

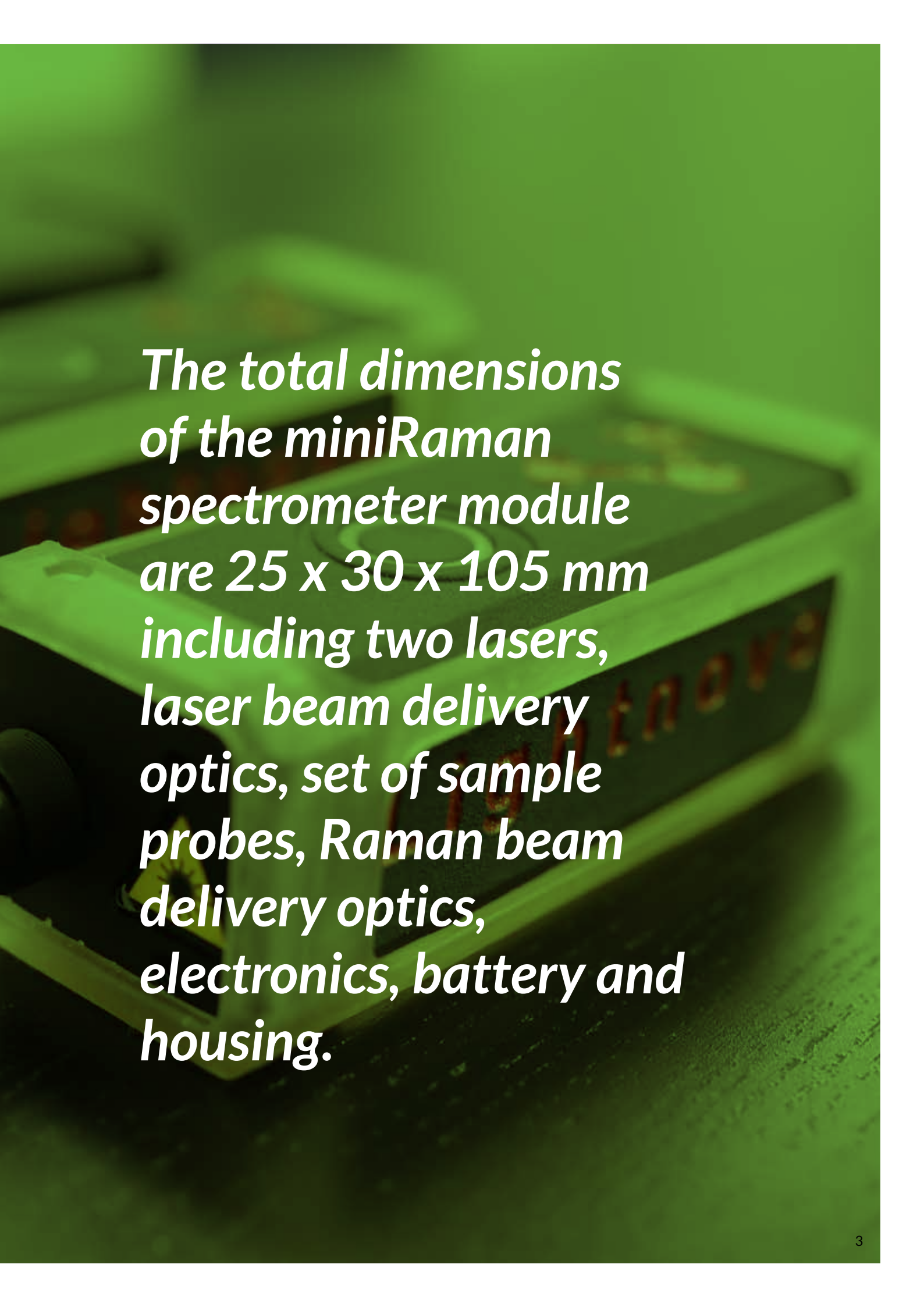


# miniRaman spectrometer

**world's smallest Raman spectrometer**



*miniRaman spectrometer is an advanced miniaturized Raman spectrometer with high sensitivity for most sophisticated applications.*



