ONDAX

THz-Raman®

THz-Raman® Spectroscopy Microscope Systems

THz-Raman® Microscope Platform

(shown with Leica DM 2700 M)

Features

- Fast collection of THz-Raman® spectra from 5cm^{-1} to >3000cm^{-1} (150GHz to 90THz)
- Simultaneous Stokes and anti-Stokes signals improve SNR while providing inherent calibration reference
- Available as add-on to an existing microscope or Raman system, or as a complete custom-configured system
- Simple optical in/out switch removes system from optical path when not in use
- Fiber coupling enables easy interface to a wide range of spectrometers
- Available at 532nm, 785nm, 850nm, 976nm and 1064nm excitation wavelengths
- Compatible with Leica, Zeiss, Nikon and Olympus microscopes

Applications

- Polymorph identification and analysis
- Trace detection and source attribution of explosives/hazmat/drugs
- Crystallization and reaction monitoring
- Structural studies of nano- and bio- materials, photovoltaics, and semiconductors
- Forensics, archeology, mineralogy

THz-Raman® – The "Second Fingerprint" of Raman

Ondax's patented[1] **THz-Raman® Spectroscopy Systems** extend the range of traditional Raman spectroscopy into the terahertz/low-frequency regime, exploring the same range of energy transitions as terahertz spectroscopy – without limiting the ability to measure the fingerprint region. This region reveals a new "Structural Fingerprint" to complement the traditional "Chemical Fingerprint" of Raman, enabling **simultaneous analysis of both molecular structure and chemical composition in one instrument** for advanced materials characterization.

See What You've Been Missing – More Data, Better Sensitivity & Reliability

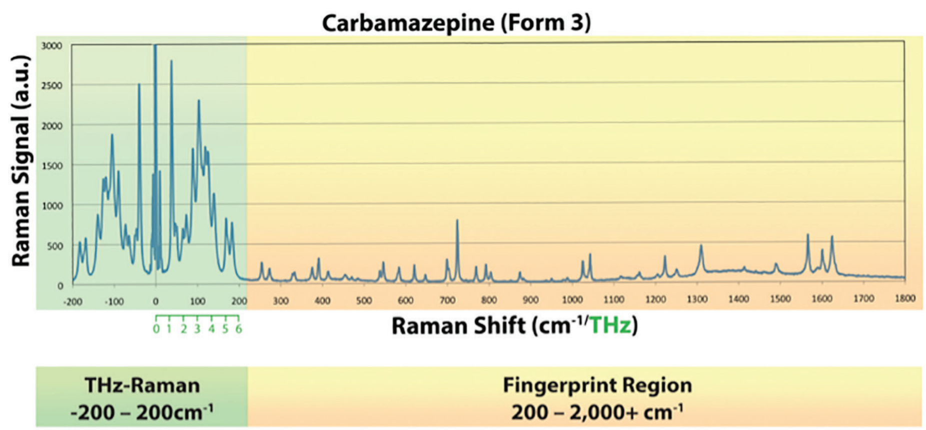
Clear real-time differentiation of structural attributes of the material enables clear identification and analysis of polymorphs, raw material sources, defects & contamination, crystal formation, phase monitoring and synthesis methods.

One Sample, One System, One Answer

Real-time, simultaneous measurement of both composition and structural analysis eliminates the need for multiple samples and instruments, lowering capital, training and maintenance costs.

Benefits

- **Both chemical composition + molecular structure from one Raman measurement**
- **Real-time structural monitoring + chemical analysis**
- **Higher SNR with inherent calibration reference**
- **Faster, more comprehensive and reliable measurements**
- **Compact, easy to use, and adaptable to existing Raman systems**



