miniRaman microscope

User Manual

v 20250127

Contents

Safety

General information

Read the following safety instructions carefully before operating miniRaman microscope and keep this manual for future reference available at any time. Always observe the instructions described in this manual to ensure user safety and to avoid property damage. Improper use or failure to follow these safety instructions can result in serious injuries and/or property damage. Any non-observance of the precautions will infringe the intended use (i.e. performing measurements by Raman spectroscopy) of miniRaman microscope. In this case Lightnovo ApS will not assume any liability. It is the operator's duty to plan and implement all necessary safety measures and to supervise their observance. Moreover, the operator must ensure that miniRaman microscope is in proper functioning condition. A safe and faultless operation can only be guaranteed if miniRaman microscope is transported, stored, installed, operated and maintained properly according to the procedures described in this manual. Never remove or deactivate any supporting safety systems during miniRaman microscope operation. Ensure that objects and/or material not required for the measurement is out of the instrument operating area.

Qualified Personnel
Primary installation and all maintenance and repair works not described in this manual should only be performed by Lightnovo service personnel. Only authorized operating personnel that have been briefed about the instrument operation and all relevant safety aspects should operate and maintain (i.e. only maintenance works that are described in this manual) the instrument. All repairs, adjustments and alignments on any miniRaman microscope component must be performed in accordance with the safety regulations and standards applied in the country in which the instrument is installed.

Correct Usage
miniRaman microscope and its components should only be used according to the instructions described in the manual or advised by a Lightnovo engineer. In case of accessories or components made by other manufacturers and used in connection with the microscope, Lightnovo does not assume any liability for safe operation and proper functioning.

Warning labels

This warning symbol indicates the existence of laser radiation.
Class 3B lasers **are hazardous for eye exposure**. They can heat skin and materials but are not considered a burn hazard. For visible-light lasers, Class 3B lasers' output power is between 5 and 499 milliwatts. Class 3B lasers are **normally hazardous under direct beam viewing conditions**, but are normally safe when viewing diffuse reflections.

Safety instructions

The following chapters describe all relevant safety aspects of the instrument operation. Depending on the degree of hazard the safety instructions are classified as follows:

Danger
indicates that death, severe personal injury or substantial property damage WILL result if proper precautions are not taken.

Warning
indicates that death, severe personal injury or substantial property damage CAN result if proper precautions are not taken.

Caution
indicates that minor personal injury or property damage CAN result if proper precautions are not taken. Important draws your attention to a particularly important information.

Note
draws your attention to an useful information on the product, e.g. product operation or to a special part of the manual.

The safety instructions Danger, Warning and Caution are marked by the corresponding warning labels.

Laser safety

General Information
The analysis system miniRaman microscope uses the light of lasers (660 and 785nm) that are installed in miniRaman spectrometer. The used laser diodes emit visible and partially visible laser radiation in the near infrared region.
According to the standard EN 60825-1/10.2003, miniRaman microscope is Class 3B laser product. Therefore, it is **normally hazardous under direct beam viewing conditions**, but are normally safe when viewing diffuse reflections.

Safety Features
The laser protective enclosure shields the area around the sample stage. The enclosure is opened and closed manually. For safety reasons, the operator must close the laser protective enclosure before starting measurement. This safety precaution protects the operator against accidental exposure to hazardous laser radiation exiting the objective.

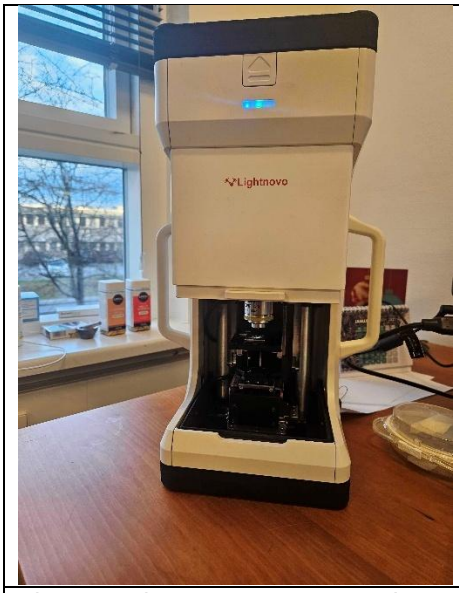

Figure 1: a) Open Laser Protective Enclosure

b) Closed Laser Protective Enclosure

Safety Instructions

In addition to the safety instructions given below, also comply with all local regulations concerning laser safety.

The analysis system is specified as a laser class 3B product), i.e. it considered safe if handled carefully, with restricted beam viewing. Nonetheless, observe the following safety instructions:

Warning:

Avoid eye and skin exposure to direct or scattered laser radiation under all circumstances! Failure to do so can cause permanent and irreversible eye damage and/or serious skin injuries!

Do NOT remove the laser protective enclosure!

Installation

General Information

Unpacking and initial installation including hardware setup and cable connection is done by qualified Lightnovo service personnel. The operating company must provide the required utilities and an installation site that meets the site requirements described in this chapter.

Delivery Scope

Standard Components
miniRaman microscope (including user manual and quality test report)
Several cables: power cord, USB cable. (See section Cable Connections below in this chapter.)
Accessories (includes spares, adaptors, objective lenses, sample preparation tools etc.)

Inspecting the Packaging
After having received miniRaman microscope, inspect the packaging for damages. If there are any signs of damage, contact your local shipping representative before opening the shipping box.

Warning:
Do not put miniRaman microscope into operation if there are signs of damage. Failure to do so may result in severe personal injuries and/or property damage.

Transportation
When transporting the microscope, use the original case to avoid damages.

Figure 2.Transportation case for miniRaman microscope

Site requirements

Space Requirements
miniRaman microscope requires a space of 20cm in diameter and 40cm in height. (For the exact instrument dimensions refer to Specifications.) At the rear instrument side, take a clearance of at least 5cm into account.

When defining the installation site, take into consideration that the power supply connections are easily accessible at any time.

Note:
A power outlet box to which miniRaman microscope connected provides a suitable solution.

miniRaman microscope requires a stable and horizontal base which can carry the instrument (ca. 12 kg) and possible accessories. This is critical for applications that require high spatial resolution.

