

thinkforward



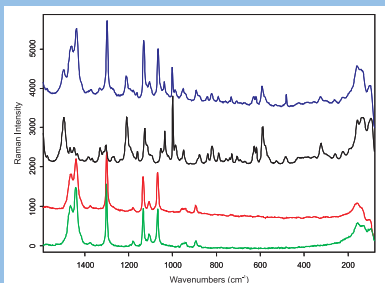
**SENTERRA™**

**Dispersive Raman  
Microscopes**



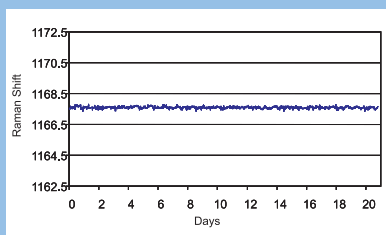
## Sure\_Cal® Automated Wavelength Calibration

Bruker Optics' patented, automated wavelength calibration method, *Sure\_Cal*® performs automatic and accurate calibration of the wavelength. This automated calibration allows spectral subtractions and guarantees stability of any Raman band for long lasting experiments.



The top spectrum in the figure above shows a mixture of two excipients. The second spectrum from the top shows the pure Amlodipine Besylate Raman spectrum. The third spectrum shows the subtraction result and the bottom spectrum is the pure Magnesium Stearate Raman spectrum.

*Sure\_Cal*® allows the user to begin collecting data right away without worrying about calibrating the system. The wavelength is calibrated without needing any external standards. The figure below shows the Raman shift over many days. The



wavelength accuracy is better than  $0.1 \text{ cm}^{-1}$  over more than 20 days continuous data collection!

**Recent advances in Raman technology are expanding the scope of Raman microscopy for evaluation of molecular structure. The *SENTERRA*™ is a high performance Raman microprobe system designed for the most demanding applications in research and daily routine operation.**

The *SENTERRA* utilizes a state-of-the-art TE-cooled CCD detector and a proprietary high quality single stage spectrograph for the highest throughput and sensitivity. The *SENTERRA* is a full-featured confocal system that can accommodate multiple excitation wavelengths with the highest possible spatial resolution.

- All-in-one, compact, confocal design
- Patented automatic permanent calibration using *Sure\_Cal*®
- Class I laser safety enclosure
- Multiple wavelengths; 785nm, 532nm and/or 633nm
- Spectral imaging utilizing sample stage mapping
- Confocal depth profiling with True\_Focus
- High spatial and spectral resolution
- Large spectral range
- Automatic instrument response correction with NIST standards
- Automatic fluorescence rejection using SERDS

## Compact Design

Most commercial Raman microscopes employ spectrographs that are separate from the microscope. Therefore, alignment and maintenance of these devices was time consuming. *SENTERRA* integrates a dual laser Raman spectrometer onto the confocal microscope. The spectrometer part is integrated in between the base and the binocular of the microscope. Due to this compact design, the beam path is kept very short which accounts for the high robustness and stability of the system.

