BRUKER

SENTERRA II

- The Next Level of Compact Raman Microscopy

Innovation with Integrity

Raman

Next Level Compact Raman Microscopy

The SENTERRA II defines a new level of spectroscopic performance and user friendliness in the class of compact Raman microscopes. SENTERRA II is designed to deliver excellent sensitivity combined with high resolution and state-of-the-art imaging performance. Therefore, the SENTERRA II is the platform of choice for conducting the most challenging research.

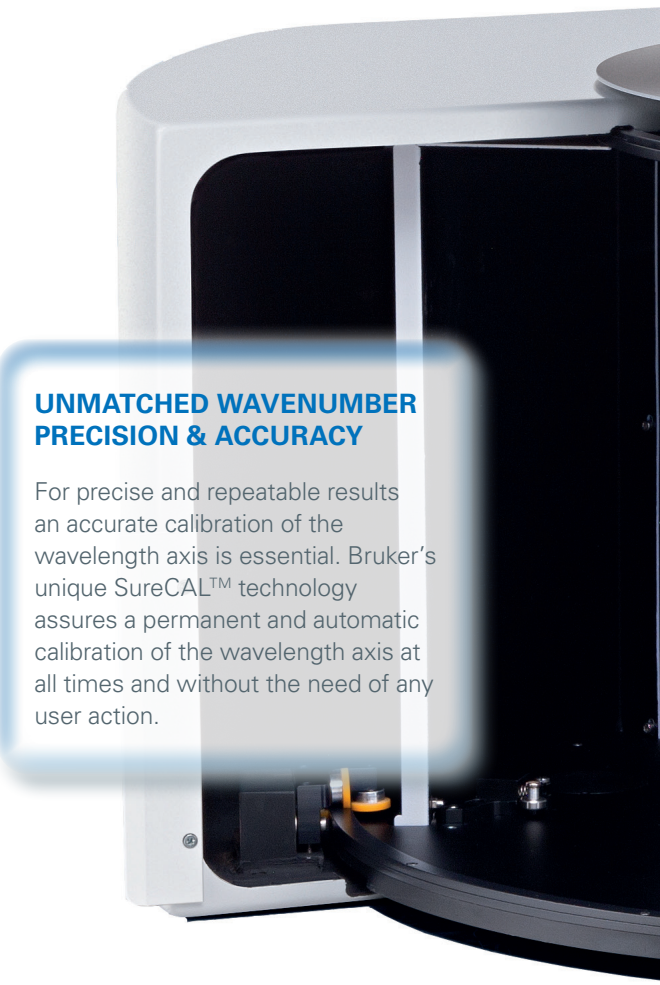
Due to its high degree of automation, compact size and efficient workflow, the SENTERRA II is the ideal tool for solving real world problems in the quality control laboratory. Unmatched permanent stability of the wavenumber axis guarantees precise and accurate results every time.

The SENTERRA II is THE Raman microscope for both, the multi-user environment with high daily throughput and for the lab working at the forefront of scientific research.

RESEARCH-GRADE SPECTROSCOPIC PERFORMANCE

The SENTERRA II provides excellent detection sensitivity and high spectral resolution without compromising spatial resolution.

In single point as well as imaging measurements the full Raman spectrum is recorded in a single scan at 4 cm^{-1} resolution. For demanding studies such as isotope splitting or polymorphism, the resolution can be set to 1.5 cm^{-1} by a mouse click.



UNMATCHED WAVENUMBER PRECISION & ACCURACY

For precise and repeatable results an accurate calibration of the wavelength axis is essential. Bruker's unique SureCAL™ technology assures a permanent and automatic calibration of the wavelength axis at all times and without the need of any user action.

- Research-grade spectroscopic performance
- Highest degree of automation
- Intuitive software-guided workflow
- Unmatched wavenumber accuracy and precision by SureCAL™
- Straight forward fast Raman imaging
- Full spectral range with all gratings
- Multi-laser excitation with fast switching capabilities
- Fully automated instrument tests according to USP <858> & <1858>, PhEur 2.2.48, ASTM E1840 and E2529-06
- Full compliance with GMP/cGMP, GLP and 21 CFR p11

INTUITIVE & SAFE OPERATION

SENTERRA II is a very comfortable and intuitive to use system for both the routine user and the expert. The hardware and software are integrally linked. While the operator is guided by the software through the Raman microanalytical workflow, all relevant hardware changes are performed automatically.

RAMAN IMAGING WITH CONVENIENCE

SENTERRA II provides powerful confocal Raman imaging and mapping functionality that is applied straight forward without time-consuming selection of parameters. The combination of efficient data acquisition and a high precision mapping stage result in submicron spatial resolution and fast generation of Raman images. Even high resolution Raman images can be collected in seconds.

Raman Microscopy Becomes Easy and Productive

The 5 steps to reliable results

1 Inspect your sample to determine the area of interest. Capture visual images.

2 Check the quality of the spectra using the live preview, optimize parameters if required.

Efficient and Flexible

SENTERRA II leads you quickly and smoothly to the desired result. You are guided step-by-step through the procedure of data acquisition from the visualization of your sample, to checking the spectral quality, to the definition of the region of interest before you start the Raman measurement.

At every analytical step, only those functions are presented which are useful to proceed. Yet, all flexibility is maintained, meeting the demands of even the most challenging research applications.

Comfortably from Spectra to Results

While the measurement is running, SENTERRA II evaluates the data according to your predefined analysis method. The OPUS software contains a comprehensive selection of uni- and multivariate methods to turn the collected Raman spectra into meaningful images. Smart search algorithms and numerous Raman libraries makes identification of sample components a breeze.

