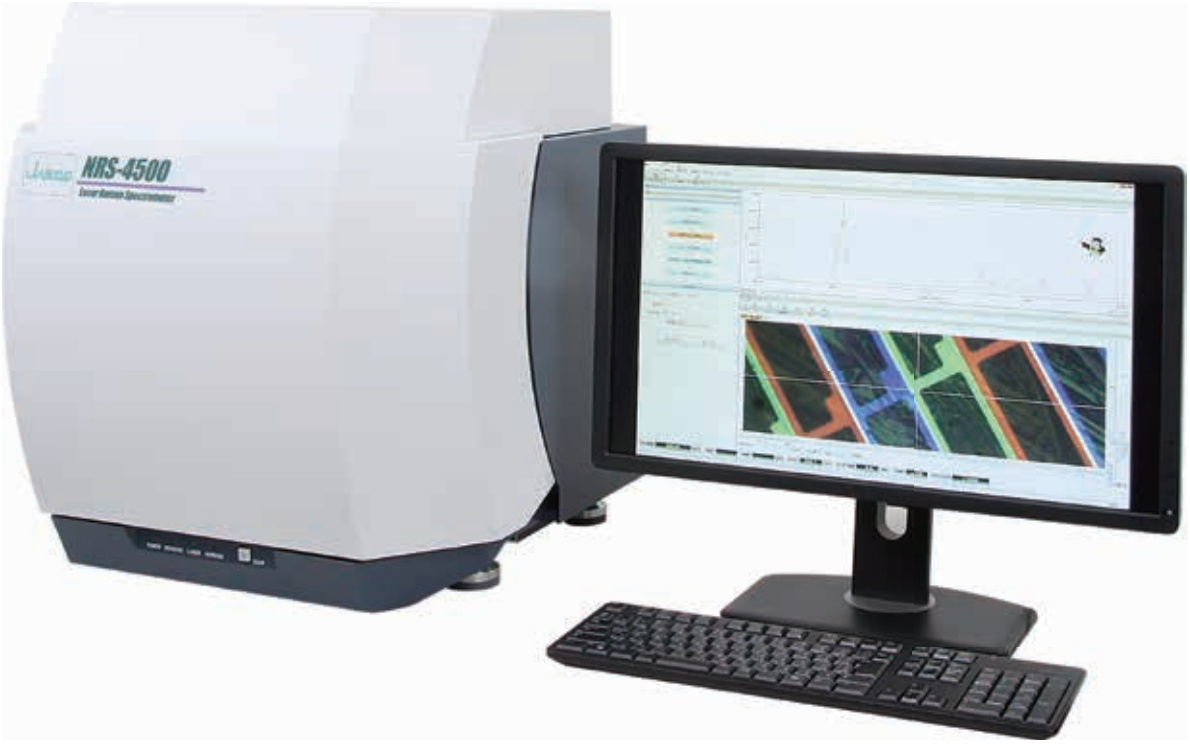
NRS-4500

Laser Raman Spectrometer

The New NRS-4500 Dispersive Laser Raman



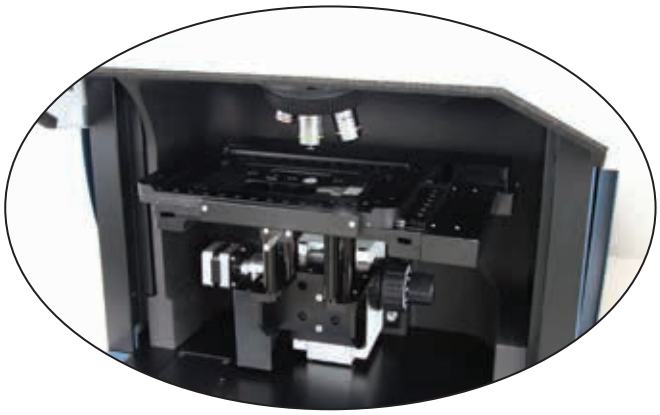
In Raman spectroscopy, sample preparation is generally considered to be much easier than for infrared spectroscopy and unlike FTIR microscopy, Raman offers greatly improved spatial resolution.

As a result, the use of Raman spectrometry is rapidly spreading as the analytical technique of choice for materials analysis. One of the factors which has previously held back the adoption of laser Raman instruments is the skill set required for optical adjustment, measurement optimization and data analysis. The NRS-4500 will change the way Raman is used for so many different applications from QA, to academic teaching, to cutting edge research.

