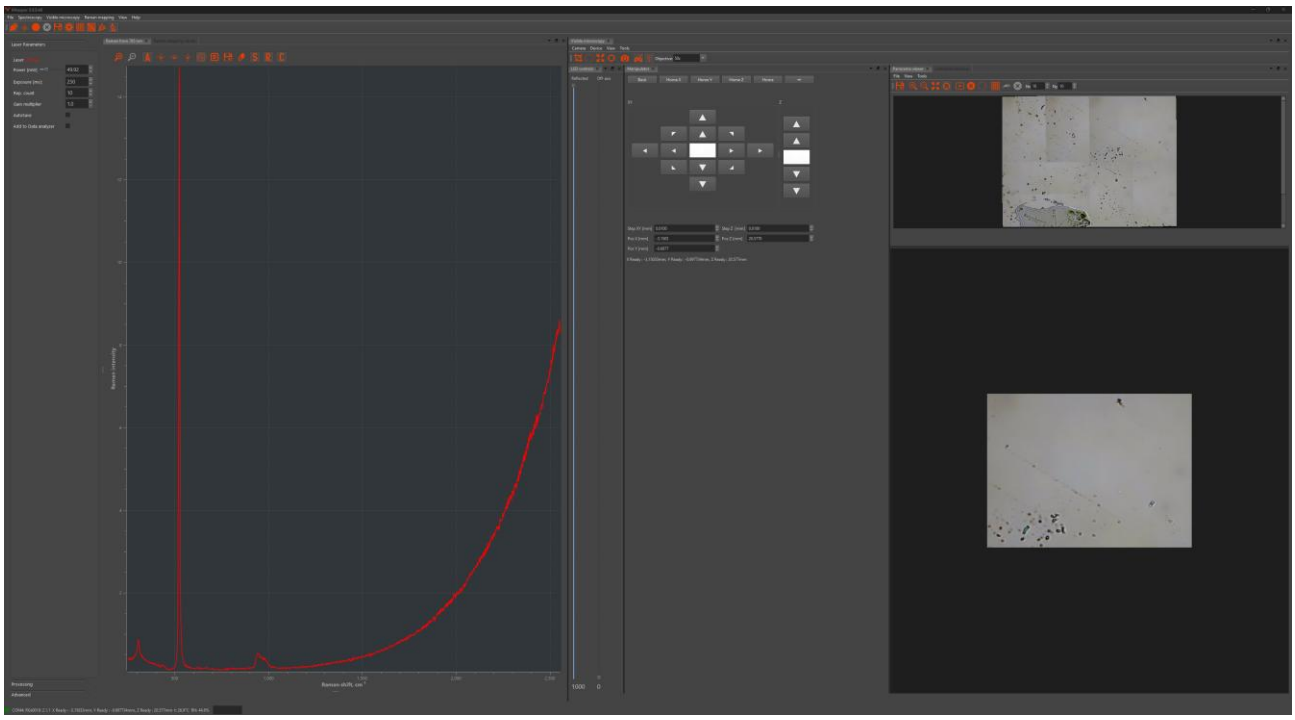
1. Switch off the laser. In the visible microscopy window enable view -> Panorama viewer and view-> calibration window.
2. Choose microscope objective preset. You can create new preset by typing the text directly.
3. Go to the edge of the sample or any region with sharp features. Adjust focusing.
4. Click on “Play” button in calibration window.