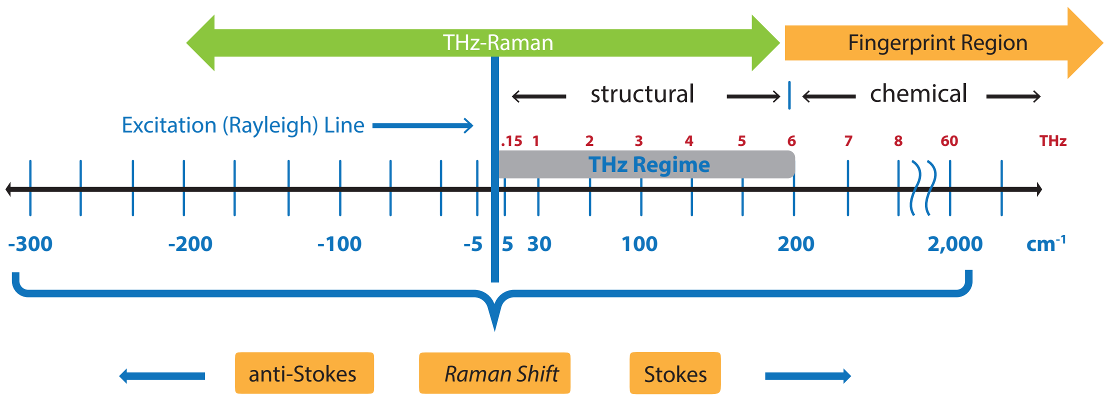
Full Raman spectrum of the pharmaceutical Carbamazepine showing both the THz-Raman "Structural Fingerprint" and traditional "Chemical Fingerprint" regions. Note higher intensity and symmetry of THz-Raman signals.

[1] Patents #8,184,285 and 7,986,407

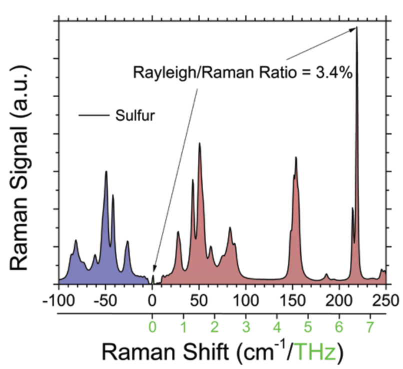
THz-Raman®

THz Raman: Covering low frequencies, anti-Stokes, plus the traditional fingerprint region!

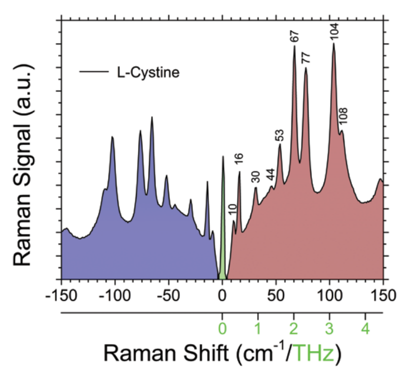
THz-Raman® extends the reach of Raman systems into the low-frequency, (low wavenumber) spectral regime where important structural details can be discerned, including polymorphs, isomers, cocrystals, and lattice/phonon modes. The high optical density, ultra-narrowband, high-throughput design virtually eliminates the Rayleigh signal while enabling rapid collection of both Stokes and anti-Stokes signals from $\pm$ 5cm^{-1} to >3,000 cm^{-1}.



The examples below show spectra in the ~5-200cm^{-1}, or 150GHz-6THz regimes, using two different excitation wavelengths. For strong Raman scatterers such as Sulfur (left), the ratio of Rayleigh peak to signal peak is exceptionally low. The L-Cystine spectrum (right) shows how narrow the filters are by producing clearly differentiated signals down to <10cm^{-1}. Both examples also demonstrate the simultaneous capture of symmetrical anti-Stokes signals, which can be used to confirm peak locations while providing an inherent calibration reference (the Rayleigh line is exactly between the symmetrical peaks).