"For the first time, the new NRS-4500 brings together a number of critical elements to make Raman spectroscopy accessible not only to experienced spectroscopists, but also to first-time users."

Rigid optical bench and laser image

The purposed-designed microscope is completely rigid to prevent flexing; this is not the case with other systems built around an optical microscope. The NRS-4500 also offers direct observation of the laser spot (not generally available) to ensure it is perfectly aligned to the target sample and with XY spatial resolution down to only to 1 µm (Z=1.5 µm). Switching between observation and measurement modes is completely automatic and can be done with the safety cabinet closed.



Flexible sampling options

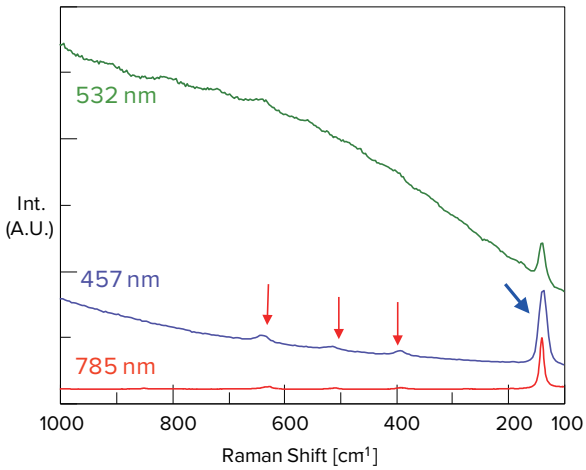
With a choice of refractive objectives, both micro and macro measurements are possible as well as options for long working distance objectives for heated sample stages and other sampling accessories. The NRS-4500 can also be specified with a manual sample stage or with the PC-controlled, automated XYZ imaging stage, and with the option of the large sample stage (80 mm working distance) to accommodate a variety of heating and cooling sample accessories. With options for macro sampling and for probe based measurements, the NRS-4500 has everything you will need for virtually any type of Raman experiment.

Standard Configuration with 532/785nm lasers

The NRS-4500 offers standard configurations that include the typical 532/785nm laser combination with matching edge filters and an option for a third laser. All laser wavelengths are automatically selected in the software with matching edge filter and, once selected, the optical system including the laser is automatically aligned for optimal throughput and resolution. Four software selectable gratings control the spectral range and resolution from 8000 to 100 cm^{-1} as standard (8000 to 50 cm^{-1} as an option). With a direct-drive rotary encoder, the wavelength reproducibility is ±0.2cm^{-1}

Laser choices for improved fluorescence rejection

As with other Raman systems, we can utilize laser wavelengths of 785nm and up to 1064nm. Selecting optional excitation laser wavelengths is only one of the ways JASCO minimizes fluorescence interference.



Raman spectrum of foreign object (TiO_2) on fluorescent substrate

improved Raman intensity

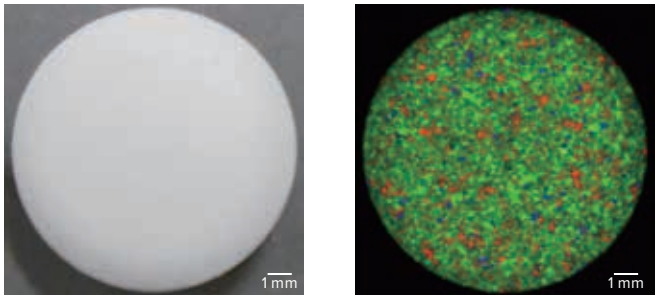
High Speed imaging Raman system - QRI

The QRI consists of high speed / high accuracy stage and high speed data aquisition in CCD detector and it makes it possible to shorten amount of analysis time dramatically.
In addition, EMCCD is an attractive option for high speed weak light measurement .

Quick in wide

QRI is suitable tool to have imaging analysis quickly in wide area sample as like tablet type medicine.