5. Move to panorama viewer. Click on play, now you will see the panorama view of the sample after the scan is completed.

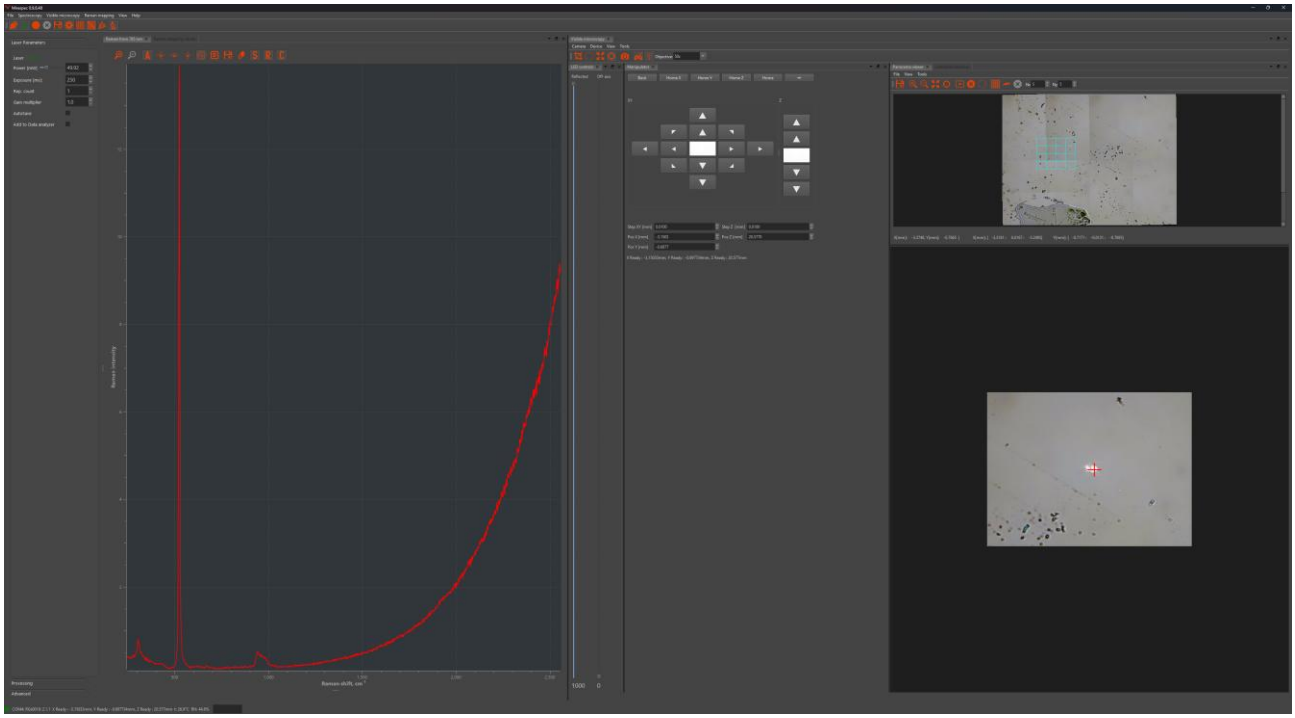


6. Move to the area of interest, perform