

miniRaman spectrometer

User Manual

English

version 202202



Table of Contents

Safety	4
General Information	4
Warning labels.	5
Safety instructions	5
Laser Safety.	6
Installation	7
Overview	10
General information.	10
Instrument design	12
Operation.	14
Hardware connection	14
Operation procedure	14
Technical drawings.	21
Service addresses	22



Lightnovo

Safety

1 General Information

Read the following safety instructions carefully before operating miniRaman spectrometer 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 spectrometer. 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 spectrometer is in proper functioning condition. A safe and faultless operation can only be guaranteed if miniRaman spectrometer 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 spectrometer 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 spectrometer 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 spectrometer 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.

Safety

2 Warning labels



This warning symbol indicates the existence of laser radiation. A Class 3R laser is considered safe if handled carefully, with restricted beam viewing. With a class 3R laser, the maximum permissible exposure (MPE) can be exceeded, but with a low risk of injury. Visible continuous lasers in Class 3R are limited to 5 milliwatts.



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.

3 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.

4 Laser Safety

General Information

The analysis system miniRaman microscope uses the light of a 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, model MiniRaman microscope SERS is laser class 3R product and it is considered safe if handled carefully, with restricted beam viewing.

According to the standard EN 60825-1/10.2003, miniRaman microscope models: MiniRaman microscope Standard, MiniRaman microscope Standard Dual, MiniRaman microscope Power Dual, MiniRaman microscope Power are Class 3B lasers products. Therefore, they are normally hazardous under direct beam viewing conditions, but are normally safe when viewing diffuse reflections.

Safety Instructions

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

The analysis system is specified as a laser class 3R/3B product (depending on the model, see overview section), 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

1

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

2

Standard Components

miniRaman spectrometer (including user manual and quality test report)

USB-C 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 spectrometer, 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 spectrometer 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 spectrometer, use the original case to avoid damages.

Figure 1. Transportation case for miniRaman spectrometer

Installation

3

Space Requirements

miniRaman spectrometer requires a space of 12cm in diameter and 4cm in height. (For the exact instrument dimensions refer to Specification.) At the rear instrument side, take a clearance of at least 3cm into account.

Note:

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

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)

4



Figure 2. miniRaman spectrometer with transportation case.

Please unpack miniRaman spectrometer and remove it from the transportation case (see Figure 2).

Installation



Figure 3. Rear side – overview of the USB connector socket

5

1. Download miniRaman microscope software package from Lightnovo website: <https://lightnovo.com/lightnovo-software/>
Please select version 32 or 64 bit depending on your operation system.
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.

Overview

1 General information

MiniRaman spectrometer has no moving parts (see section Instrument Design below in this chapter.)

This instrumental setup allows for acquiring Raman spectra from 785 and 660nm lasers. Raman spectra reveal information about the molecular structure and chemical composition of a sample.

This instrumental setup is designed for industry and 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, identification of powders and liquids.

MiniRaman spectrometer 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 fluoresces 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.

Overview

2

Lasers

Depending on the selection of the miniRaman spectrometer model miniRaman spectrometer could be configured in the following models with different laser parameters:

- MiniRaman spectrometer Standard (includes one laser with optical isolation: 785 nm, power range on a sample 5-50 mW)
- MiniRaman spectrometer Power (includes one laser with optical isolation: 785 nm, power range on a sample 15-150 mW)
- MiniRaman spectrometer SERS (includes one laser with optical isolation: 785 nm, power range on a sample 0.5-5 mW)
- MiniRaman spectrometer Power Dual (includes two lasers with optical isolation: 785 nm, power range on a sample 15-150 mW; 660 nm, power range on a sample 1-32 mW)
- MiniRaman spectrometer Standard Dual (includes two lasers with optical isolation: 785 nm, power range on a sample 5-50 mW; 660 nm, power range on a sample 1-32 mW)

Spectral range

- 400-2700 cm⁻¹ (at 785 nm laser excitation),
- 2750-4500 cm⁻¹ (at 660 nm laser excitation)

Spectral resolution

- 10-15 cm⁻¹ (slit size dependent; slit size can be customized)

Sensitivity in point mode at laser wavelength 785 nm (determined as SNR of polystyrene spectrum)

- SNR 350:1
- spectral range 400-2700 cm⁻¹
- laser wavelength: 785 nm
- laser power: 100 mW
- integration time: 0.1s
- number of repetitions: 1

Sensitivity in point mode from laser wavelength 660 nm (determined as SNR of polystyrene spectrum).