Environmental Requirements
To ensure optimum instrument performance and long-term reliability the following environmental conditions are essential:
- Ambient temperature range:18 - 35°C (64 - 95°F)
- Humidity (non-condensing): ≤ 70% (relative humidity)

Temperature variations can impair the results of long-term measurements. Therefore, the temperature variations should be less than 1°C an hour and not more than 2°C per day for high spatial resolution type of measurements.

Note:
For some kinds of application, the opportunity to black out the room is advantageous.

Vibration
Ideally, the instrument is not installed near vibration sources (e.g. ventilation hoods, air conditioners, motors, elevator).

Power Supply
The instrument power supply unit automatically adapts to the most common power sources.
Valid voltage range:
- 100V microscope system: 100V to 120V AC 10%
- 200V microscope system: 220V to 240V AC 10%
- Valid frequency range: 50/60Hz

MiniRaman microscope is an instrument of protection class I (electric safety).

Caution:
To avoid personal injury and spectrometer damage, connect miniRaman microscope only to a socket outlet with earthing contact.

To provide good data quality and a long miniRaman microscope service life, ensure that the following site requirements are met:
- Do not install miniRaman microscope near sources of potential inductive electrical interference (e.g. pumps, switching motors, microwave ovens etc.), sources of high energy pulses, and sources that might cause magnetic or radio frequency interference.
- Do not place devices such as large electric motors, heaters, welding equipment, radio transmitting equipment, units emitting pulsed electromagnetic radiation (e.g. NMR systems), or high powered lasers in close vicinity to miniRaman microscope. These devices can interfere with the instrument and cause instrument malfunction. Ensure that these types of devices are not connected to the same electrical circuit as miniRaman microscope.
- If there are any problems concerning main power supply (e.g. brownouts, power surges, frequent thunderstorms), take precautions to ensure an uninterruptible power supply.

Cable Connections

Please unpack miniRamaman microscope and remove it from the transportation case.

Please remove power adaptor and connect it to the left connector (POWER) on the rear panel of the miniRaman microscope (Figure 5). Then connect USB C cable to the right connector (DATA) on the rear panel and connect it to PC from the other side.

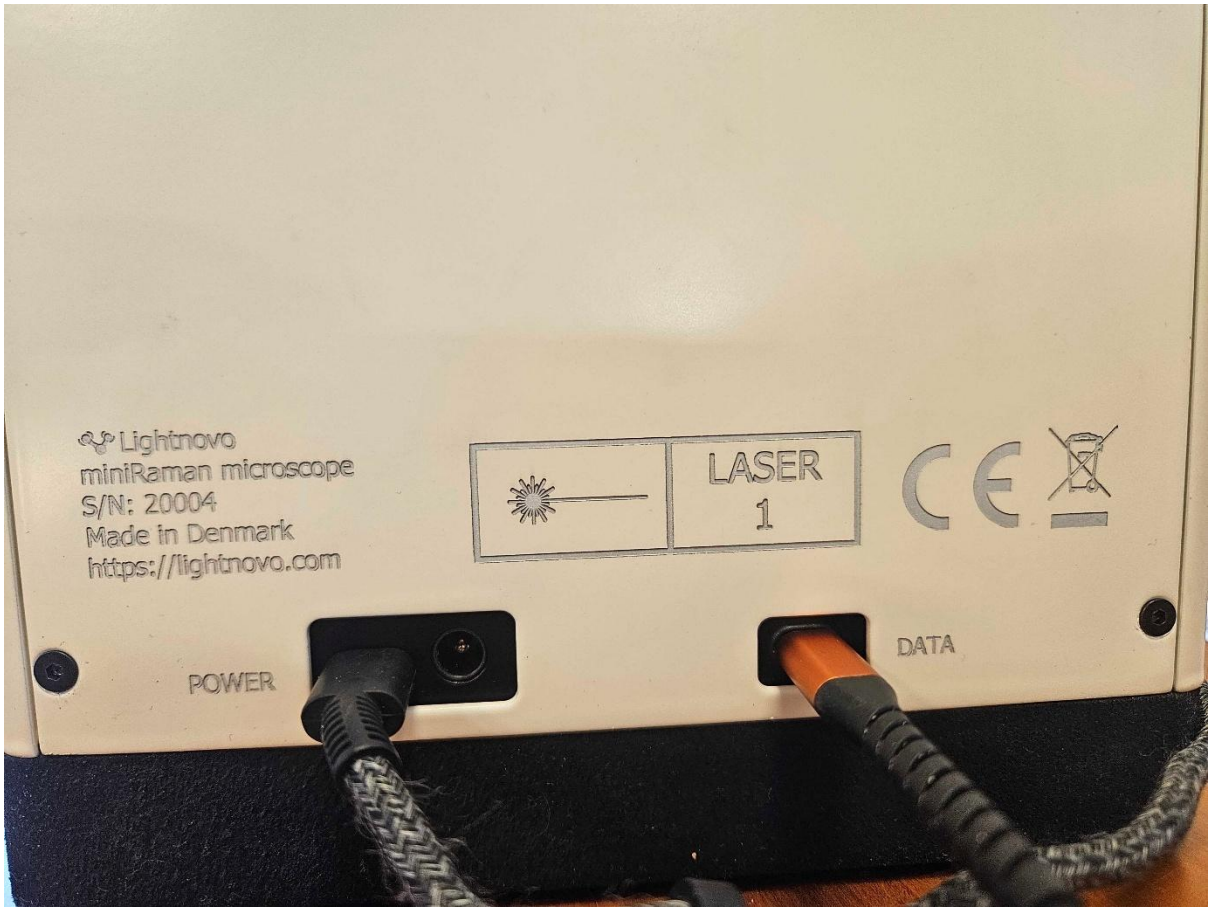

Figure 3. Rear side – overview of the connector sockets

Software Installation

1. Download miniRaman microscope software package from Lightnovo website: https://lightnovo.com/lightnovo-software/
2. Install all drivers from the corresponding software folder.
3. Run miraspec.exe file to start the data acquisition software.
4. Software is ready for operation.