panorama view to explore the sample

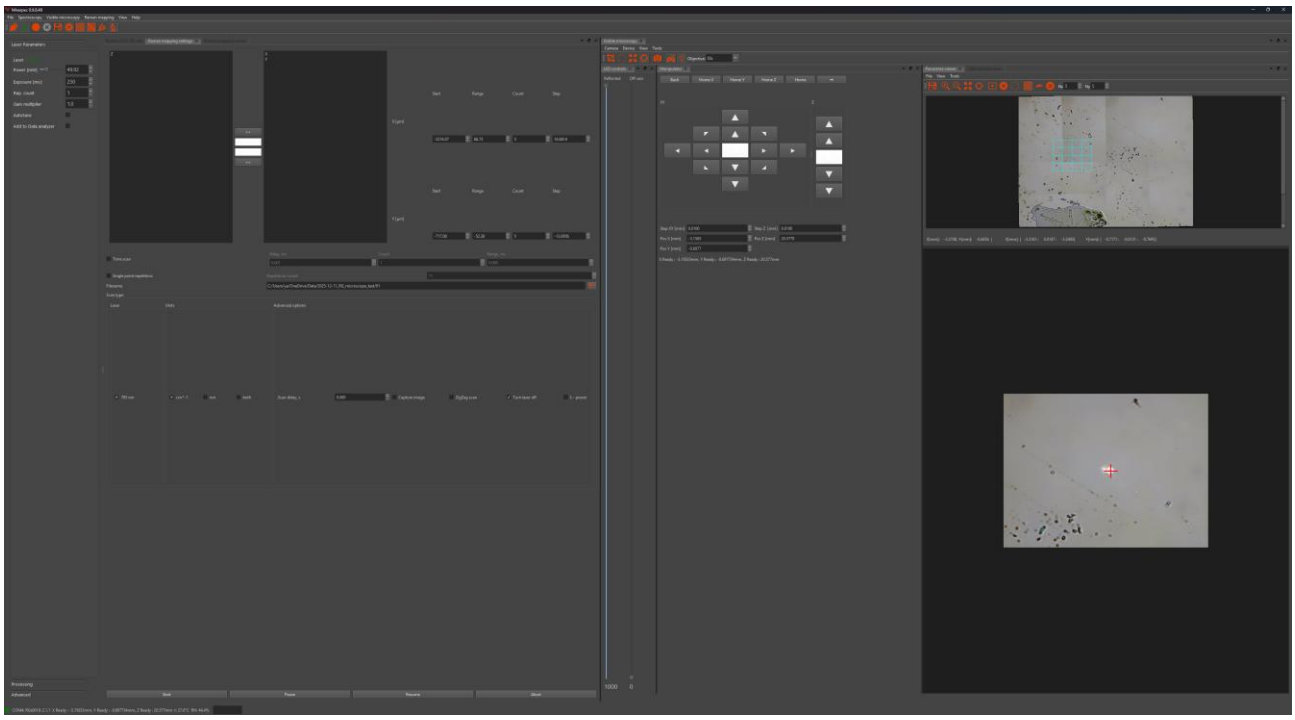


6.4 Raman mapping

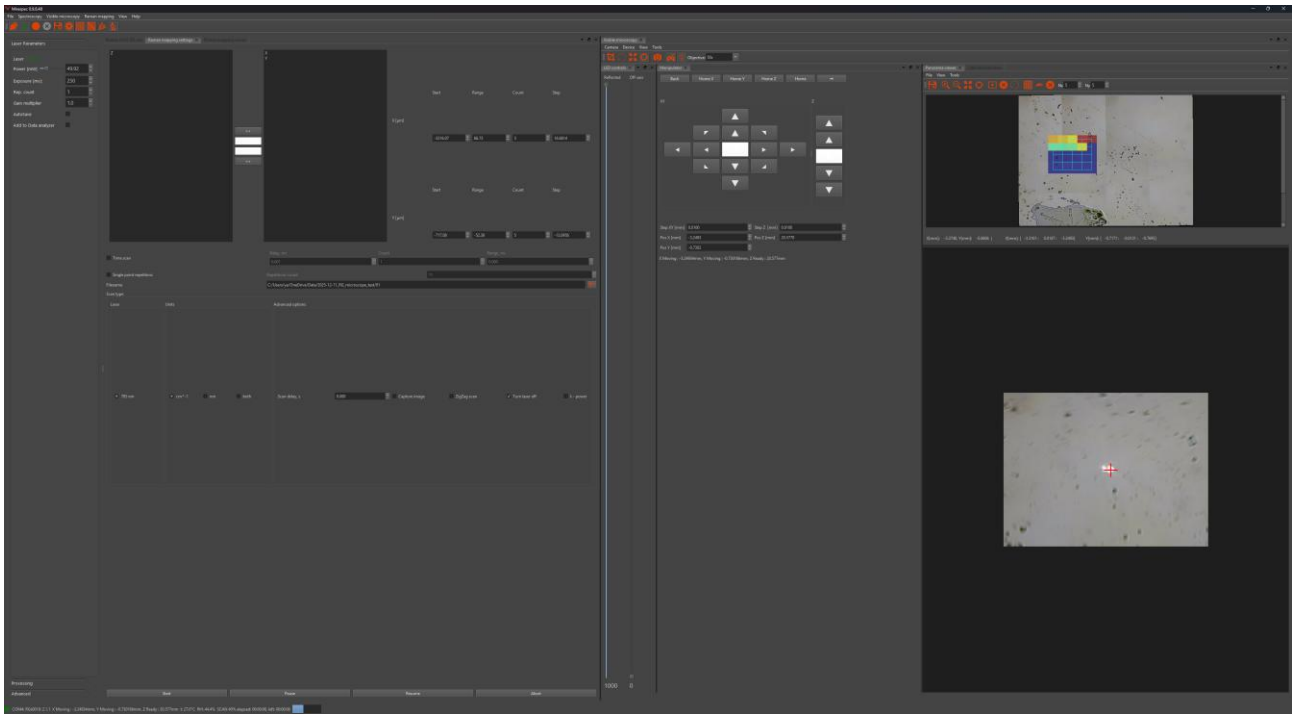
1. Select the grid tool and choose the area of scan.