## *Sure\_Cal*® Automatic Continuous Calibration

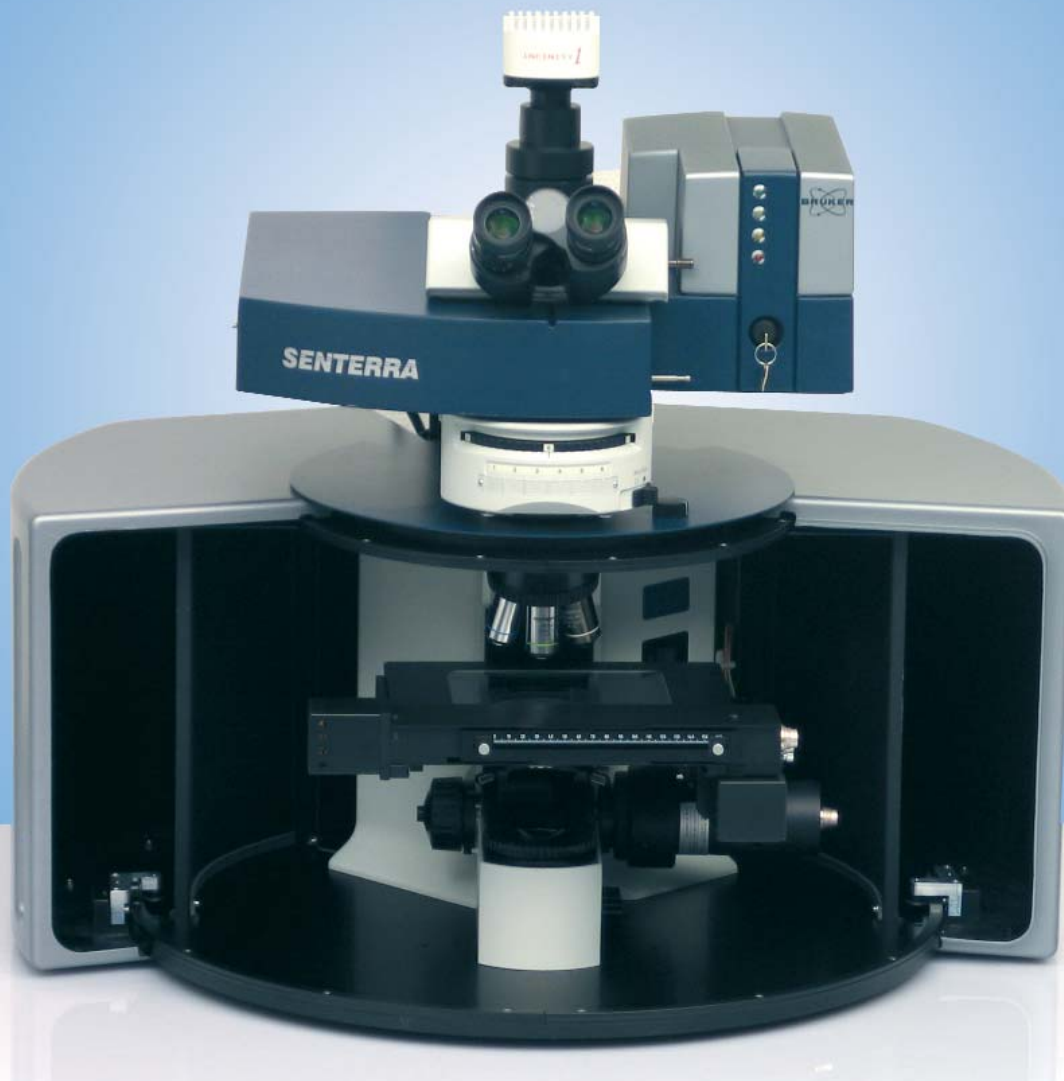
Stability is a crucial issue for both research applications for highly accurate determination of band shifts as well as for routine identification in the QA/QC laboratories. *SENTERRA*'s patented *Sure\_Cal*® method calibrates the system automatically with unmatched wavelength precision and accuracy. With *Sure\_Cal*®, the system utilizes a reference Neon laser, analogous to the HeNe laser in an FT-IR, to calibrate wavelength without the need of daily system calibration or an external wavelength standard. An Integral Transform Process (ITP) is employed to automatically correct the Raman data for inherent laser instabilities. The wavelength accuracy and precision is maintained to better than  $0.1 \text{ cm}^{-1}$  over the lifetime of the instrument without user calibration or maintenance. The resultant Raman spectrum is automatically calibrated in both frequency and intensity.

## Automatic Fluorescence Rejection by SERDS™

The new *SENTERRA* incorporates the revolutionary and patented Automatic Fluorescence Rejection (AFR) method for eliminating fluorescence from many samples. Historically, Raman spectroscopy has been a complimentary tool for sample analysis, because many samples exhibited fluorescence. With the *SENTERRA*, sample fluorescence can frequently be eliminated to produce high quality Raman spectra even on the most demanding samples.

## Software

The *OPUS* software provides an easy to use platform that is compatible with even the most stringent validation environments. *OPUS* is a fully integrated "all-in-one" software that allows data acquisition, manipulation and evaluation in one intuitive package. The *OPUS* software can also select the best grating for the collection parameters. Chemical images can also be collected by selecting and collecting point, line, or area maps in the fully integrated video assisted measurement package. Bruker Optics also offers various Raman libraries covering fibers, inorganics, organics, polymers and natural compounds.