Everything under Control

SENTERRA II can be configured for a certain application or experiment by simply loading predefined measurement settings. As defined in such parameter file, all instrument parts like excitation lines, gratings and apertures will be selected automatically by the system. Also, any interactive adaptation of instrument parameters in the software leads to an immediate adjustment of the hardware. A high degree of instrumental intelligence prevents selection of an improper configuration.

Assured Reliability

When working with the SENTERRA II you can be sure that the results will be reliable at any time. Thanks to fully automated instrument test routines, the performance verification is applied without losing precious analysis time. During the actual analysis, spectral precision and accuracy are assured by the permanent and automated calibration of the wavelength axis.

3 Define region(s) for the Raman measurement.

4 Run automated Raman analysis & evaluation.

5 Perform post-run data evaluation and reporting of the results.

RAMAN MICROSCOPY THAT DOES NOT REQUIRE THE LEARNING OF COMPLICATED INSTRUMENT OPERATION.

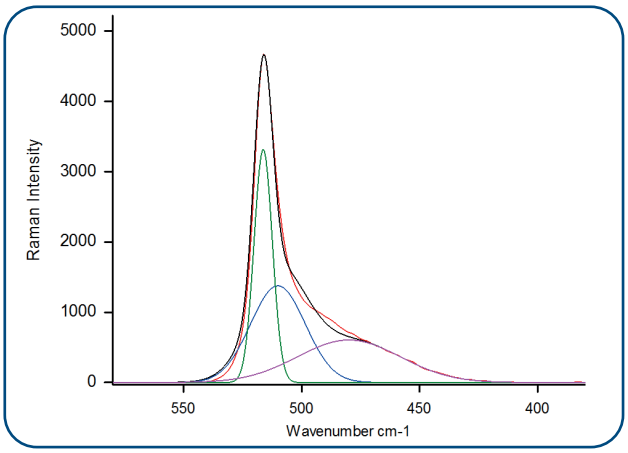
WITH IT´S INTEGRATED HARDWARE AND SOFTWARE DESIGN SENTERRA II LETS YOU FOCUS ON YOUR ANALYTICAL TASK!

SENTERRA II

Built-in Sensitivity

The SENTERRA II combines a high throughput Raman spectrometer with cutting edge optical and electronic components in a compact system with a short beam path.

As a result, the SENTERRA II provides excellent detection sensitivity and high spectral resolution without compromising confocal spatial resolution. As outstanding sensitivity is the prerequisite for successfully employing low laser power, SENTERRA II allows the analysis of delicate samples such as battery electrodes, carbon nanotubes or solar cells.



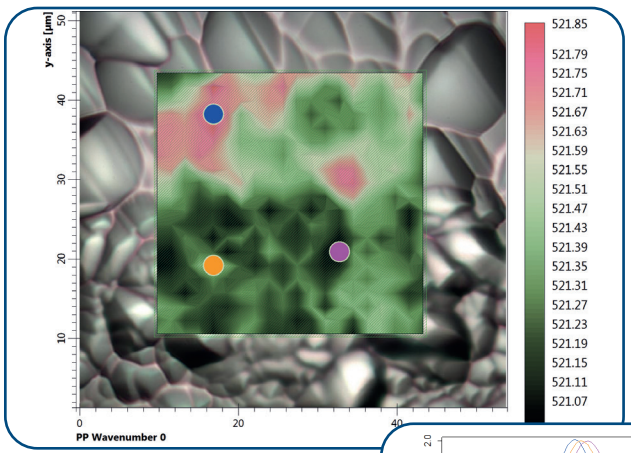
Characterization of the crystallinity of a silicon thin film on a solar cell. The spectrum (red) was measured with very low power to avoid any sample damage.

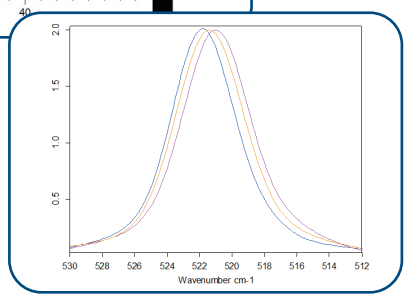
By applying a curve fitting procedure, the spectral contribution of amorphous (pink), microcrystalline (blue) and crystalline (green) silicon to the overall signal could be determined. The sum spectrum of the fitted bands is shown in black.

Unmatched Wavenumber Precision & Accuracy

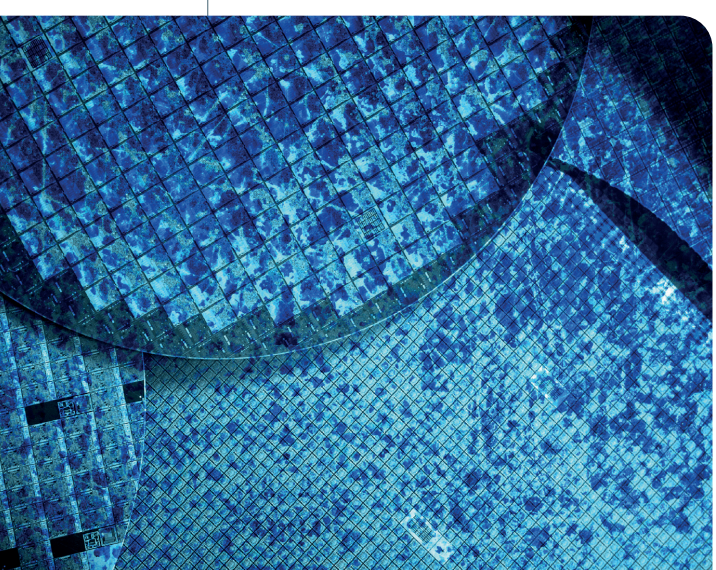
High wavelength precision and accuracy is essential for the detection of small band shifts and accurate identification of unknown samples.