- SNR 150:1
- spectral range 2750-4500 cm⁻¹
- laser wavelength: 660 nm
- laser power: 30 mW
- integration time: 0.5 s
- number of repetitions: 1

Weight 400 g **Dimensions** 112 mm x 39 mm x 34 mm

Overview

2 Instrument design

Key system components are shown on Figure 4.

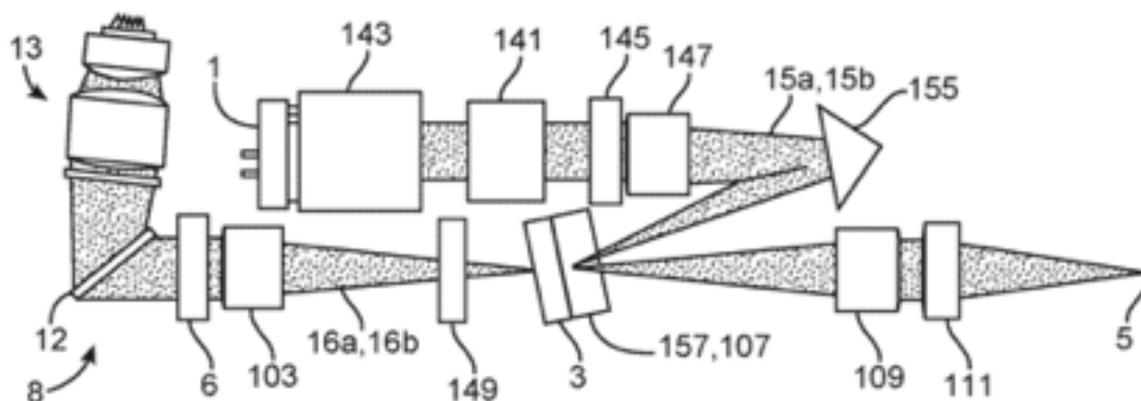


Figure 4. Optical schema of MiniRaman spectrometer. See details for patent # US20210072158 here: <https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2019145005>.

- 1 - laser
- 143 - collimation lens
- 141 - Wollaston unit
- 145 - laser line filter
- 147 - focusing lens
- 155 - mirror
- 3 - slit and Raman filter
- 157 - polystyrene (reference sample)
- 109 - collimation lens
- 11 - Raman probe lens
- 5 - sample
- 149, 6 - Raman filters
- 103 - collimation lens
- 12 - grating
- 13 - focusing lens for spectroscopic sensor

Overview

3

MiniRaman spectrometer has multiple control elements:

1. Laser with wavelength 785nm (ON/OFF and power control)
2. Laser with wavelength 660nm (ON/OFF and power control)
3. Spectroscopic sensor for Raman spectra acquisition (exposure, gain, row selection and binning control)

Operation

1 Hardware connection

MiniRaman spectrometer has two connection options:

1. Via USB-C cable for system control from PC
2. Via Bluetooth for system control from Android based smartphone or tablet

Connection via USB-C cable

miniRaman spectrometer starts loading process when USB cable connected. It takes between 30sec to 60sec. When bottom is blinking "Blue" device is ready for connection from PC.

Connection via Bluetooth

miniRaman spectrometer starts loading process when USB cable connected. It takes between 30sec to 60sec. When bottom is blinking "Blue" device is ready for connection from Android based smartphone or Tablet.

2 Operation procedure

Switching the system ON/OFF

When the analysis system is not used for a longer period of time, it is highly recommended to switch off the Raman excitation laser (785nm and/or 660nm). This action will prolong the service lifetime of the laser.