Measurement area : 11 mm angular domain
Measurement points : 32,761 points (181 x 181)
Measurement interval : 60 µm
Exposure time : 10 msec
Laser : 785 nm
Detector : EMCCD
Measurement time: 16 minutes

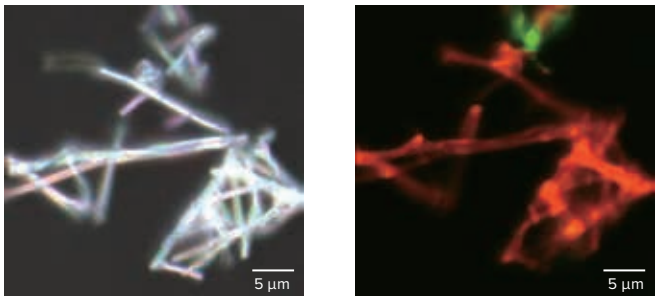


Left: Observation image of tablet
Right: Color-coded image of tablet
(Red: Acetaminophen, Green: Ethenzamide, Blue: Caffeine)

Detail in narrow

In microstructure imaging analysis, the micro interval measurement function of QRI can be optimum solution for detail imaging with higer spatical resolution.

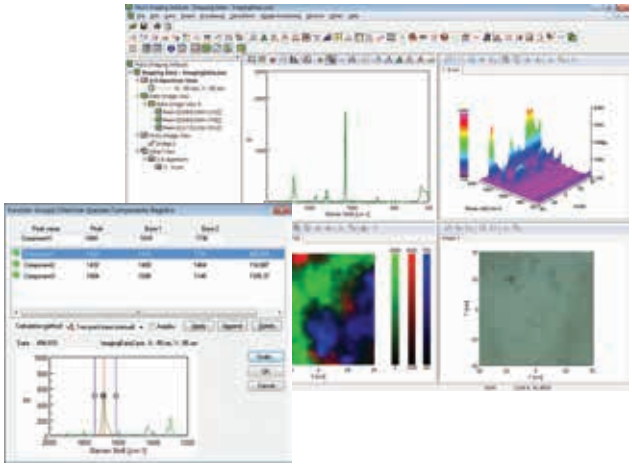
Measurement area : 30 µm angular domain
Measurement points : 22,801 points (151 x 151)
Measurement interval : 0.2 µm
Exposure time : 2 msec
Laser : 532 nm
Detector : EMCCD
Measurement time: 5 minutes

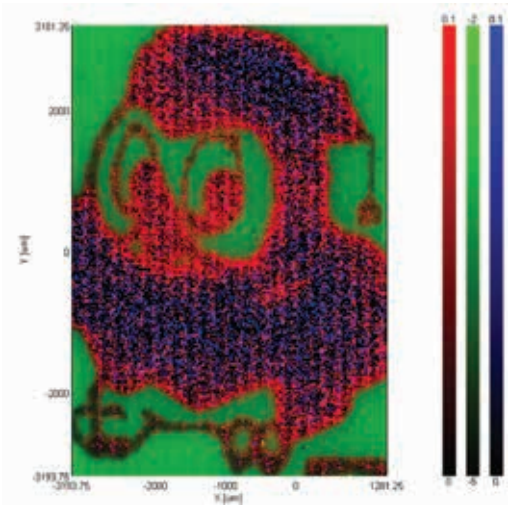


Left: Observation image of Titanium dioxide fiber
Right: Color-coded image of Titanium dioxide fiber
(Red: Anatase-type, Green: Rutile-type)

Chemical Image identification and functional groups registry

To provide faster Raman image processing, the Imaging Analysis software includes a ‘Registry’ of functional groups or other relevant compound information based on peak height or area calculations. After a peak height or area calculation has been developed, it can be saved to the Component Registry for use in future analysis. The registry includes the peak calculation information and a ‘label’ describing the relevant vibrational motion. The registered functional group(s) can be monitored in real time to evaluate the imaging of a sample area.





Creative Color Imaging

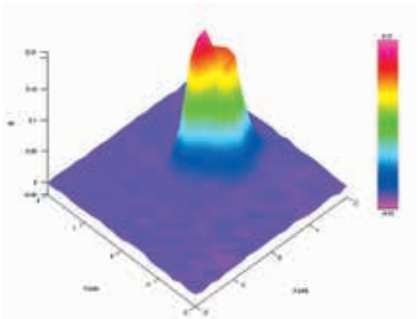
The large amount of spectral data obtained by Raman imaging operations can be overwhelming. Color image maps provide a simplified ‘picture’ of the spectral data, based on the Raman peak intensity for selected functional groups. Image maps are developed from the imaging data by simply clicking on a specified registered calculation, which can be based on the peak height/peak height ratio or the peak area/peak area ratio of selected Raman peaks. Up to 10 functional groups or molecular vibrations can be selected simultaneously to create descriptive image patterns of the sample being analyzed.