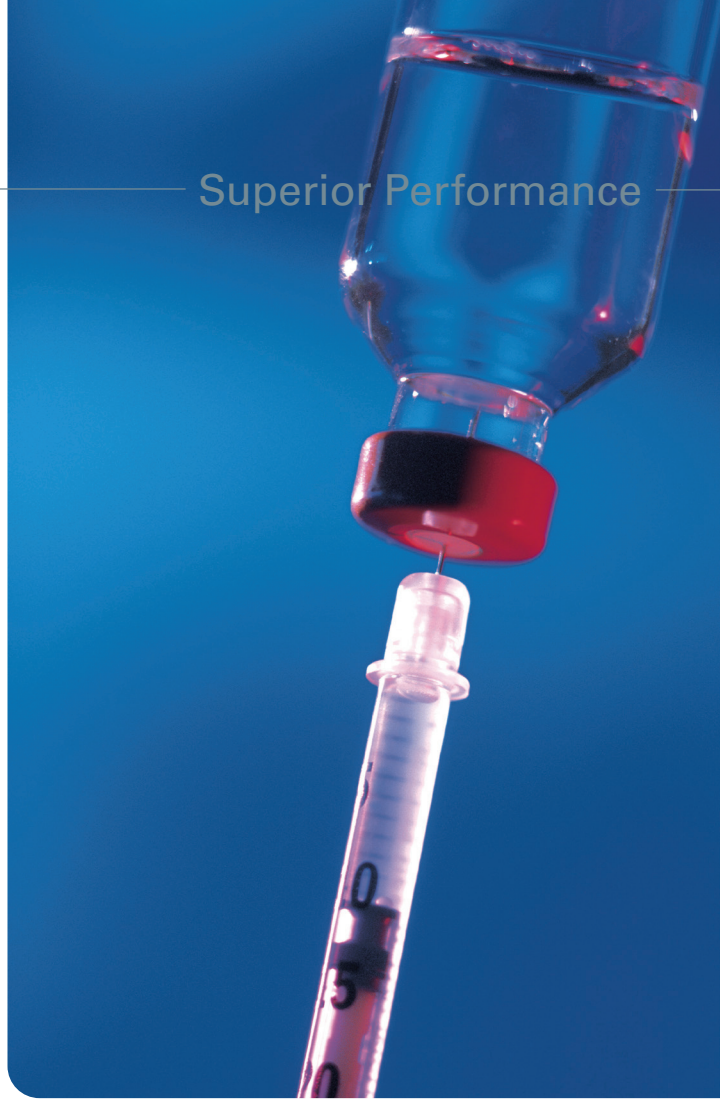
Bruker's unique SureCAL™ technology assures a permanent and automatic calibration of the wavelength axis. At any time SureCAL™ provides a stability of better than 0.1 cm^{-1}.





The permanent wavenumber calibration of SENTERRA II allows the determination of crystallinity dependent variations on a silicon surface with the highest precision. The spectra colors match the selected measurement positions on the Raman image.



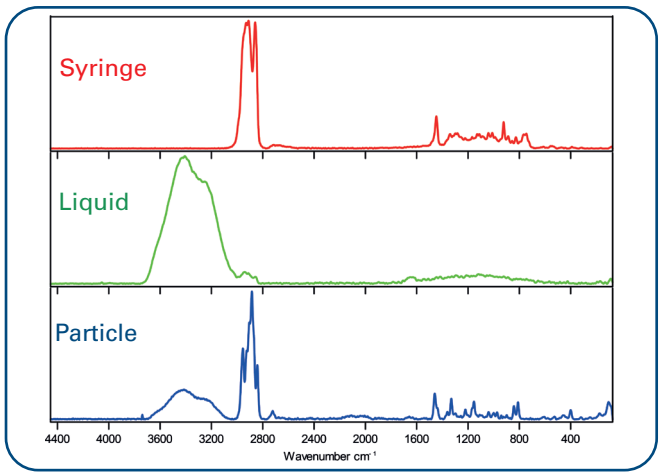


High Throughput and Confocality on Demand

We call it FlexFocus.

SENTERRA II is a fully confocal Raman microscope with exceptional depth resolution for structured materials **and** a high throughput system for maximizing the signal intensity of bulk samples.

FlexFocus uses a hybrid aperture containing an array of pinholes and slits. With just a mouse click, high throughput or confocal performance is provided on demand.

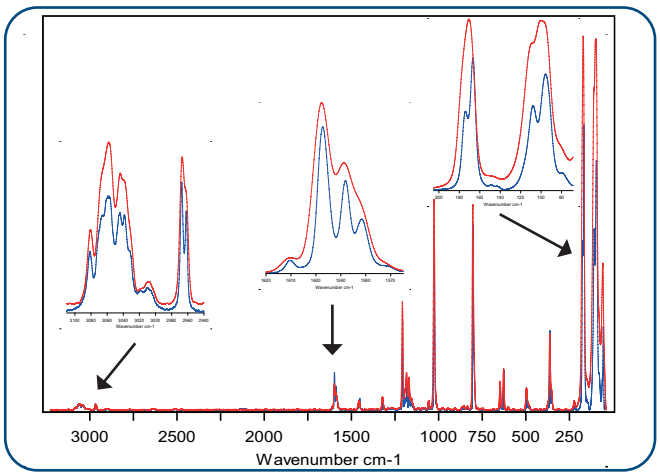


Failure analysis in a pharmaceutical product: Non-invasive analysis of a particle in a liquid filled syringe. Confocal measurement provides spectra of the syringe (red), liquid (green) and particle (blue).