*The total dimensions of the miniRaman spectrometer module are 25 x 30 x 105 mm including two lasers, laser beam delivery optics, set of sample probes, Raman beam delivery optics, electronics, battery and housing.*

# SPECIFICATIONS

## Lasers

- **785 nm** (power range from **18 to 176 mW** on a sample)
- **785 nm** optional power range is **0.5-5 mW** (for SERS applications)
- **660 nm** (power range from **1 to 32 mW** on a sample)

## Spectral Range

- **400-2700 cm<sup>-1</sup>** (at **785 nm** laser excitation)
- **2750-4500 cm<sup>-1</sup>** (at **660 nm** laser excitation)

## Spectral Resolution

- **7-15 cm<sup>-1</sup>** (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<sup>-1</sup>**
- laser wavelength **785 nm**
- laser power **100 mW**
- integration time **0.1 s**
- number of repetitions **1**

## Sensitivity in point mode at laser wavelength 660 nm

(determined as SNR of polystyrene spectrum)

- SNR **150:1**

- spectral range **2750-4500 cm<sup>-1</sup>**
- laser wavelength **660 nm**
- laser power **32 mW**
- integration time **0.5 s**
- number of repetitions **1**

## Physical dimensions and weight

- weight **400 g**
- dimensions **112 mm x 39 mm x 34 mm**

## miniRaman MRs accessories

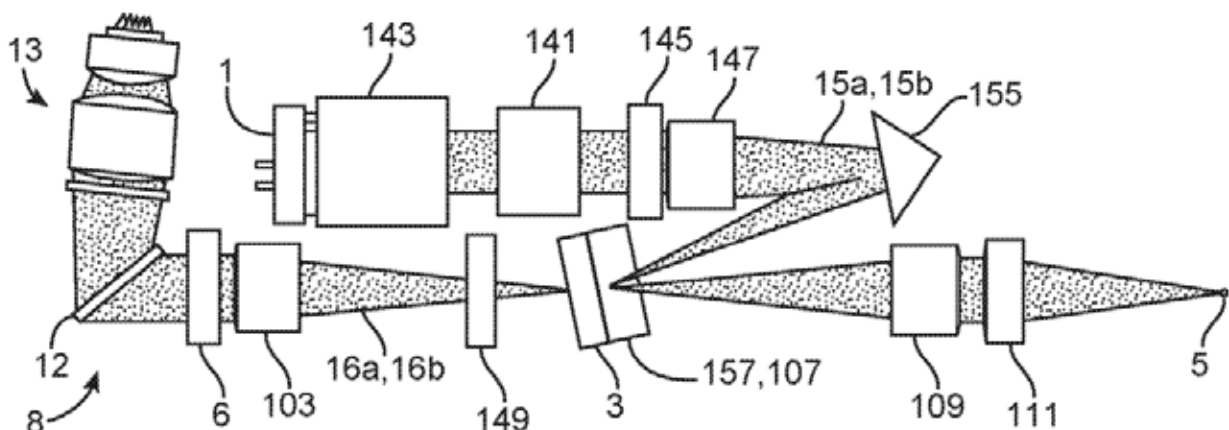
- long working distance probe, **f=30 mm (NA=0.05, laser spot size 50 μm)**
- middle working distance probe, **f=15 mm (NA=0.1, laser spot size 15 μm)**
- short working distance probe, **f=6.25 mm (NA=0.34, laser spot size 3 μm)**
- immersion probe; for in-vivo skin measurements, direct contact measurements of powders and liquids (**f=6.21 mm, NA=0.38, spot size 2.5 μm**)
- sample holders
- axial focusing accessories
- light protection sample cover
- objective covers
- adapters for standard microscopy objectives (**RMS, M25/0.75, M27/1**)