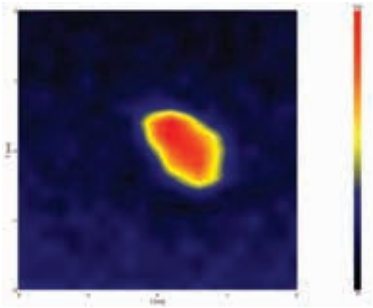
Figure: Use color overlays for up to 10 different bond conformations to map a target material

Color Data Display

There are numerous methods for display of the calculated image maps, including contour, false-color images, line images and 3-D image maps. All of the displayed images can provide fine detail based on the high resolution imaging capability of the NRS-4500 Raman instrument.

Left: 3-D color map of a 4 µm x 4 µm sample with excellent spatial resolution.
Right: 2-D contour map of the same data show the spatial resolution down to about 1 µm



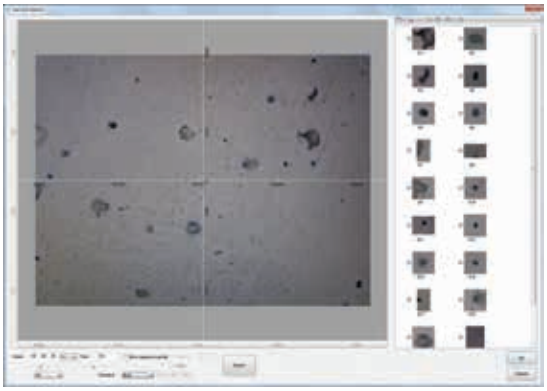


Spectra Manager II

Spectroscopy data analysis

Powerful ‘User Assist’ control

The ‘User Assist’ guide aids the user in setting up the NRS-4500 for sample measurement; a simple sequence takes you through setup and optimization of measurement parameters with helpful advice and tips, such as a warning if you have the laser intensity set too high. When each of the parameters has been set, the NRS-4500 automatically selects the laser and matching edge filter, the grating for the appropriate resolution, focuses on the sample and then the sample measurement is performed.



‘Sample Search’ function

The new ‘Sample Search’ function is used with the automated XYZ stage. A new algorithm developed by JASCO (patent pending) analyzes the microscopic image and automatically selects measurement position(s) based on the size, contrast and/or color of the target material described by the user, then simply click the measurement button to execute spectral measurements of the automatically identified sample positions.

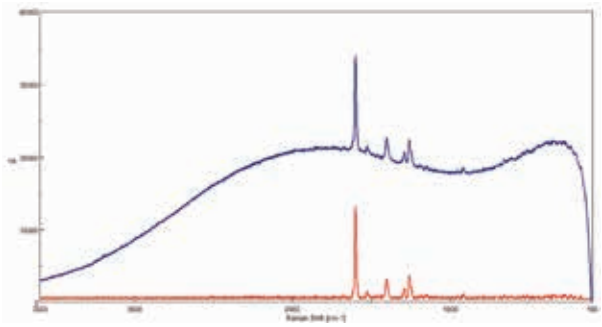
Real time data processing functions

Spectra Manager II includes a wealth of user-selectable options for data analysis; as well as the usual tools like opening single or multiple spectra, zooming, normalization and a range of arithmetic data processing functions. In addition, there are a variety of Raman specific tools and analysis functions which can be applied during Raman spectrum collection, immediately after Raman data collection as a post-collection processing algorithm, or independently using the Micro Imaging Analysis software.

Useful Corrections for Raman spectroscopy

There are a number of different spectral processing functions available for Raman spectra, some of which are required to eliminate interference that may obscure the Raman peaks, others can be used to 'enhance' the Raman spectra, providing data for further calculations. The most common correction functions are listed in order below.

- Cosmic Ray, Fluorescence, Wavenumber and Intensity Corrections.
- Smoothing and Peak find
- Automated operations for routine use
- Expanded PL measurement



Overlay showing data before and after fluorescence rejection

Fluorescence correction

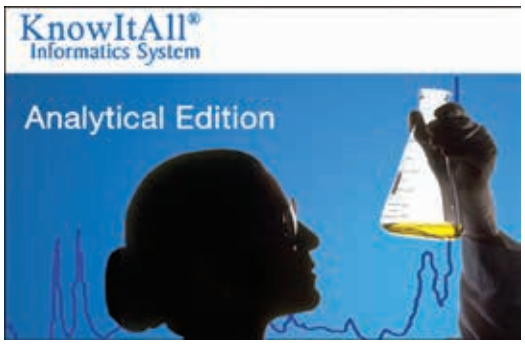
The NRS-4500 has two physical methods of reducing fluorescence - confocal aperture size to limit the amount of the surrounding matrix being measure for a sample, and changing the excitation wavelength to one which minimizes sample fluorescence. A fluorecence correction algorithm* is also included which is highly effective at removing fluorescence after data collection.