**SENTERRA Raman microscope with class 1\* safety enclosure**



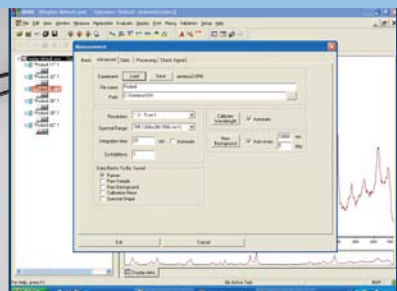
SENTERRA can accommodate up to 3 different excitation wavelengths simultaneously.



SENTERRA offers all optical microscopy capabilities for better sample visualization.



Accessories such as the external fiber optic probes provide flexibility for demanding macroscopic applications.



OPUS is a comprehensive and intuitive software package for the SENTERRA.

## Ease of Use

SENTERRA is the first Raman microscope to provide hassle free operation. *Sure\_Cal*® automatically calibrates the system to better than 0.1 cm<sup>-1</sup> accuracy and precision without the necessity of daily wavelength calibrations. Switching between excitation lasers could not be easier. The user simply selects the laser of choice and SENTERRA will automatically positions the detector, grating and filters in seconds. Video images of the sample are saved with the Raman spectra, so that data can be analyzed conveniently.

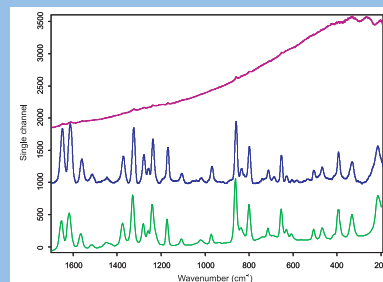
## Flexibility

The SENTERRA incorporates all the features and functionality traditionally found in much larger and more expensive systems. The SENTERRA can acquire data in different modes including high throughput and confocal. The true confocal design provides, high quality Raman spectra with highest lateral and depth resolution at the diffraction limit. Multiple laser excitation can be used; up to three lasers at the same time; two lasers are mounted internally with a third being externally linked through the fiber optics. The SENTERRA dispersive module can hold three gratings for acquiring the highest quality data at both low and high spectral resolution. Bruker Optics offers various accessories including mapping stages, heating/cooling stages, polarizers and depolarizers to enhance the capabilities of your Raman spectrometer.

## Upgradeability

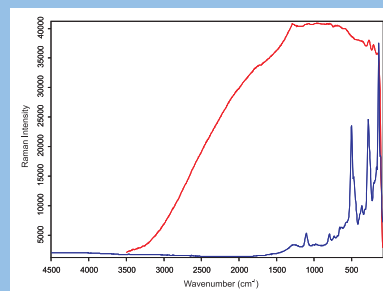
The SENTERRA can be equipped with any infinity corrected Olympus microscope or to many other infinity corrected microscopes. Second and third lasers can also be easily added to the SENTERRA to enhance your research Raman capabilities. Raman fiber probes can be connected to SENTERRA for macro and remote sampling. A number of optical components such as objectives, polarizers, fluorescence illumination, etc. are readily available. In addition, the SENTERRA can be used with the 1064nm excitation, being coupled to Bruker Optics FT-Raman systems.

## Automatic Fluorescence Rejection using SERDS™



For samples that exhibit fluorescence even at 785nm, Bruker Optics' patented method for rejecting fluorescence can be utilized. The top spectrum in the figure above shows the problematic fluorescence background of an acetaminophen tablet with 785nm excitation. The middle spectrum shows the AFR result with the fluorescence removed and the bottom spectrum on the above figure shows the reference acetaminophen spectrum collected at 1064nm.

## Flexibility in data collection



The figure above shows an Fe<sub>2</sub>O<sub>3</sub> spectrum at 785nm (red) and 532nm (blue). Fe<sub>2</sub>O<sub>3</sub> is a good example of needing more than one laser source. Frequently, it is advantageous to move to longer wavelengths in an attempt to reduce or eliminate problematic fluorescence, but some samples require shorter wavelength excitation to reduce fluorescence. The SENTERRA can accommodate up to three lasers at the same time.