Warning:

Do not work with miniRaman spectrometer at laser power that is high than specified for particular model. This could lead to the decreased life time of the laser diode or laser damage

Starting the Miraspec software

1. Connection

Press "Connect" bottom in Connection window (see Figure 5). This will initialize hardware accessories. Connection window can be found in Menu/Tools/Connection (Figure 6).

Operation

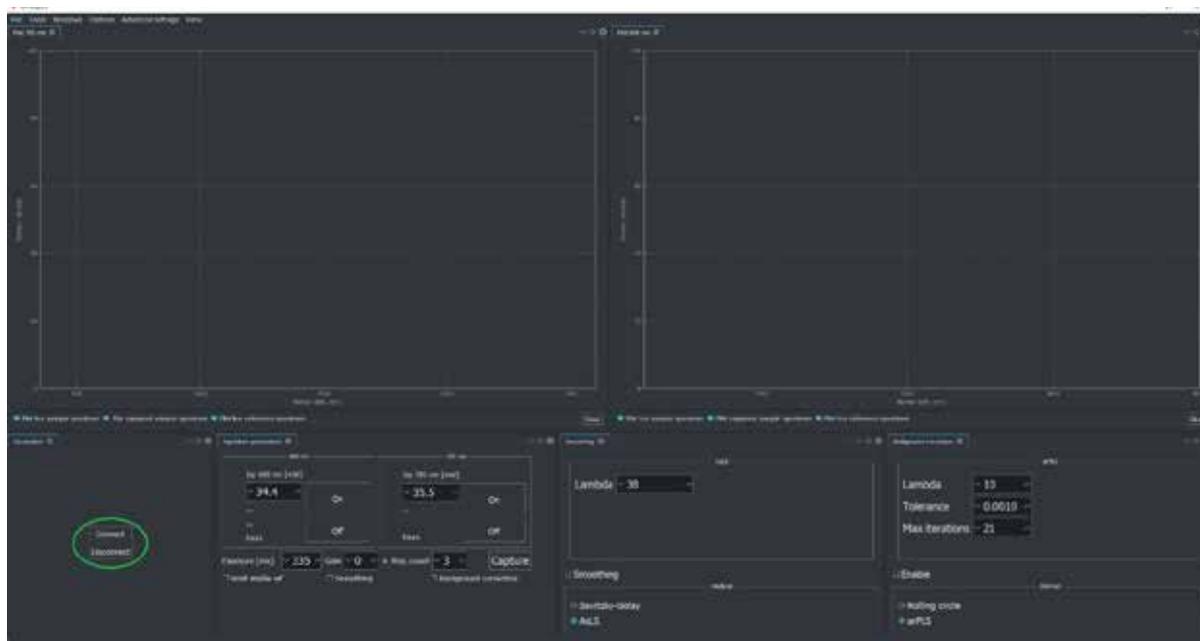


Figure 5. miniRaman spectrometer software interface; connection of accessories

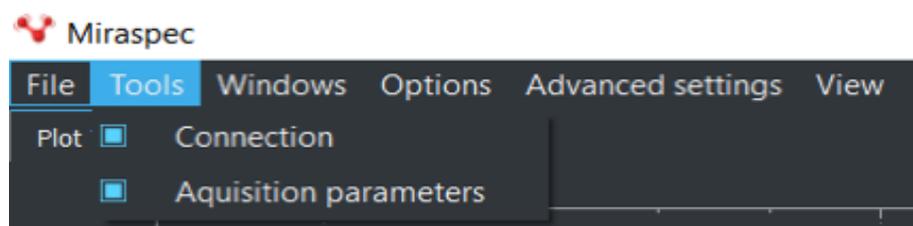
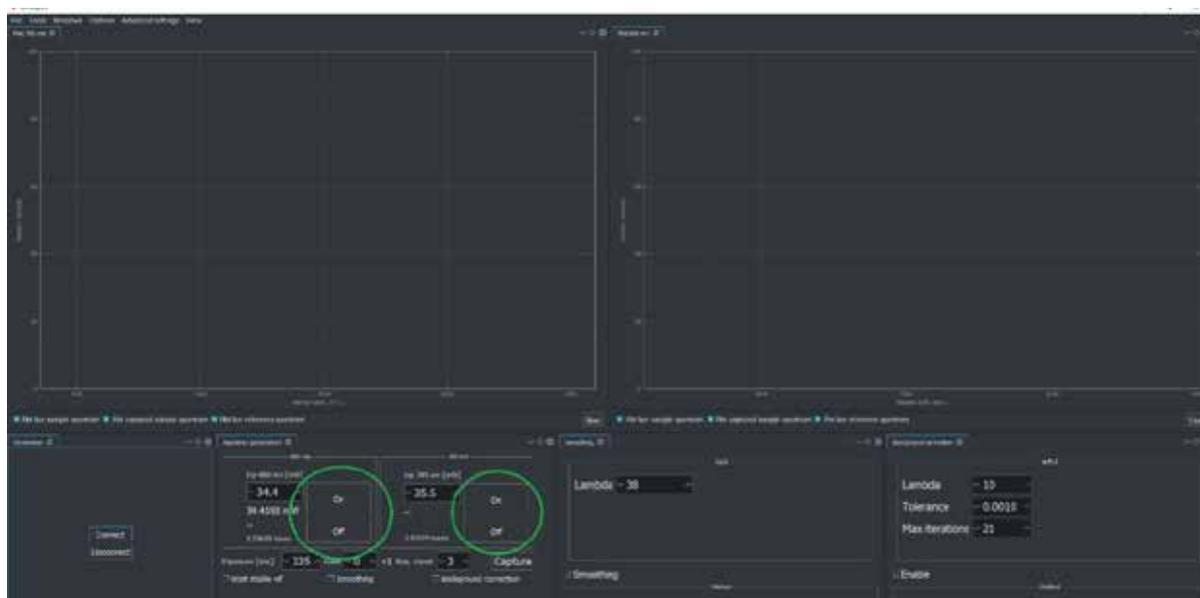


Figure 6. Tools menu

2. Turn ON/OFF lasers

Press "On" or "Off" bottoms, see below. Figure 7. Switch on/off laser



Operation

3. Measuring the Raman spectrum of the sample

Raman spectra shown in the "Plot" window, see below.