Removal and installation of miniRaman spectrometer

MiniRaman microscope has an in-build product inside which is miniRaman spectrometer. It can be inserted and removed by the user without the need of realignment. Removal steps are shown below in Figure 4.


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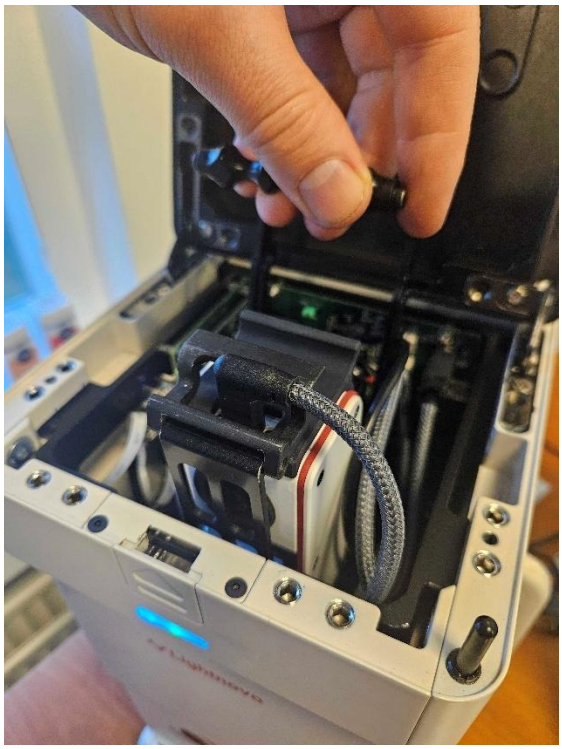

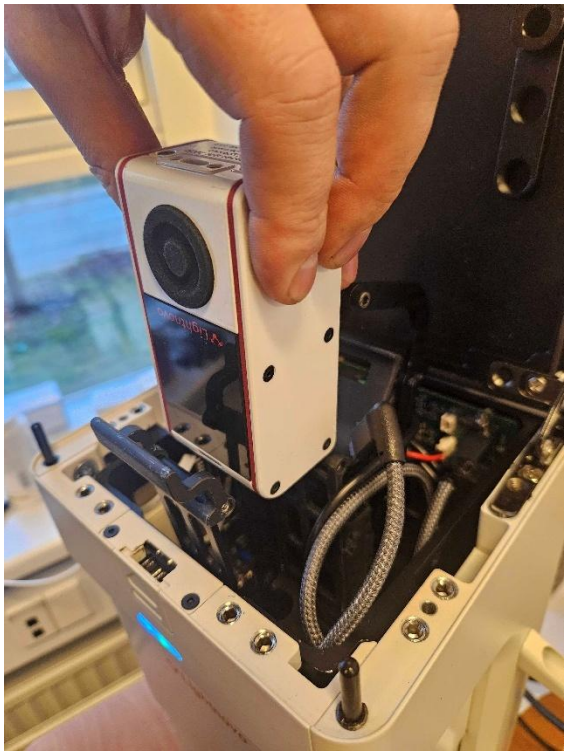

Figure 4. Removal of miniRaman spectrometer from the microscope.

Overview

General information

miniRaman microscope has a modular design with reflection and off-axis white light illumination microscopy unit combined with motorized 3D stage and miniRaman spectrometer.
This instrumental setup allows for both sample viewing using the optical microscopy capabilities and performing measurements by Raman spectroscopy simultaneously. The visual observation reveals morphological details of a sample (e.g. color, size, shape), whereas the spectroscopic measurement reveals information about the molecular structure and chemical composition of a sample.

This instrumental setup is designed for demanding R&D application in materials science, pharmacy, life science or forensics, for example. Possible fields of application are analyses of SERS signals on plasmonic substrates, thin sample films, nano particles and surfaces.
miniRaman microscope is also suitable for samples that tend to fluoresce when exposed to laser radiation. Due to the usage of a 785nm laser, the excitation energy is low enough for these samples not to fluoresce or only to a minor degree.

Note:
In Raman spectroscopy, sample fluorescence can yield a much more intense signal than the Raman scatter of the sample, masking any Raman bands in the spectrum. Therefore, Raman spectroscopy is normally not a suitable analysis technique for fluorescent samples.

Operation

Hardware connection

MiniRaman microscope has two wire connections:

1. USB C cable for system control and data transfer
2. Power cable

Both cables could be connected (order does not matter). User should wait for LED 1 shining “Blue” Then software is ready for connection (“Connect” button in Miraspec). After connection LED 2 should be “Green”. It means that device is properly connected. If LED 2 is “Red” – device has connection problems. Please try to reconnect USB cable and power cable. If it does not help – contact service.
If connection with PC is lost LEDs 2 and 3 will not shine. During Raman mapping LED 3 will be blinking “Yellow”.

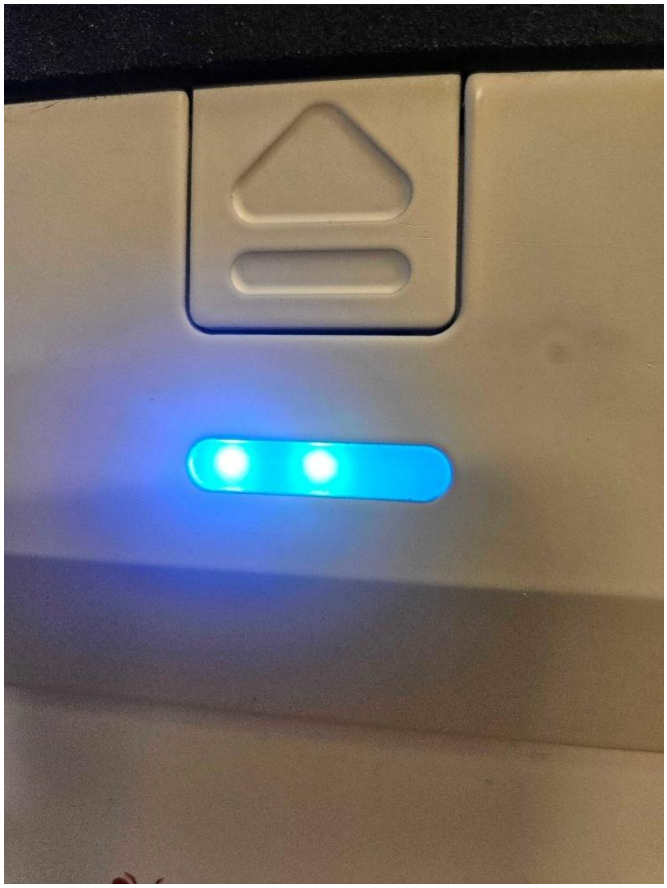

Figure 5. Front panel LEDs

Operation procedure

Starting Miraspec software

1. Connection

Press “green connection button in the upper menu of Miraspec software window (Figure 5). The button should turn red when the device is connected (Figure 6). 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 7.