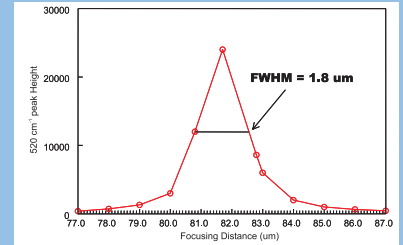
The SENTERRA sampling stage accommodates internal accessories such as cooling and heating devices.

The interlocked, Class 1\* safety enclosure offers a large working space with easy access to the sample stage.



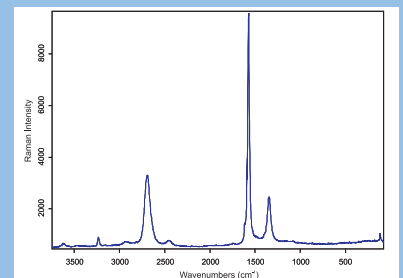


## True Confocal Performance



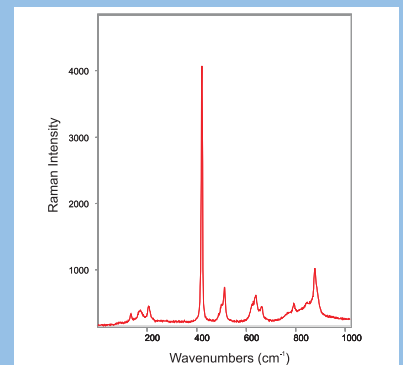
The *SENTERRA* can be operated in two modes of acquisition, confocal and high throughput. The graph above shows a plot of the silicon band at 520  $\text{cm}^{-1}$  as a silicon wafer surface is brought into focus with 532 nm excitation. The full width at half maximum (FWHM) clearly shows a confocal depth resolution of better than 2 microns.

## Research Raman



Even the most demanding research samples can be readily analyzed with the *SENTERRA*. The Raman spectrum above is a carbon nanotube collected with 20 seconds integration.

## Fiber Optics Sampling



A wide range of fiber optic probes are available for the *SENTERRA*. Fiber optic probes readily attach to the fiberlink on the front of the *SENTERRA*. An isopropanol Raman spectrum is shown above as collected through a vial using the fiber optic probe.

## SENTERRA for optical and spectroscopic microscopy

### Optical Microscopy

As the *SENTERRA* is based on the Olympus BX series optical microscope, all the necessary tools for sample visualization and contrast enhancements like Koehler brightfield illumination, polarized light, Nomarski differential interference contrast (DIC), darkfield, fluorescence and many others are available. The standard trinocular viewer allows you to safely see your sample on the computer monitor or through the binoculars. The standard aperture stop in the Koehler illumination provides the first and easiest method for enhancing contrast. Visible polarizers can be employed for birefringent samples. Darkfield illumination, phase contrast, and DIC can also be important tools for sample observation and characterization. Fluorescence illumination and observation is a very sensitive technique for samples that are autofluorescent or contain fluorescent markers.

### Applications

The *SENTERRA* can be utilized for wide range of applications, including Identification, verification and characterization of various different materials.

- Forensics applications
- Pharmaceutical applications
- Life Science applications
- Polymers and plastics
- Semiconductors
- Mineralogy and gemmology applications
- Materials research on thin films, nano particles and surfaces



Bruker Optics is staffed by expert scientists and engineers that have an in-depth knowledge of instrumentation and applications. Our product specialists are available to assist you with method development either remotely or in your lab, assisting you in selection and use of sampling accessories, choices of optical components and software operation. We offer customized instruction and support packages to fit your needs.

Bruker Optics spectrometers are designed to provide years of dependable trouble-free operation, but should a problem occur a network of Bruker companies and representatives throughout the world are ready to promptly respond to your needs. Professional installations and a high standard of post-delivery service are commitments Bruker Optics makes to each of its customers. Remote diagnostics in addition to a variety of service contract packages are available for comprehensive support.

US 6,141,095, 6,281,971B1

\* Class 1 with safety enclosure, exceeds class 1 without safety enclosure. Depending on accessories adapted the classification of the Raman microscope may equal the classification of the exciting laser and exceed class 1

LASER CLASS 1\*



for more information, visit:  
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