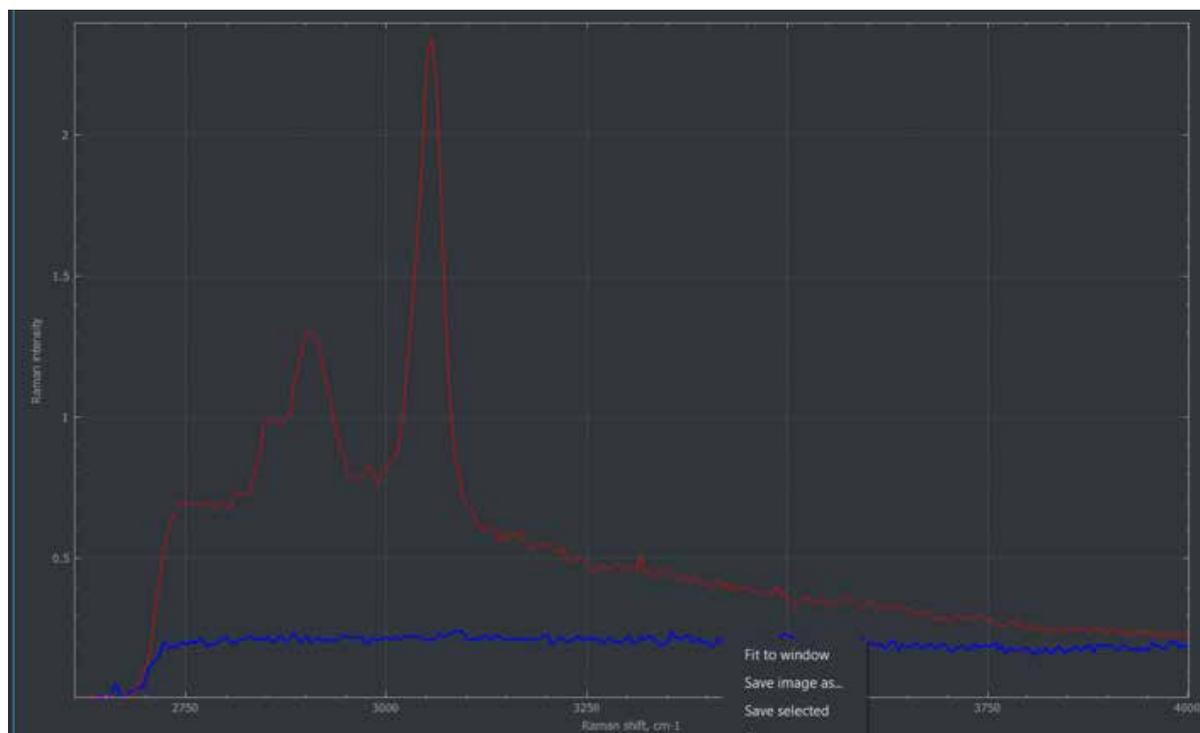


Figure 8. Curve context menu

If laser is ON system should show the "live" spectrum, see below. Spectrum scale can be adjusted by right click of the mouse and selection of "fit to window" bottom.

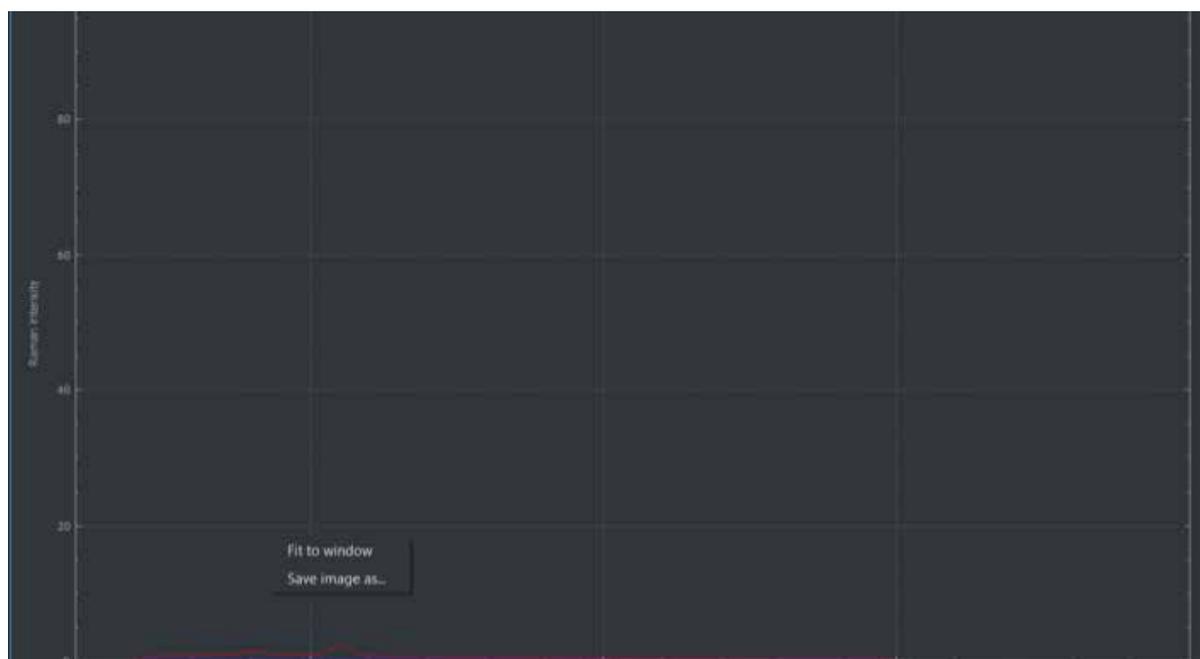


Figure 9. Fit spectra to window

Operation

Spectrum will be acquired by pressing “Capture” bottom. Acquisition parameters like laser power, gain of CMOS sensor and exposure time can be adjusted. Icon “Wait stable ref” should be applied if experiment require high resolution of Raman spectra.