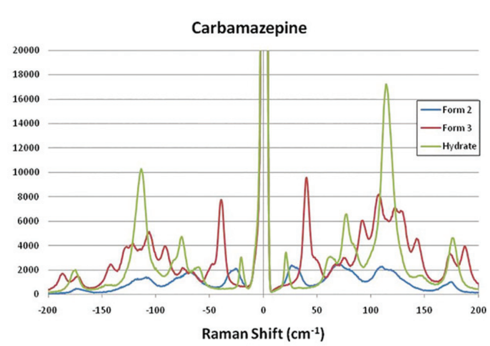


Sulfur spectrum taken at 785nm

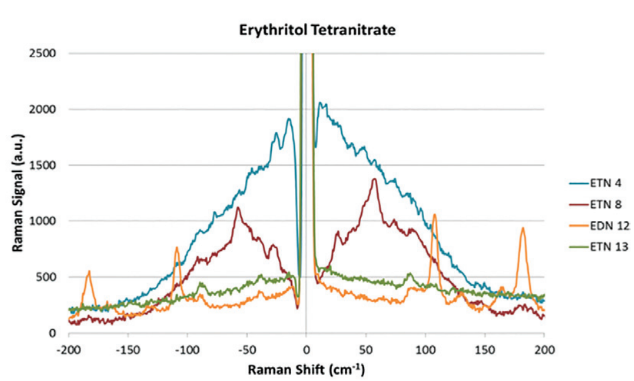


L-Cystine spectrum taken at 532nm

The clean, distinct signals from the THz-Raman® systems provide clear differentiation between phases, crystals and polymorphs, capturing molecular structural information via their vibrational/phonon modes. Carbamazepine (left) exhibits clearly unique low-frequency spectra for all polymorphic forms. THz-Raman signals are typically much stronger than fingerprint signals, and are also affected by synthesis methods: various formulations of the home-made explosive ETN show distinct differences and can used in source attribution (right).



Polymorphic forms and hydrates of pharmaceuticals can easily be distinguished in raw materials analysis, finished goods, process monitoring, and QC applications.



Multiple samples of ETN (Erythritol Tetranitrate), representing systematic variations of ingredients and preparation routes, show distinctive differences.

THz-Raman® System Specifications:

Parameter	Units	Specification			
Wavelength[1]	nm	532	785/850	976	1064
Power at sample port (min)	mW	50 to 250[2]	100	300	200 to 450[2]
Physical Dimensions (W x L x H)	in	10″ x 15″ x 3.25″			

[1] Also available with fiber-coupled input for 488nm, 514nm, and 633nm
[2] Specify power level at time of order

Spectrometer[3]:

	Fixed Grating Spectrometer	Tunable Grating Spectrometer
Spectral Range (typical)	-200cm^{-1} to +2200cm^{-1}	400-1100 nm (w/Si Detector)
Spectral Resolution	2.5cm^{-1} to 4cm^{-1}	0.7cm^{-1} or greater
Computer Interface	USB	USB

[3] Spectrometer specifications depend on manufacturer and options ordered

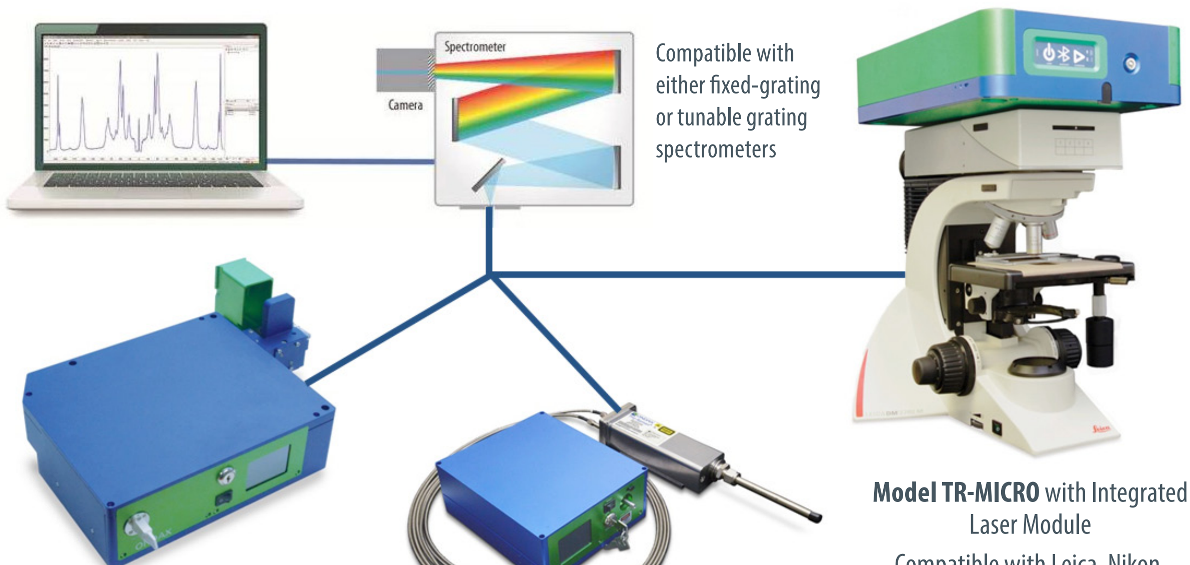
System Description and Configurations:

All **THz-Raman® Series** platforms are ultra-compact and simple to connect via fiber to almost any spectrometer or Raman system. Our patented **SureBlock™** ultra-narrow-band Volume Holographic Grating (VHG) filters precisely block ***only*** the Rayleigh excitation with >OD8 attenuation, enabling simultaneous capture of both Stokes and anti-Stokes signals. A high-power, wavelength-stabilized, ASE-free single-frequency laser source is precisely matched to the filters to assure maximum throughput and exceptional attenuation of the excitation source.