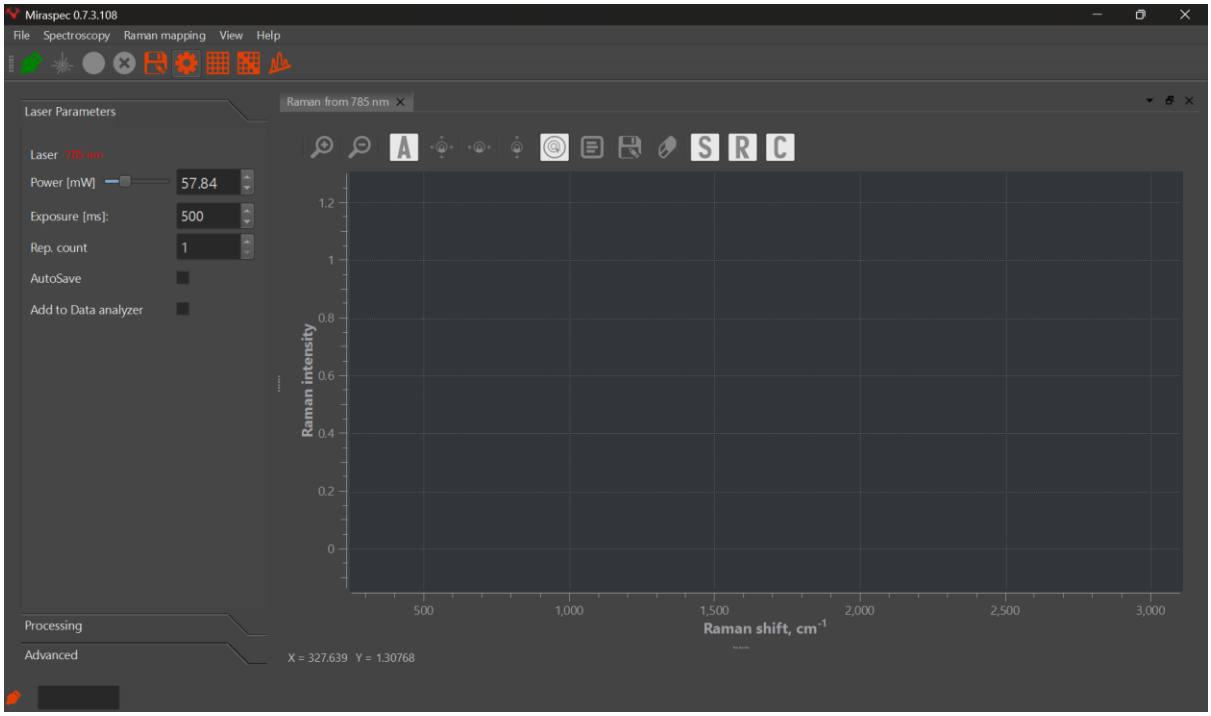

Figure 6. miniRaman microscope software interface; connection of devices.

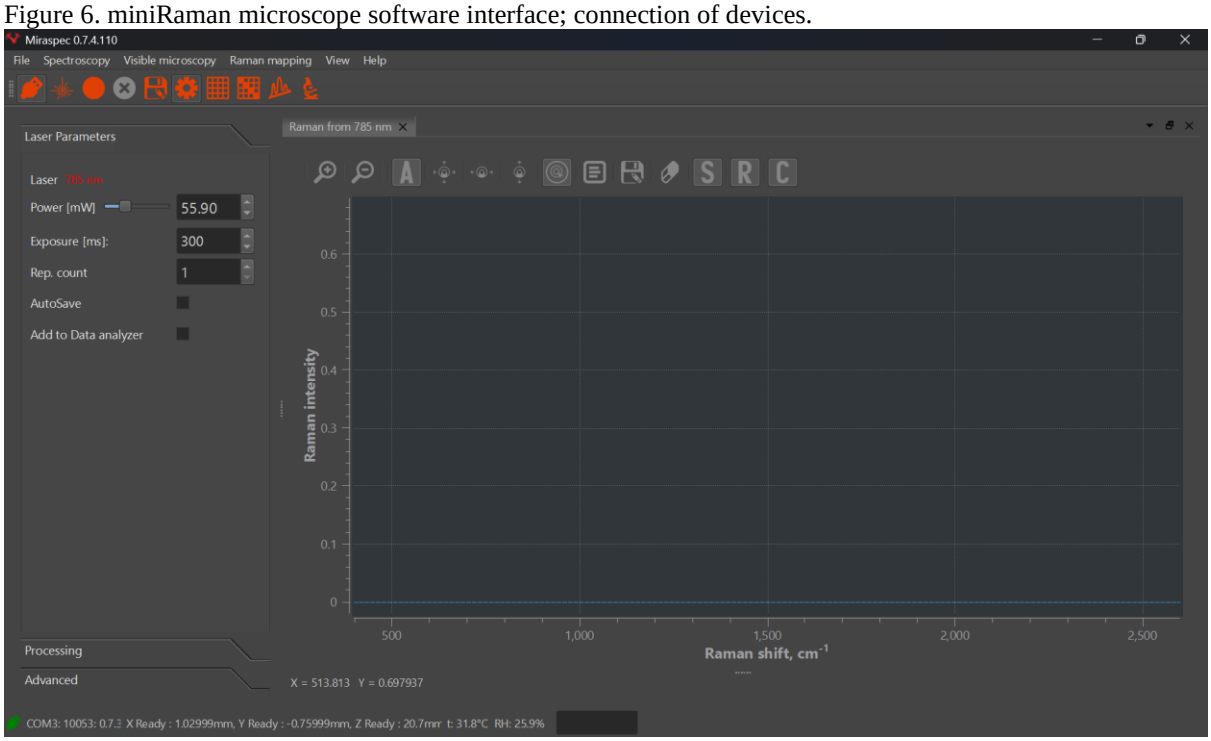

Figure 7. miniRaman microscope software interface, the device is connected.