*Patent title: Baseline Setting Method (US20100305893 A1, EP2256481A1, EP2256481A3)

The background is completely eliminated without loss of data integrity or change in signal to noise.

KnowItAll® JASCO Edition Informatics for Raman Spectroscopy

The industry standard KnowItAll informatics package with JASCO edition Raman library provides not only an excellent search tool, but also includes a range of analysis, molecule modeling and reporting tools.



Specifications

Model	NRS-4500
Monochromator	
Monochromator	Aberration-corrected, Czerny-Turner mount single monochromator, f = 200 mm
Wavenumber scanning mechanism	High-accuracy direct-drive type (with rotary encoder) Wavenumber repeatability: ± 0.2 cm^{-1}
Wavenumber range	8000 to 100 cm^{-1} (standard) 8000 to 50 cm^{-1} (option, required 532 nm E grade edge filter)
Resolution	2 cm^{-1}/pixel (standard, 100 to 3900 cm^{-1}) 0.7 cm^{-1}/pixel (option, 100 to 1350 cm^{-1}, 532 nm, 2400 gr/mm grating, 1650 pixel CCD)
Grating	Standard: 900 gr/mm Selectable from 2400, 1800, 1200, 600, 300, 150 gr/mm (Max. 4 gratings can be mounted simultaneously)
Optical alignment	Auto-Alignment (Laser light) Raman light path auto alignment function Automatic switching of imaging lens for optimized spectrograph illumination.
Rejection filter switching	Automatic filter switching mechanism (up to 4 filters) as standard
Detector	
Detector	Air-cooled Peltier CCD detector (Max. -60°C), 1650 x 200 pixel, 16 µm x 16 µm, Visible to NIR
Optional Detectors	Visible high-sensitivity type, NIR high-sensitivity type, High-resolution type, InGaAs, EMCCD etc.
Laser	
Laser	Standard: 532 nm, 20 mW Optional laser: 405, 442, 457, 488, 514.5, 532, 633, 785, 1064 nm, etc.
Number of mountable lasers	Maximum 3 lasers (3 internal or 2 internal and 1 external)
Microscope	
Sample observation	High resolution CMOS camera (3 million pixel)
Confocal optical system	Standard
Spatial resolution	XY= 1 µm, Z= 1.5 µm
Objective lens	5×, 20×, 100× objectives (Option: Long working distance type, UV type, NIR type)
Sample stage	Automatic XYZ stage with auto-focus function
Imaging measurement	Standard: Automatic stage imaging with auto focus, XYZ 0.1 µm step, 3D imaging, omni- focus
QRI high speed imaging	Option: High speed data acquisition, High speed imaging measurement
Laser safety Classification and Safety mechanism	Class I Interlock mechanism by software and hardware, Laser optical path protection
Macro measurement	Option, Carousel type macro-measurement unit is available as local upgrade option
Fiber probe	Option (Manual switching)
Other hardware options	Dichroic mirror, Polarized observation, differential interference contrast, transmitted illumination
Software	
Standard program	Microscope spectra measurement, Validation, Spectra analysis, Micro imaging analysis, Wavenumber correction, Sensitivity correction, Fluorescence correction, JASCO canvas
Imaging program	Standard: Sample search function, Multiple focus function, Focused view, 3-D structure observation, Peak calculation, PCA imaging, Refractive index correction
Correction program	Standard, Auto-fluorescence correction, Sensitivity correction, Wavenumber correction (Ne lamp and Std sample are included.)
Optional program	Interval measurement analysis, Thermal change measurement, Stress analysis, Carbon analysis
Others	
Anti-vibration table	Option (air source for anti-vibration table: nitrogen gas or air source, secondary pressure 0.25 - 0.3 MPa)
Dimension and weight	Main Unit 550 (W) × 610 (D) × 800 (H) mm, approx. 80 kg - Power Supply : 220 (W) × 320 (D) × 70 (H) mm, approx. 3 kg AC 100 V ±10 V, AC 200 V ±20 V, 200VA

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For more information, please contact :

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