Figure 12. miniRaman microscope software interface; calibration of 3D stage

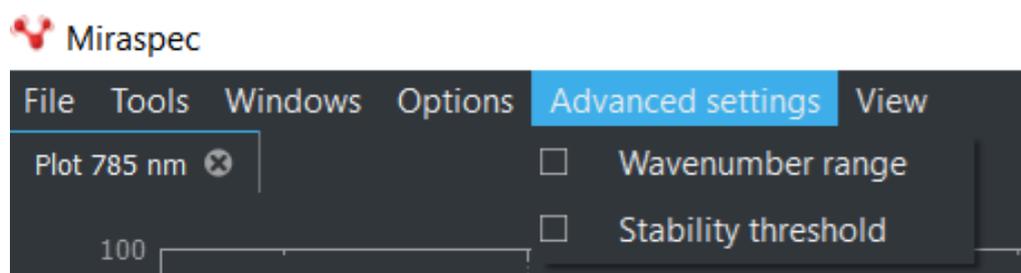


Figure 11. miniRaman spectrometer software interface; advanced settings menu



Figure 12. Wavenumber range settings

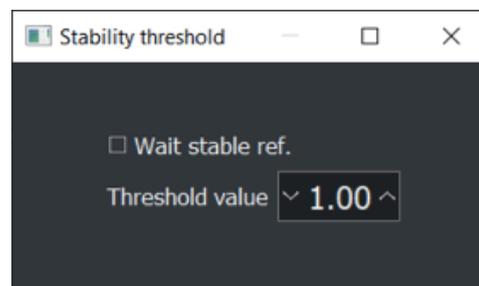


Figure 13. Stability threshold settings

Operation

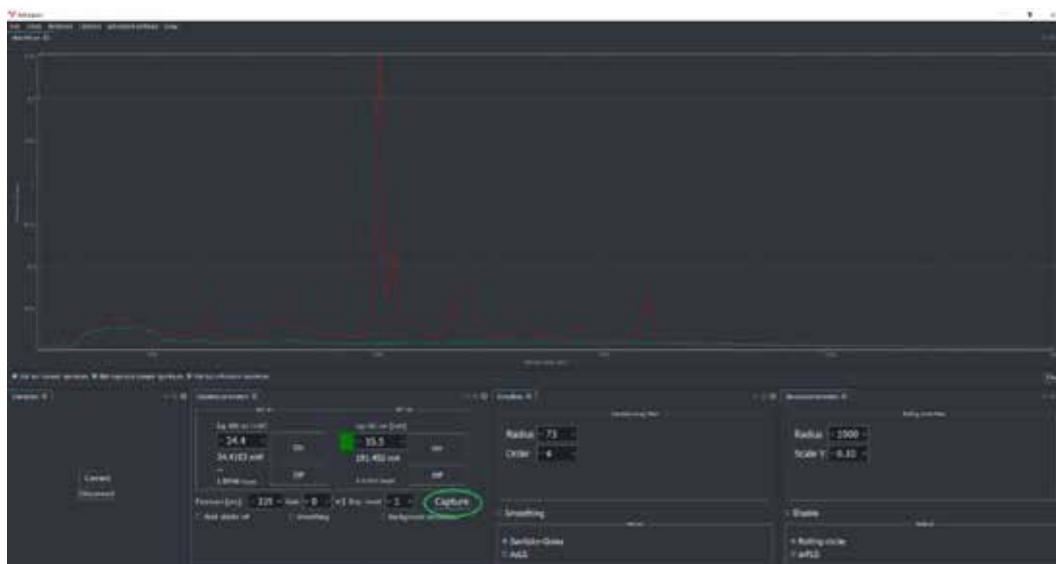


Figure 14. Spectrum capture

4. Spectra preprocessing

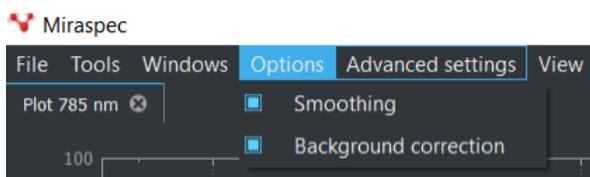


Figure 15. Options menu

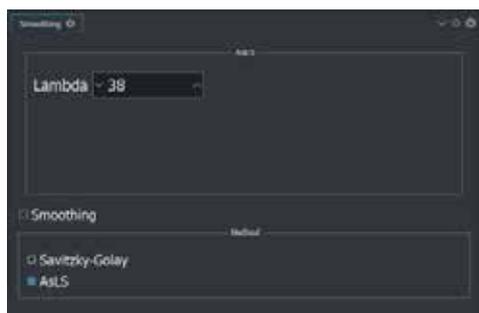