# DEVELOPMENT

One of the key problem during the development of such a small and cheap device was the wavelength and power stability of the lasers. This has been solved with the presence of a piece of polystyrene inside the device as a reference material for calibration. In this way, both lasers measure the Raman spectrum of polystyrene and the Raman spectrum of sample during each acquisition. The spectrum from the sample gets always corrected from the polystyrene spectrum for Raman shift and Raman intensity. This allows for a constant calibration of the device and, therefore, the results are fast (no need for a long calibration) and reliable. This feature makes device an ideal solution for identification and quantitative measurements.

miniRaman spectrometer has an internal battery (1000mAh) which allows continuous device operation for 2 hours (with turn on lasers). Therefore, miniRaman spectrometer becomes even more handy since it can be used just with one hand without the need of cables for the external battery.

Optical schema of miniRaman MRs. See details for miniRaman MRs patent here: <https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2019145005>



# APPLICATIONS

## in-vivo skin diagnostics

In the last years, Raman spectroscopy has shown to be a reliable technique for different skin disease such as cancer and atopic dermatitis. This technique is non-invasive and can provide several information regarding the molecular composition of the surface of the skin and up to several hundred micrometers in depth. However, the instruments are still slow, and bulky. Consequently, there is still the need of an instrument that can be used in the clinical practice and that, in future, patients will use constantly and easily at home in order to evaluate their therapy and to know in advance the triggering of the disease. This will help the diagnosis and the monitoring of a disease reducing time and costs for doctor check-ups. Therefore, the quality of life for patients will improve.

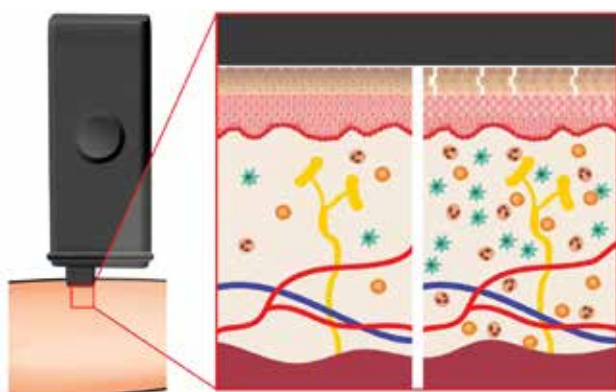
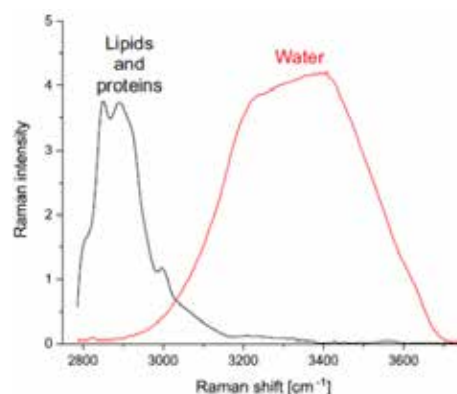
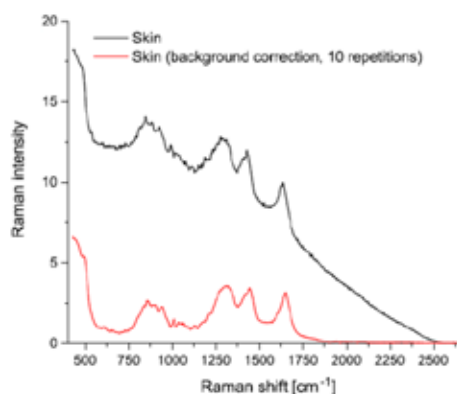