Full Spectral Range

Only a complete spectrum allows one to exploit the full analytical potential of Raman, e.g. for imaging and material identification. With the SENTERRA II, the complete Raman spectrum is recorded with 4 cm^{-1} resolution in one go, allowing fast imaging, without compromising the spectral range.

For demanding studies such as band splittings of isotopes or polymorphism where a higher resolution is required, a high resolution grating is available yielding high resolution data over the full spectral range. Even though this only can be achieved by merging spectral segments, the high precision and accuracy of the wavelenth axis is maintained by SureCAL™.



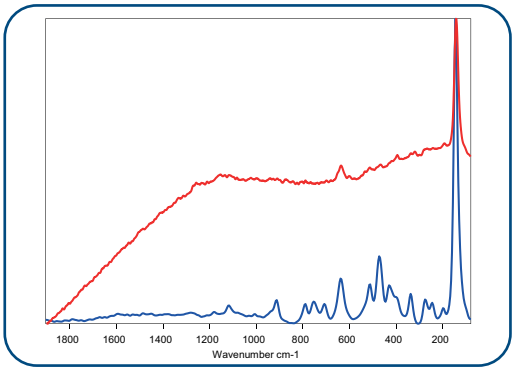
SENTERRA II provides the full spectral range even at high resolution. Spectra of triptycene measured at a resolution of 4 cm^{-1} (red) and 1.5 cm^{-1} (blue).

SENTERRA II

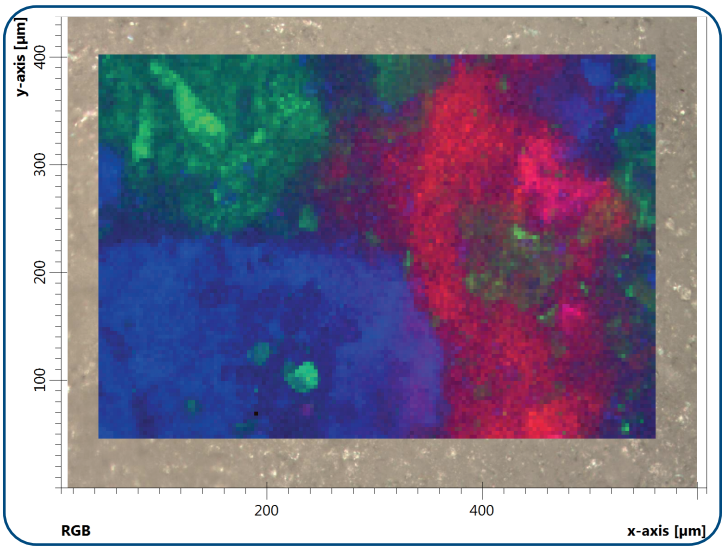
Minerals & Geo Science
Overcome Fluorescence

Get comprehensive spectral information not affected by fluorescence by choosing the appropriate excitation line. The choice of the appropriate laser excitation line is of crucial importance in obtaining meaningful Raman spectra without interfering background fluorescence.

The combination of the SENTERRA II with the FT-Raman microscope RamanScope III adds a 5th excitation line in the near infrared at 1064nm. The use of 1064nm excitation reduces the occurrence of unwanted fluorescence to a minimum.



Spectra of caolinite showing the effectiveness of various laser excitation lines.
Red: 785nm, blue: 1064nm

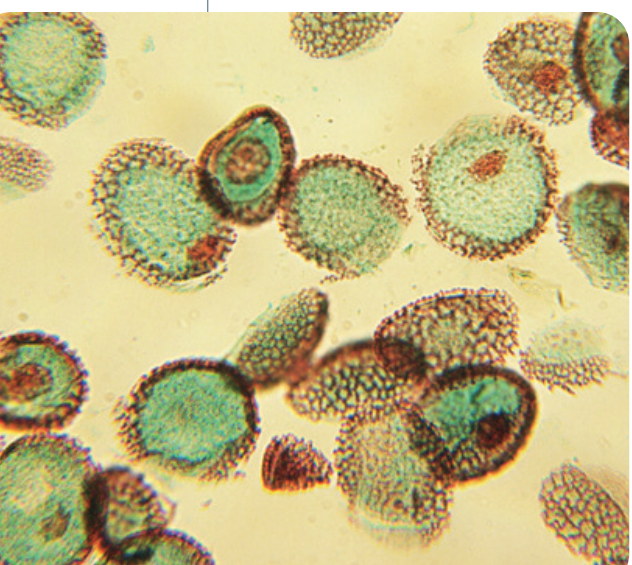


High resolution Raman image of a painkiller tablet showing the distribution of 3 different API's on top of the visual microscopic image.

Pharmaceuticals
Acquire Chemical Information Fast

The degradation of drugs over time can affect the stability and bioavailability of a pharmaceutical formulation, hence the understanding of the distribution and particle size of the ingredients is of high importance. With the SENTERRA II you get accurate and detailed spatial chemical information of the active pharmaceutical ingredients (API) and the excipients of solid state pharmaceutical formulations.