Figure 16. Smoothing methods

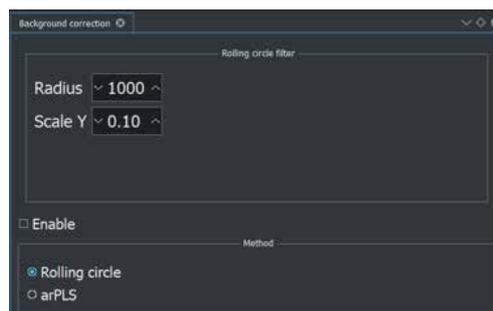
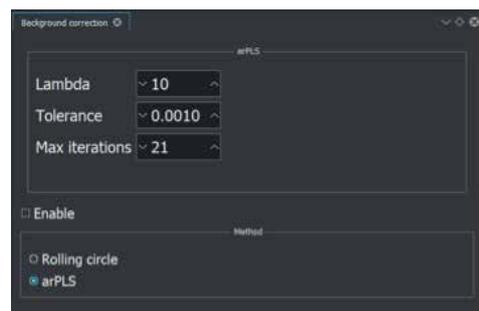


Figure 17. Background correction methods

Operation

5. Saving and/or exporting the data

Export spectrum in tsv: Menu/file/save (see Figure below).

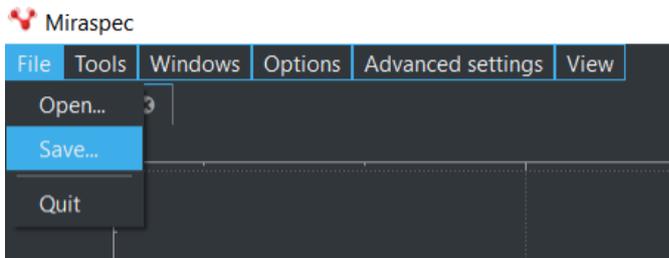


Figure 16. Spectrum capture Figure 18. Saving captured spectrum

6. GUI settings

It is possible to optimize user interface based on customer preferences. Windows can be adjusted with docking widgets, see below.