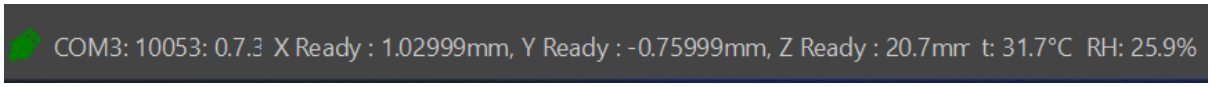

Figure 8. Status bar in Miraspec software showing the status of connected device: port, serial number of device, firmware version, status of XYZ stage, temperature and humidity.

Go to visible microscopy tab (Visible microscopy-> Visible microscopy from the main menu) and focus on the sample using Z motion control.

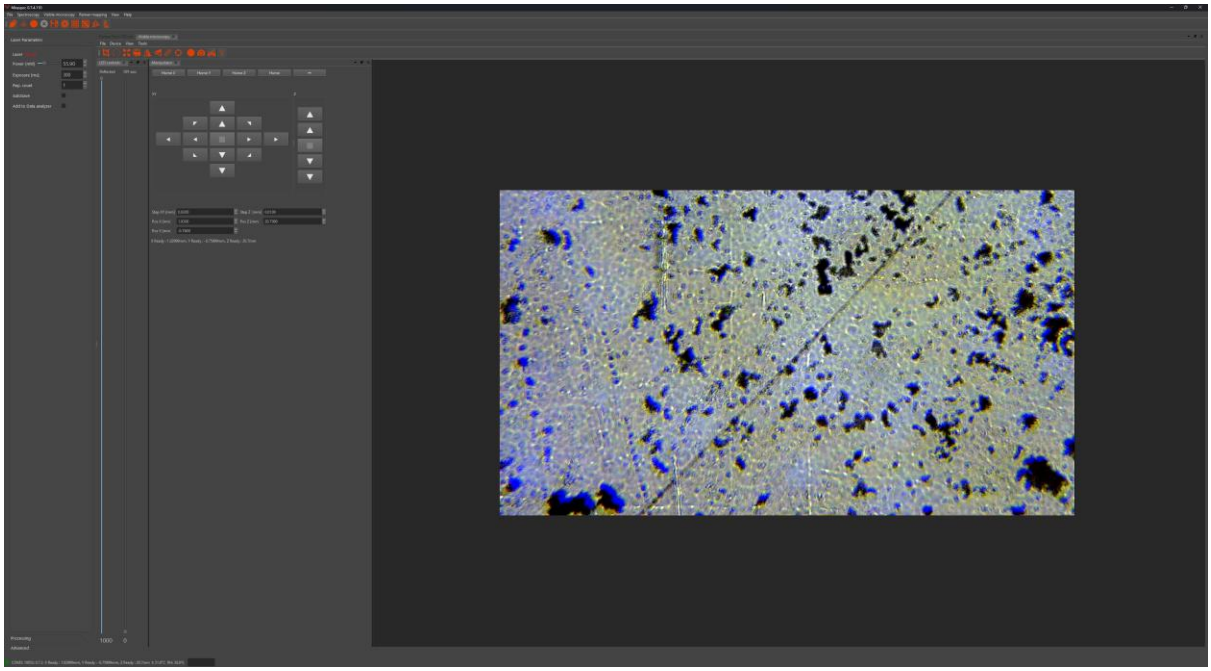

Figure 9 Visible microscopy tab showing the XYZ manipulator and sample image

To switch the laser on click on the laser control button from the main menu of the software, when laser is on the button turns green. The laser spot can be seen on microscopy image when the sample is in focus as shown in Figure 10.

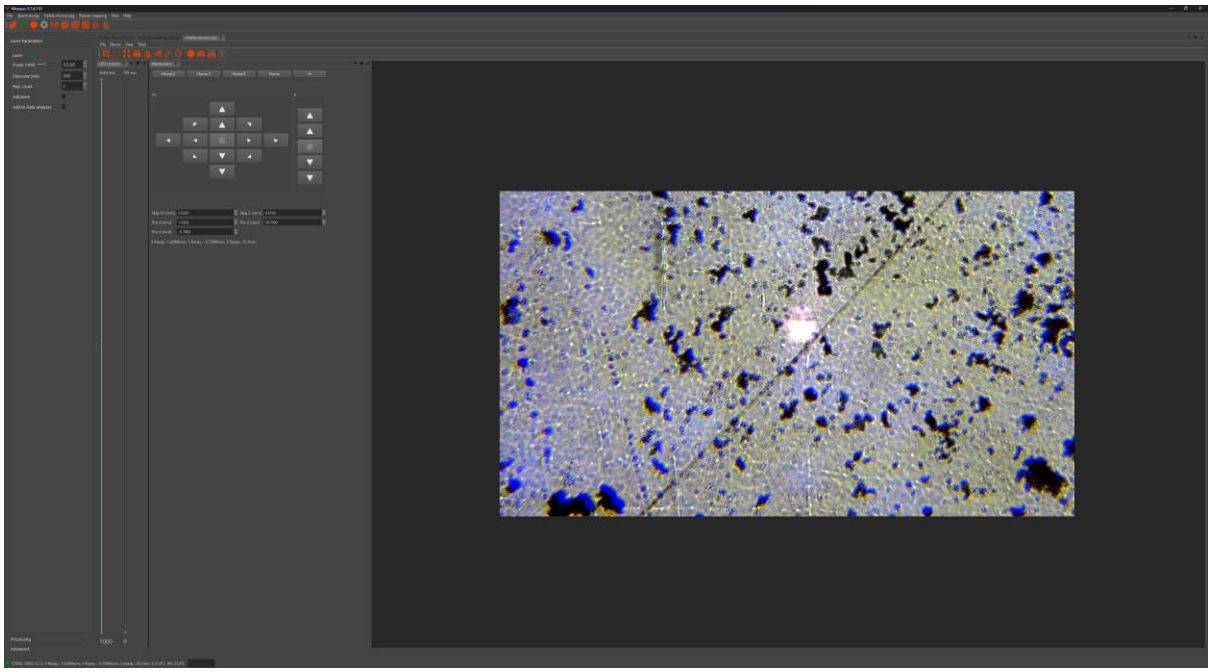

Figure 10 Visible microscopy image showing the laser spot on the sample.