Moreover, the detection of polymorphic forms in a complex matrix is one of the strengths of confocal Raman chemical imaging. A vast selection of visualization methods such as cluster analysis, chemometrical analysis, linear regression and classical integration including peak shift and broadening are provided by the SENTERRA II.

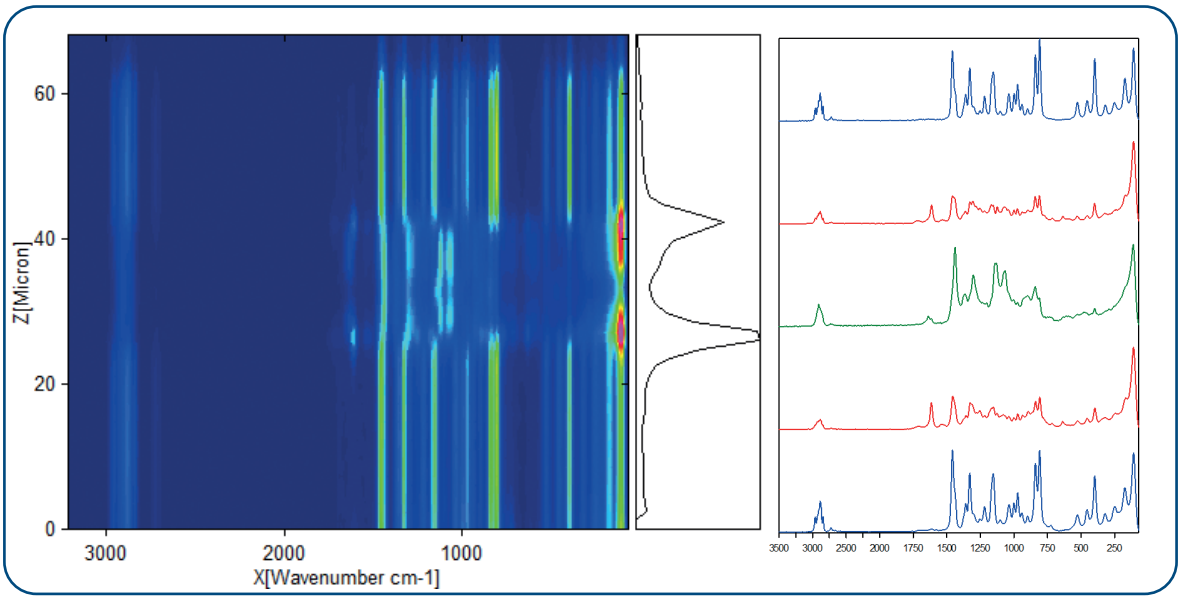


Life Science
Visualize the Chemical Structure

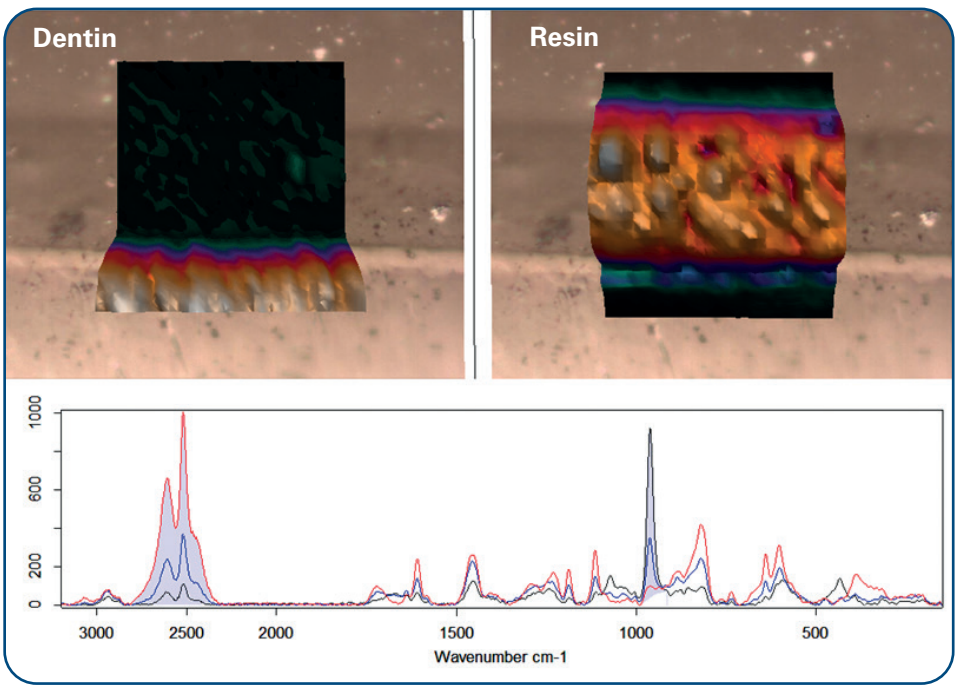
The Raman microspectroscopic analysis of complex biological materials like tissues and cells reveals information about their biomolecular composition. Therefore, the Raman method is of great interest for biological research and development of future medical diagnostics. The SENTERRA II is an excellent analytical tool for the study of delicate samples which have to be treated with the utmost care. Due to its high sensitivity, the SENTERRA II Raman spectrometer allows the use of low laser power down to less than 200 µwatt preventing heat-induced damage.

Polymers & Laminates
Reveal Structural Details in Depth

Confocal Raman microscopy is an extremely useful technique for investigations in the z-direction without the need of sample preparation. Raman depth profiling with the SENTERRRA II reveals subsurface information at the physical diffraction limit. The powerful OPUS software lets you generate automated x, z depth profile scans and volumetric x, y, z scans.