2. Choose proper parameters such as laser power, exposure time, repetitions count, etc.
3. Input the file name under Raman mapping settings

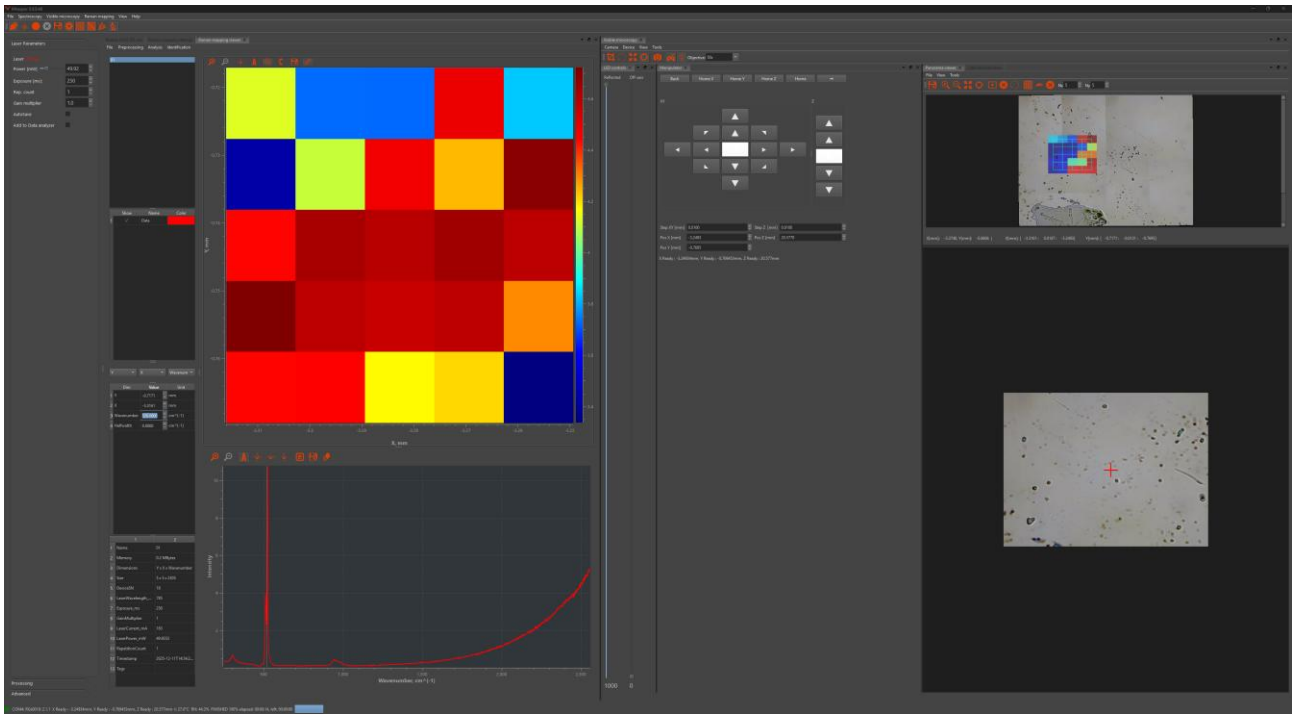


4. Click on double arrow to start the scan.
5. The scan will start.



6. Upon the scan as well as during the scan you can explore maps in the Raman mapping viewer for instance you can go to the wavenumber of interest.