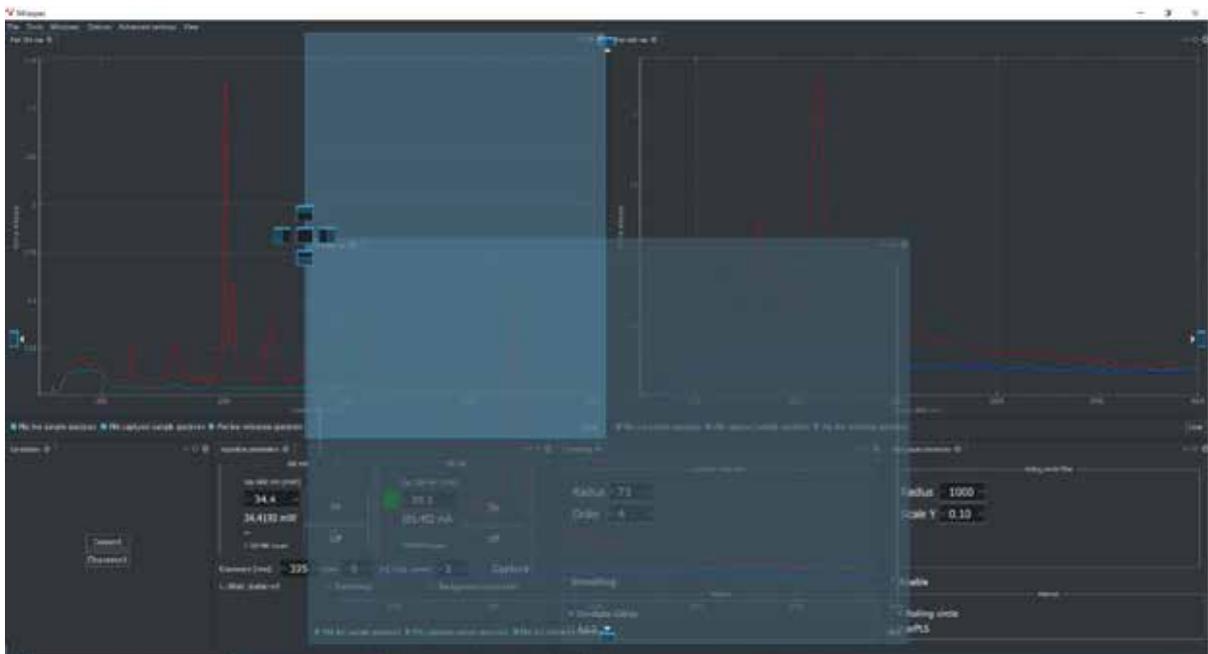


Figure 19. Docking widgets

Operation

Each user interface can be saved, see below.

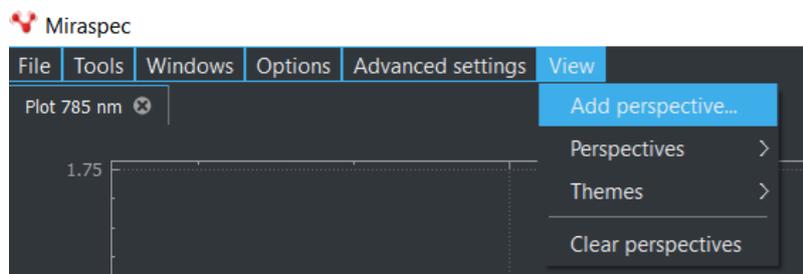


Figure 20. Adding perspective

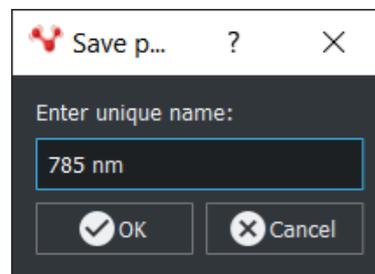


Figure 21. Saving perspective

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

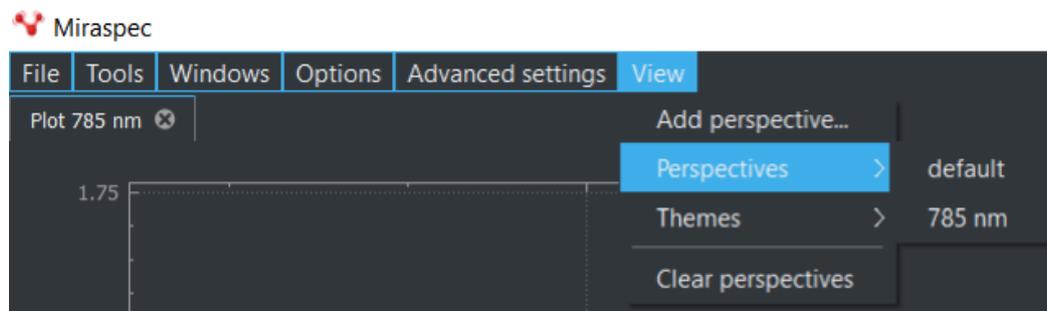


Figure 22. Saved perspective list

Service addresses

Lightnovo ApS
Blokken 15, 1. Tv.
3460 Birkerød
Denmark

Phone: +45 71370410
<https://lightnovo.com/>
service@lightnovo.com