Raman depth profile of a 5 layer polymer laminate revealing intermediate layers with diameters less than 3µm and 4µm.



Coatings and Interfaces
Determine Homogeneity

The SENTERRA II provides valuable insight into composition and homogeneity of surface coatings and interfaces between different materials. The high-precision motorized stage enables you to explore chemical and morphologic information with a minimum step size of just 50nm.

Study of a medical implant: Raman chemical images of a dental interface of an adhesive resin that was applied on a tooth´s dentin surface.

All-Inclusive Functionality & Usability

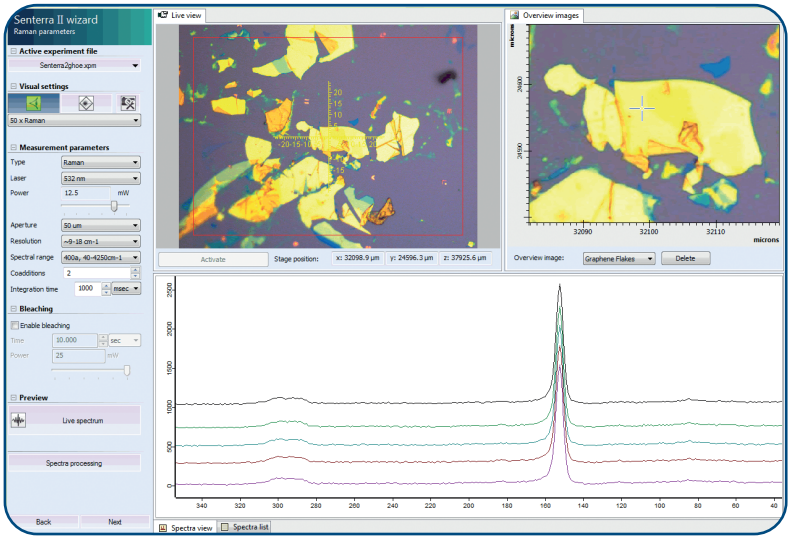
OPUS Spectroscopic Software

Bruker's OPUS spectroscopic software is the interface that clears the way to efficient and successful Raman analysis. From measurement via data processing and evaluation to the final visualization and reporting of the results, all required functionality is provided in a single software package.

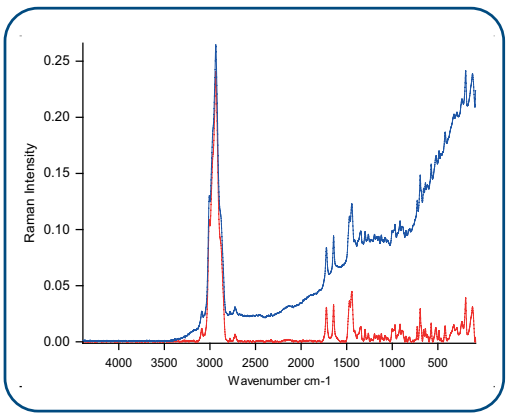
The intuitive Video Wizard guides the user through the measurement process, ensuring a comfortable workflow and high efficiency.

If needed, fine-tuning of the acquired Raman spectra is performed by smart data processing functions such as the patented concave rubberband correction (CRC) that removes fluorescence background.

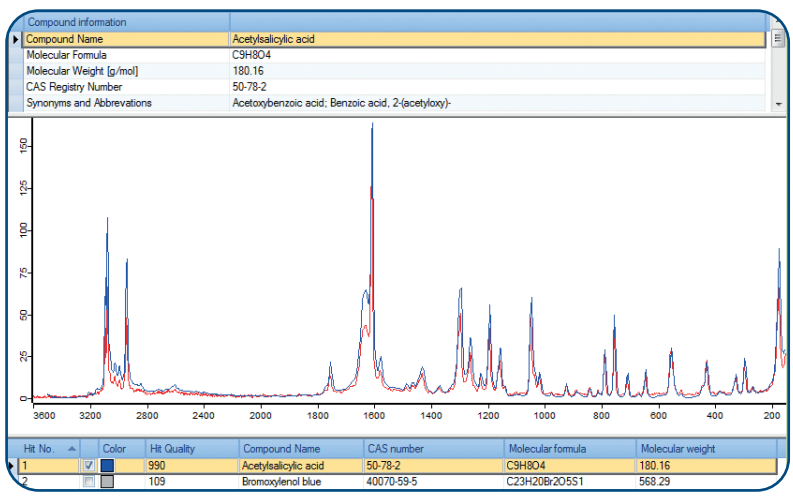
OPUS provides a wide range of uni- and multivariate evaluation methods for extracting all available information from the spectral matrix and converting it into chemical images. These images can be displayed in 2D and 3D views on top or next to the visual microscopic image. Individual spectra from 3D data can be selected for display or identification by library search.



The Video Wizard guides the user comfortably through the analytical workflow of the SENTERRA II.



CRC baseline correction removes fluorescence background reproducible and artifact free.

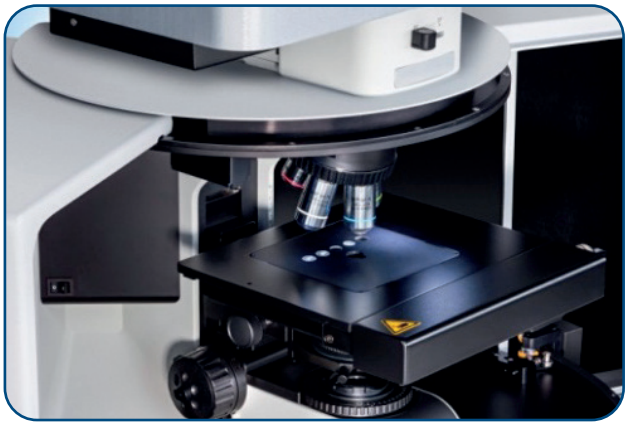


OPUS/SEARCH accurately identifies both pure substances as well as mixtures.