The **TR-MICRO** mounts directly to a broad range of popular microscope platforms and micro-Raman systems, and can be easily switched in and out of the optical path. The system includes an Ondax SureLock™ 785nm, 850nm, 976nm or 1064nm laser source, notch filters, and optional circular polarization (linear polarization is standard). A 532nm excitation source or a sample imaging camera are also available upon request.

The new **TR-PROBE** is a compact, robust THz-Raman® probe that enables in-situ reaction or process monitoring. The TR-PROBE can be configured with a variety of immersion or contact probe tips, a convenient vial holder, tablet holder, or a steerable collimated beam (see sample options on previous page).

The **XLF-CLM** and **XLF-C** are configured for Benchtop use and offers an optional vial/cuvette sample holder for fast, easy measurements. The system also comes with a standard cage mounting plate (centered on the collimated output beam) to allow for customized collection optics or easy integration into a customized system. The XLF-CLM includes a SureLock™ 785nm, 850nm, 976nm or 1064nm laser source, notch filters, and optional circular polarization. The XLF-C has a fiber-coupled input for DPSS and gas laser excitation wavelengths.



Model TR-BENCH with Integrated Laser Module and Sample Vial/Cuvette Holder

Model TR-PROBE with fiber-coupled laser source and interchangeable probe tips and sample holders

Model TR-MICRO with Integrated Laser Module

Compatible with Leica, Nikon, Olympus and Zeiss microscopes (shown mounted on Leica DM 2700 M)

THz-Raman®

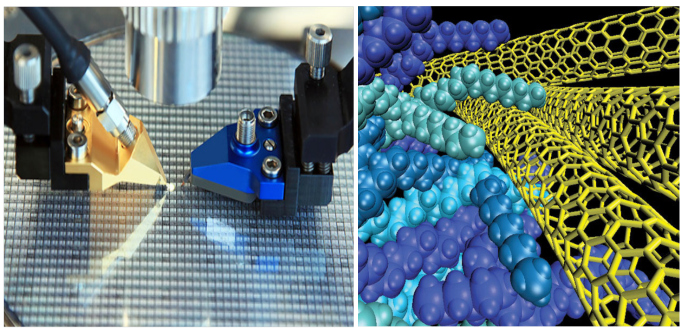
Additional Applications

Pharmaceutical Applications

Key challenges for the pharmaceutical industry include polymorph identification, reaction monitoring, raw material quality control, and counterfeit detection. THz-Raman® reveals "structural fingerprints" that can rapidly differentiate polymorphs, isomers, co-crystals, and other structural variations of substances and compounds.

Explosives Detection, Forensics and Source Attribution

THz-Raman® goes beyond chemical detection to reveal a "structural fingerprint" that can be attributed to specific ingredients, methods of manufacture, and storage/handling of many popular home-made explosive (HME) materials, revealing clues about how and where they were formulated.



Semiconctor and Nanomaterials

Graphene and carbon nanotubes are just two of the many nanomaterials that exhibit strong low-frequency signals. For Graphene, THz-Raman® analysis can determine the number of monolayers, and for carbon nanotubes, the diameter of the structure. Differences in structural characteristics and defects in crystals can also be detected.

Crystallization and Reaction Monitoring

Low-frequency THz-Raman® signals undergo clear, rapid shifts corresponding to changes in molecular structure, enabling highly sensitive, real-time monitoring of crystal form, phase, or structural transformations.

Industrial and Petrochemical

THz-Raman® delivers additional sensitivity and information about molecular structure to control processes, improve yields, and monitor crystallization or structural transformation during formulation of chemicals and polymers

Gas Sensing

Rotational modes of gases such as Oxygen provide signal intensities up to 10x those in the fingerprint region. Stokes/anti-Stokes ratios can also be used for remote sensing of temperatures in gases, plasmas, liquids and solids.

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For more information about Ondax products and the name of a local representative or distributor, visit www.ondax.com,email sales@ondax.com, or call (626) 357-9600. Specification Subject to change without notice. Each purchased laser is provided with test data. Please refer to this data before using the laser.