6.5 Image analysis



After Raman mapping is completed, the acquired data can be analyzed in the **Raman Mapping Viewer**.

The viewer allows users to visualize spatial distributions of Raman signal intensity across the scanned sample area. The intensity can be displayed for a selected Raman shift or spectral region.

Users can interactively explore the dataset by selecting different Raman shifts and observing how the signal intensity varies across the sample.

6.6 Multivariate Analysis

Miraspec provides tools for multivariate analysis of Raman mapping data. One commonly used method is **Principal Component Analysis (PCA)**.

PCA helps identify patterns in complex spectral datasets and highlights spatial regions with similar spectral features.

To perform PCA analysis:

1. Open the **Analysis** menu in the Raman Mapping Viewer.
2. Select **PCA Analysis**.
3. Specify the number of principal components to compute.
4. Start the analysis.

After computation, PCA component maps will be displayed. These maps show the spatial distribution of each principal component across the scanned area.

To explore PCA results, ensure that the axes **X, Y, and Raman shift** are selected. This allows the user to visualize the contribution of each spectral component across the sample.

Such analysis is useful for identifying different materials, phases, or chemical compositions within the mapped area.

6.7 Microscopy data format

During Raman mapping experiments, the Miraspec software records spectral data together with the spatial coordinates of each measurement point. The collected data form a hyperspectral dataset in which every pixel of the scanned area contains a full Raman spectrum.

Microscopy datasets typically include the following information:

- Spatial coordinates of each measurement point (X, Y)
- Raman shift axis (wavenumber scale)
- Spectral intensity values for each measurement point
- Acquisition parameters such as laser power, exposure time, and number of repetitions
- Instrument metadata including device serial number and firmware version

Raman mapping data are stored using two complementary files:

- **.mrspectra file** – a binary file that contains the spectral intensity data for all measurement points in the Raman map
- **.json file** – a metadata file that contains information about the dataset, including spatial coordinates, spectral axis, acquisition parameters, and instrument configuration

The binary .mrspectra format allows efficient storage of large hyperspectral datasets generated during Raman mapping experiments, while the .json file provides a structured description of the dataset and measurement parameters.

During data analysis, the Miraspec software automatically reads both files to reconstruct the full Raman mapping dataset.

Raman mapping data can be saved and exported using the **Raman Mapping Viewer**. The exported files contain both spectral data and spatial information required for further analysis.

7. Troubleshooting

This section describes common issues that may occur during operation of the Miraspec software and provides possible causes and recommended solutions. If a problem persists after following these steps, contact technical support.

Table 1. Common Issues and Solutions.

Problem	Possible Cause	Suggested Solution
Instrument not detected by the software	Device not connected or powered on	Verify that the instrument is powered on and properly connected to the computer.
Instrument not detected	Driver not installed correctly	Reinstall the device drivers and restart the software.
Software cannot communicate with the device	USB or network connection issue	Check cables and reconnect the device. Restart the software if necessary.
No spectrum signal	Laser not enabled or shutter closed	Ensure that the laser is enabled and the optical path is properly configured.
Very weak or noisy spectrum	Integration time too short or poor sample alignment	Increase the integration time and verify that the sample is correctly positioned.
Spectrum appears saturated	Integration time too long or laser power too high	Reduce integration time or decrease laser power.
Raman map acquisition fails to start	Measurement parameters not configured	Verify mapping parameters and stage settings before starting the measurement.
Software becomes slow during large measurements	Large datasets or limited system memory	Close unnecessary applications and ensure sufficient system memory is available.

If the problem cannot be resolved using the information above, contact **Lightnovo technical support** and provide the following information:

- Miraspec software version
- Operating system version
- Instrument model and serial number
- Description of the issue
- Screenshots of error messages if available

Providing detailed information will help technical support diagnose and resolve the problem more efficiently.

8. Support and Service

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