Identification Performance

Availability of comprehensive spectral libraries and powerful software for searching such libraries are the crucial factors for successful identification of unknown spectra. The OPUS software provides high-performing algorithms for the quick and reliable identification of spectra from both pure substances and multi-component mixtures.

Combined with Raman libraries containing more than 28,000 spectra, SENTERRA II will identify polymers, chemicals, pigments, minerals, fibers and many other materials.



Validation plate with integrated standard materials for automated instrument qualification tests

Instrument Qualification Fully Automated

SENTERRA II is prepared to be operated according to the requirements of GMP/cGMP, United States European Pharmacopoeia (USP) and European Pharmacopoeia (EP).

Controlled by the OPUS Validation Program (OVP), the SENTERRA II with the motorized stage runs all required instrument tests in fully automated way. A validation plate with integrated ASTM based standard materials is used for operational and performance qualification (OQ/PQ) according to USP <858> & <1858> and EP 2.2.48 as well as for system verification following the ASTM methods E1840 and E2529-06.

Data Security, Integrity & Traceability

SENTERRA II meets the GLP requirements for security, integrity and traceability of analytical data. The OPUS software provides extended user and password management and access control. All relevant data of each measurement including spectra, images, parameters and audit trail is stored in one, clearly assigned file.

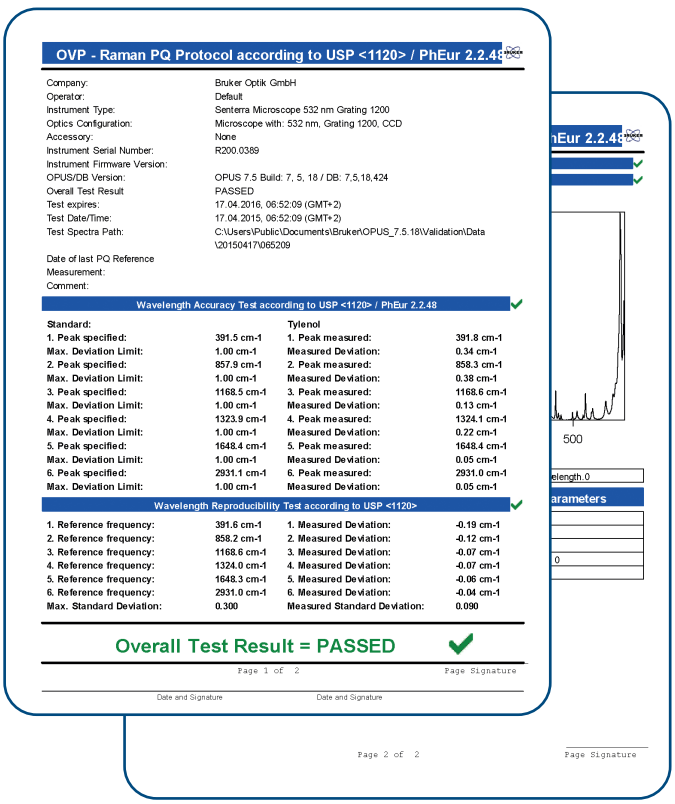
The OPUS/VALIDATION package provides the functionality for working compliant in a FDA regulated 21 CFRp11 environment.

Supported Validation

Bruker cares about your regulatory needs and offers options and services to greatly facilitate your daily validation work.

A system validation manual is available to guide you through the validation procedure (DQ/IQ/OQ/PQ) of the SENTERRA II. Certified service engineers are ready to perform all required steps for validation during initial installation or in the course of a regular maintenance of the SENTERRA II.

SENTERRA II MEETS ALL REQUIREMENTS FOR COMPLIANCE IN TODAY'S REGULATED ANALYTICAL LABORATORIES!



OVP - Raman PQ Protocol according to USP <1120> / PhEur 2.2.48

Company:	Bruker Optik GmbH
Operator:	Default
Instrument Type:	Senterra Microscope 532 nm Grating 1200
Optics Configuration:	Microscope with: 532 nm, Grating 1200, CCD
Accessory:	None
Instrument Serial Number:	R200.0389
Instrument Firmware Version:	
OPUS/DB Version:	OPUS 7.5 Build: 7, 5, 18 / DB: 7,5,18,424
Overall Test Result	PASSED
Test expires:	17.04.2016, 06:52:09 (GMT+2)
Test Date/Time:	17.04.2015, 06:52:09 (GMT+2)
Test Spectra Path:	C:\Users\Public\Documents\Bruker\OPUS_7.5.18\Validation\Data \20150417\065209
Date of last PQ Reference Measurement:	
Comment:	