In order to start the scan go to Raman mapping settings tab (Raman mapping -> Raman mapping settings), choose X and Y coordinates, as well as choose the laser. Set the range and the number of steps. The step size will be calculated automatically and displayed in the software.

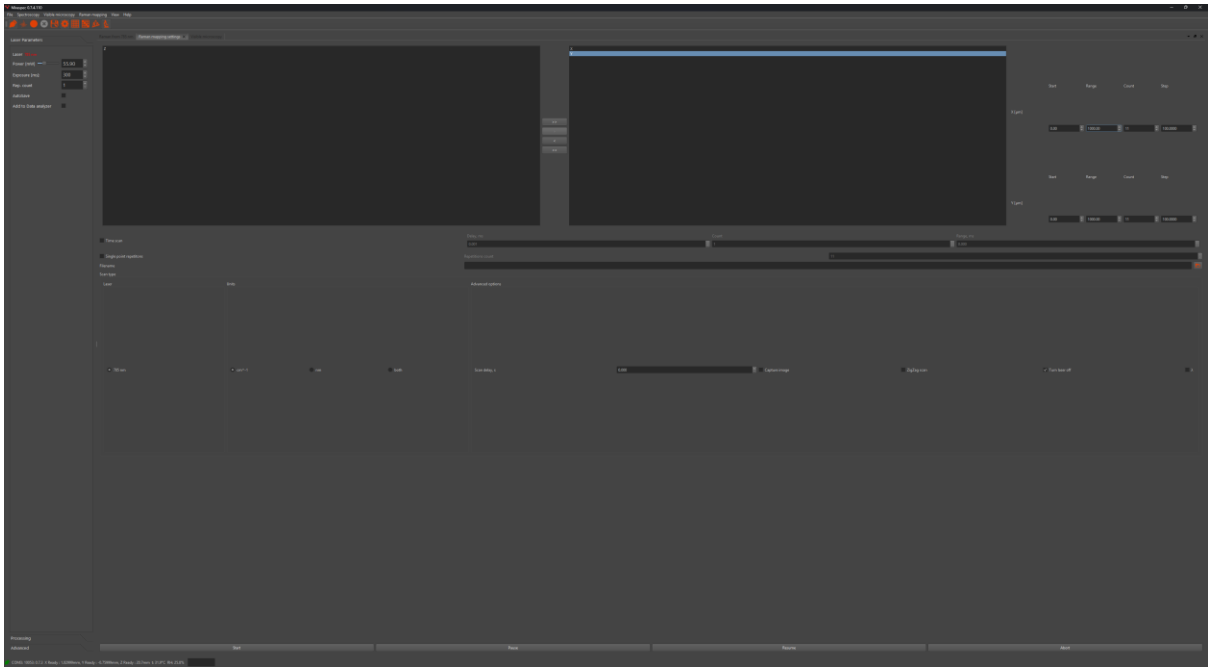

Figure 11. Raman mapping settings tab.

In order to start the scan from the current position go back to the visible microscopy tab, and click on the button with the arrow as shown in Figure 12 to transfer current coordinates as the initial coordinates of the scanning map.

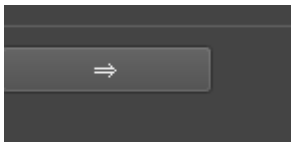

Figure 12. Transfer current position as the origin of the scan

In order to choose the origin of the scan and the scan area it is sometimes convenient to position the live spectrum tab and the visible microscopy tab next to each other such as shown in Figure 13

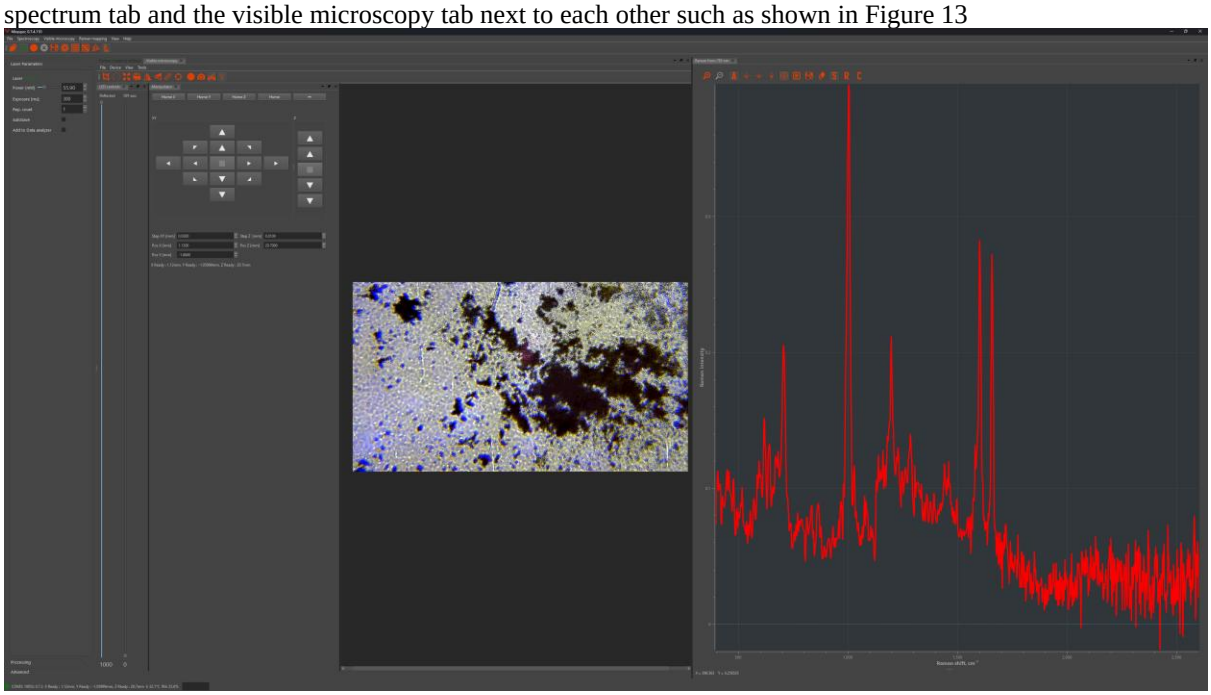

Figure 13. Simultaneous monitoring of live Raman spectrum and visible image of the sample