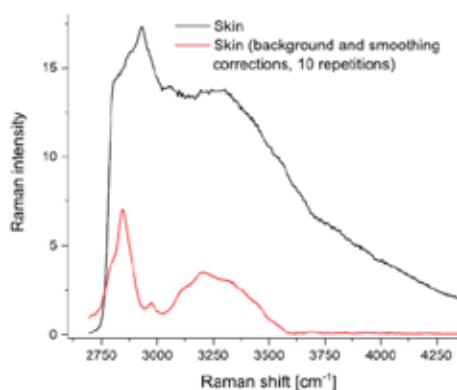
Illustration of in-vivo skin measurements by miniRaman MRs



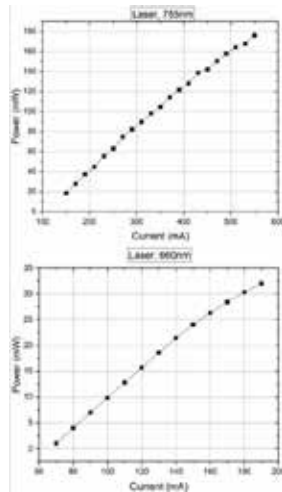
Raman spectrum of lipids and proteins in comparison with the spectrum of water



Skin measured using Skinmeter with and without background correction and averaging of 10 repetitions using laser at 785 nm



Skin measured using MRs with and without background correction and averaging of 10 repetitions using laser at 660 nm

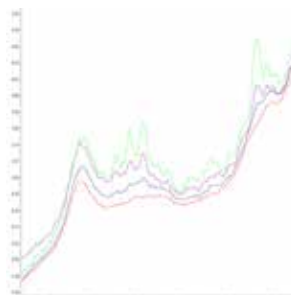
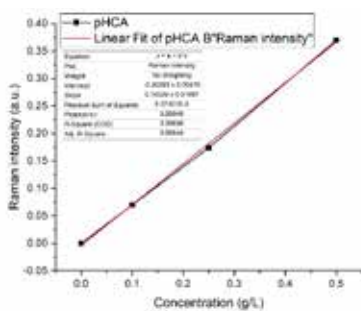


## Low concentration quantitative measurements in liquid solutions

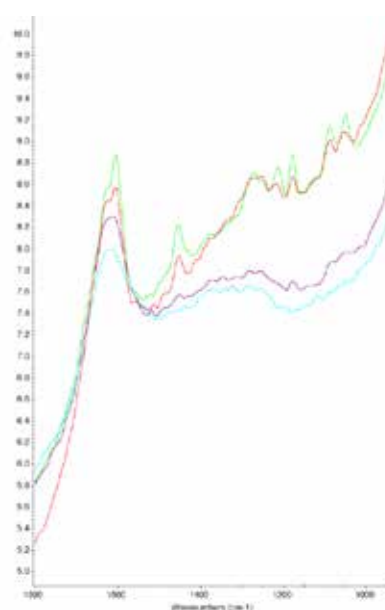
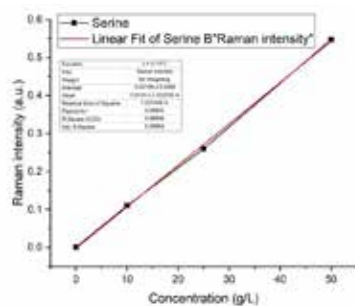
miniRaman MRs is well suited for quantitative Raman measurements due to patented Raman intensity calibration during each measured spectrum via built-in reference channel.

Here we present miniRaman performance in the terms of sensitivity and reproducibility for the detection and quantification of P-coumaric acid and Serine diluted in water based solutions.

We demonstrate the limit of detection (LoD) at the level of 0.1g/L for P-coumaric acid. This results is challenging to obtain even with research grade Raman spectrometers.



P-coumaric acid (pHCA) Raman spectra: green 0.5 g/L, red 0.25 g/L, purple 0.1 g/L and cyan 0 g/L



Serine Raman spectra: green 50 g/L, purple 25 g/L, blue 10 g/L and red 0 g/L



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