Wavelength Accuracy Test according to USP <1120> / PhEur 2.2.48

Standard:		Tylenol	
1. Peak specified:	391.5 cm-1	1. Peak measured:	391.8 cm-1
Max. Deviation Limit:	1.00 cm-1	Measured Deviation:	0.34 cm-1
2. Peak specified:	857.9 cm-1	2. Peak measured:	858.3 cm-1
Max. Deviation Limit:	1.00 cm-1	Measured Deviation:	0.38 cm-1
3. Peak specified:	1168.5 cm-1	3. Peak measured:	1168.6 cm-1
Max. Deviation Limit:	1.00 cm-1	Measured Deviation:	0.13 cm-1
4. Peak specified:	1323.9 cm-1	4. Peak measured:	1324.1 cm-1
Max. Deviation Limit:	1.00 cm-1	Measured Deviation:	0.22 cm-1
5. Peak specified:	1648.4 cm-1	5. Peak measured:	1648.4 cm-1
Max. Deviation Limit:	1.00 cm-1	Measured Deviation:	0.05 cm-1
6. Peak specified:	2931.1 cm-1	6. Peak measured:	2931.0 cm-1
Max. Deviation Limit:	1.00 cm-1	Measured Deviation:	0.05 cm-1

Wavelength Reproducibility Test according to USP <1120>

1. Reference frequency:	391.6 cm-1	1. Measured Deviation:	-0.19 cm-1
2. Reference frequency:	858.2 cm-1	2. Measured Deviation:	-0.12 cm-1
3. Reference frequency:	1168.6 cm-1	3. Measured Deviation:	-0.07 cm-1
4. Reference frequency:	1324.0 cm-1	4. Measured Deviation:	-0.07 cm-1
5. Reference frequency:	1648.3 cm-1	5. Measured Deviation:	-0.06 cm-1
6. Reference frequency:	2931.0 cm-1	6. Measured Deviation:	-0.04 cm-1
Max. Standard Deviation:	0.300	Measured Standard Deviation:	0.090

Overall Test Result = PASSED

Page 1 of 2 Page Signature

Date and Signature Date and Signature

Page 2 of 2 Page Signature

Sample report of the Performance Qualification (PQ) of a SENTERRA II.

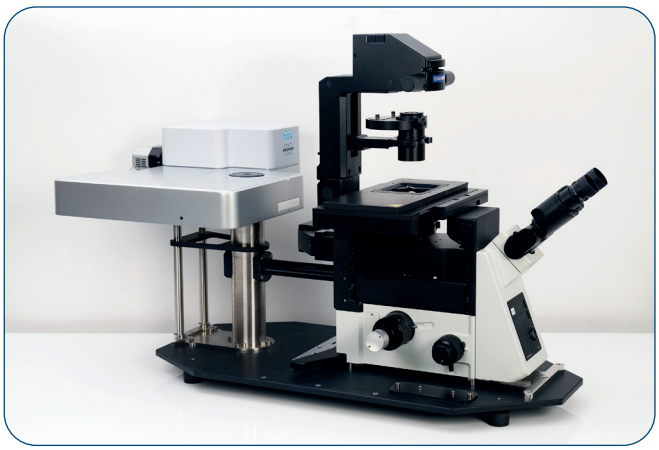
SENTERRA II can be coupled with the RamanScope III offering laser excitation from the visible to the near infrared at 1064nm.

Expand your Scope with a Hybrid System

By combining the FT-Raman microscope RamanScope III with the dispersive SENTERRA II Raman microscope, a hybrid system is formed, and up to 4 excitation lasers can be used. The laser excitation is extended to the near infrared (1064nm), to mitigate sample fluorescence.

Dedicated to Life-Science

SENTERRA II can also be configured with an inverted microscope without compromising any functionality. The inverted Raman microscope gives open access for sample handling , which is particularly favorable in characterization of tissue and cells. Besides cell research, the inverted microscope also brings advantages in researches like in vitro pharmaceutical verification and in situ Raman measurement that requests better access to the microscopic stage.



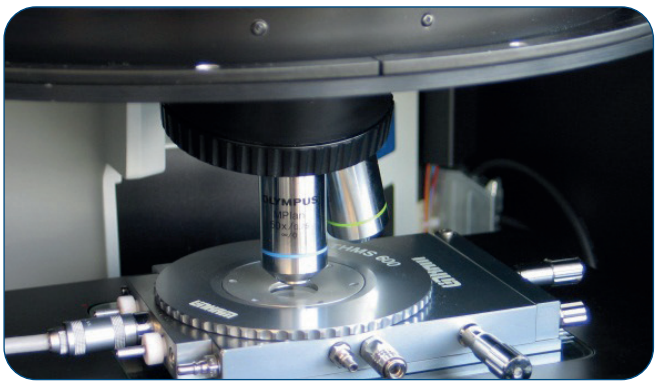
Enlarge your Sample Portfolio for Raman Microscopy

For larger samples, the SENTERRA II can be configured as an open architecture Raman microscope. Typical applications are the Raman analysis of art objects like paintings, ancient books and documents, as well as aircraft or automotive components.

Accessories

A wide selection of accessories including heating/cooling stages, Raman polarizers and depolarizers expand the capabilities of your Raman spectrometer.

For remote sampling, fiber optics probes with an optional video camera can be connected to the SENTERRA II without hindering the microscopic sampling.



Heating/cooling stage used in the SENTERRA II.

Unlimited Visible Microscopy

The SENTERRA II is based on a platform of an optical microscope. All the necessary tools for excellent sample visualization and contrast enhancements like Koehler brightfield illumination, polarized light, Nomarski differential interference contrast (DIC), darkfield and fluorescence are available.

Technologies used are protected by one or more of the following patents:
US 6141095; US 7102746

Bruker Optics is ISO 9001 and ISO 13485 certified.

Laser safety classification:
LASER CLASS 1
Depending on accessories adapted the classification of the Raman microscope may equal the classification of the exciting laser and exceed class 1.

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