To start the scan enter the file name and click on start button in the Raman mapping settings tab.

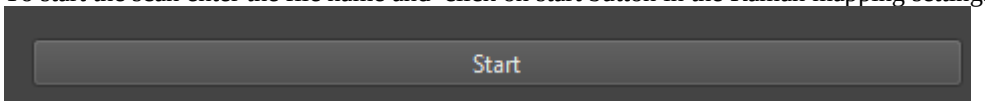

Figure 14. Start button of the Raman mapping settings tab.

Go to Raman mapping viewer to monitor the progress of scan

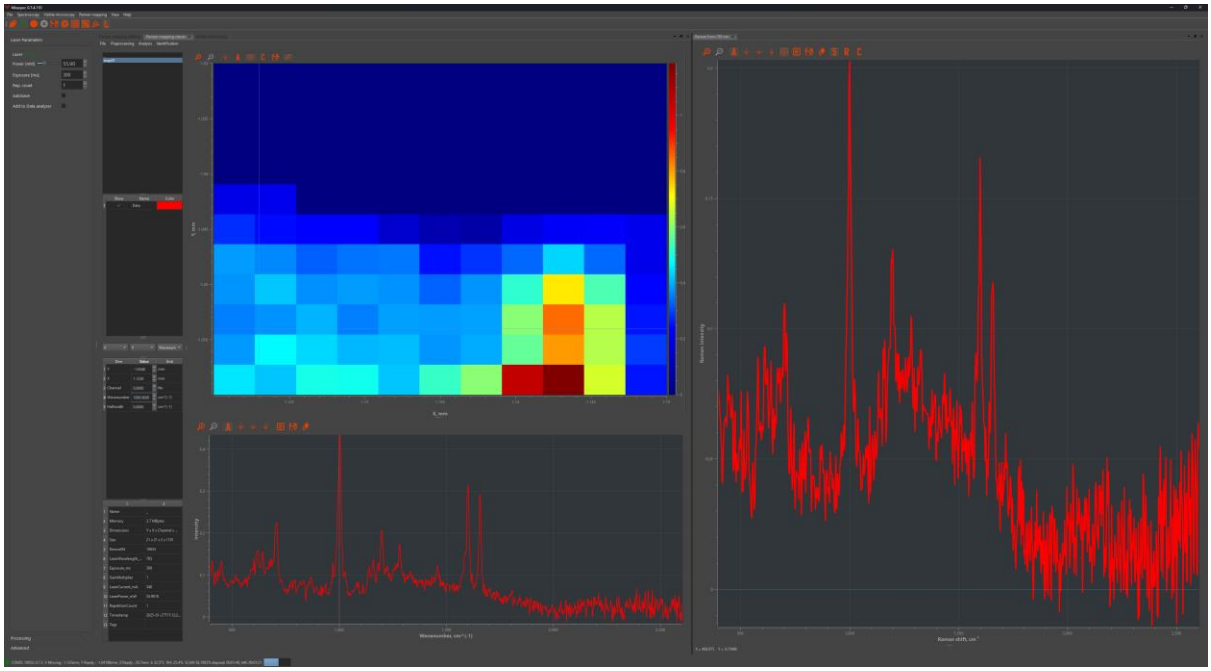

Figure 15 Live scan in Raman mapping viewer

When the scan is completed, data analysis of the maps can be performed in the Raman mapping viewer

For example: preprocessing -> baseline correction to remove fluorescence baseline:

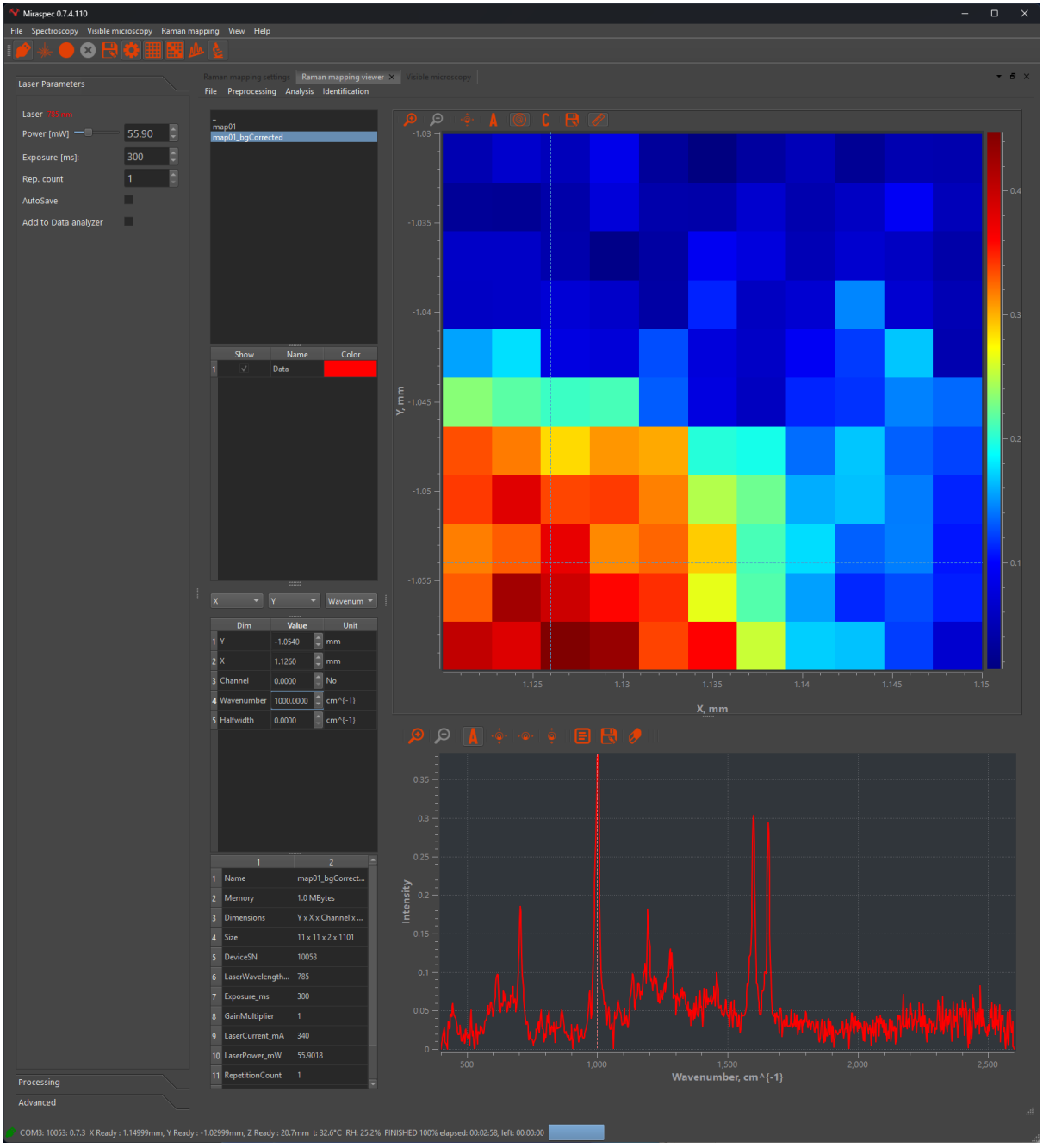

Figure 16 Data postprocessing in Raman mapping viewer: baseline correction

And Analysis -> PCA to perform principal component analysis

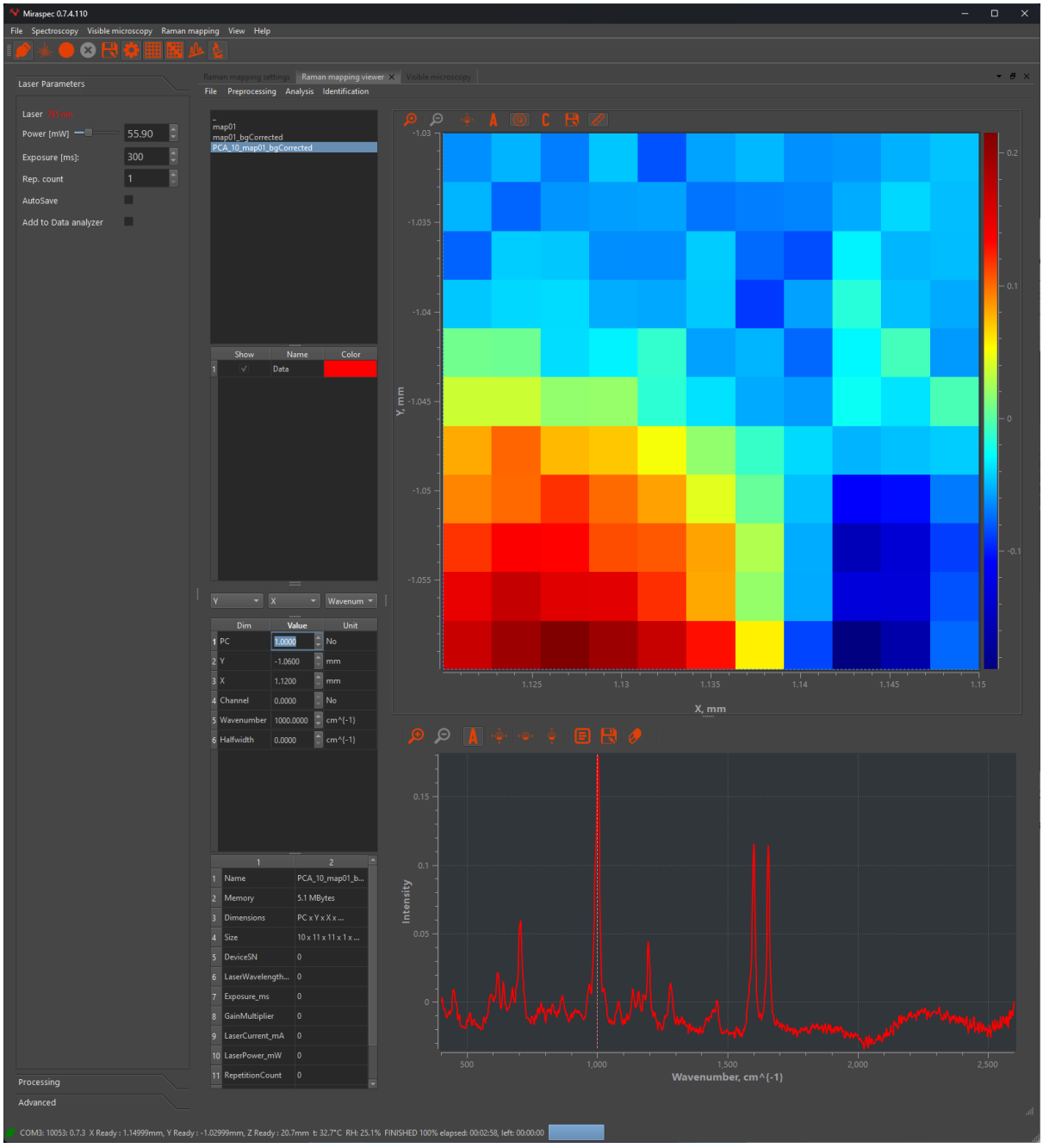

Figure 17 Data analysis in Raman mapping viewer: PCA

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