



NANONICS IMAGING Ltd.



*Trailblazing
Results in
AFM-Raman-TERS*

SpectraView™ Series

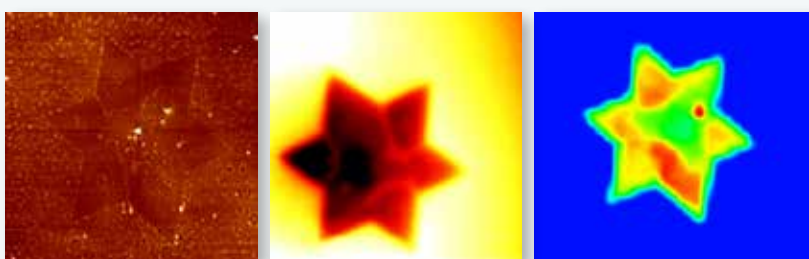
AFM-Raman-TERS

One System - All Configurations, All Modes of Operation

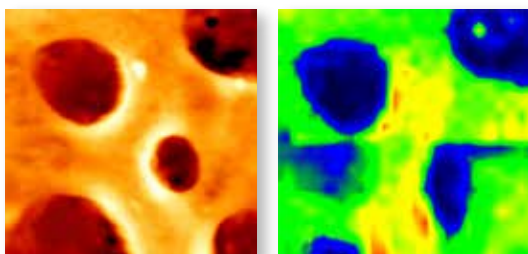
AFM & Raman

Atomic Force Microscopy (AFM) provides a variety of nanometric characterizations such as topography, conductivity, and thermal measurements. While very effective at measuring certain properties, AFM can not identify the chemical composition of a given material.

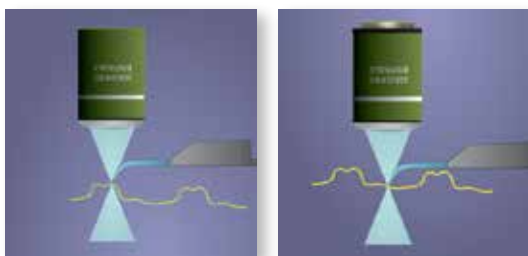
Raman spectroscopy, however, has emerged as a critical technique in the field of chemical characterization, accurately identifying and classifying materials in a number of diverse fields and industries such as: material science, chemistry, biophysics, semiconductors, and many more.



WS₂MoS₂ heterostructure characterized with colocalized AFM (left) KPFM (center) and Raman (right)



Colocalized AFM (L) and Raman (R) images of polymer blend



The integration of AFM and Raman addresses a known challenge in far-field Raman microscopy: maintaining uniform focus on samples with variant morphology. With on-line AFM, the sample is brought to the same focal point at every pixel with nanoscale precision, generating a true Raman image with no out-of-focus artifacts.

Combining AFM with Raman

Harnessing the power of these two techniques enables a synergistic and holistic analysis of a given material. As early as 2001, Nanonics Imaging exhibited the foresight to combine the advantages of AFM and Raman by providing an integrated platform. The joint AFM-Raman system allows for the strength and versatility of all modes of AFM (including mechanical, thermal, SECM, and electrical) combined with the chemical characterization of Raman.

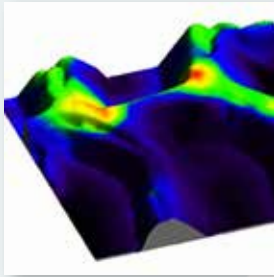
Nearly two decades later, Nanonics Imaging continues to be at the vanguard of integrated optical AFM-Raman systems, providing solutions in the most challenging areas of research and in the most innovative fields in applied sciences:

- **Graphene and 2D materials**
- **Carbon Nanotubes**
- **Semiconductor metrology**
- **Biological samples**

AFM – Raman

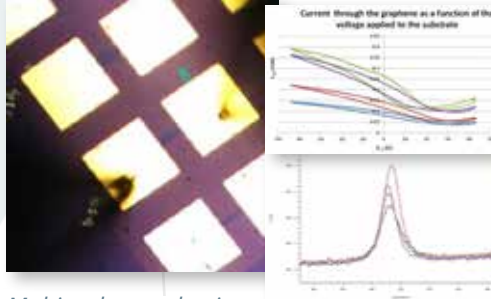
Proven Nanonics Results Across the Spectrum

BioAFM Raman



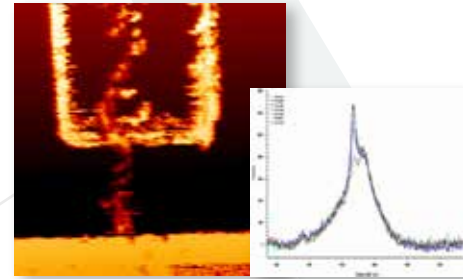
AFM-Raman collage of lignin distribution on wood cell walls

Multiprobe CAFM Raman



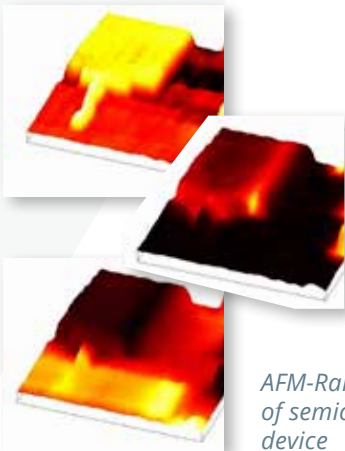
Multiprobe conductive AFM characterization with on-line monitoring of current and the 2D Raman scattering band of Graphene

CAFM Raman



Conductive AFM imaging with on-line monitoring of the Raman scattering G band of conducting SW CNTs

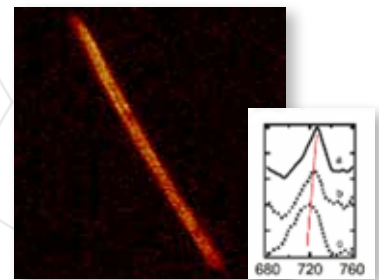
AFM Raman



AFM-Raman imaging of semiconductor device

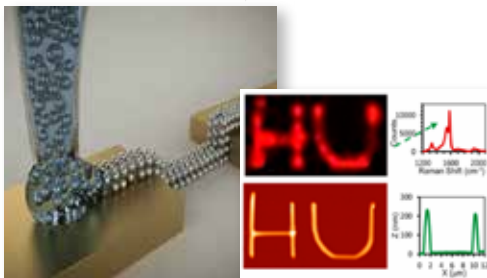
The characterization power of SPM combined with Raman offers a broad nanoscale characterization combined with strong material confirmation, across a wide spectrum of applications.

SThM Raman



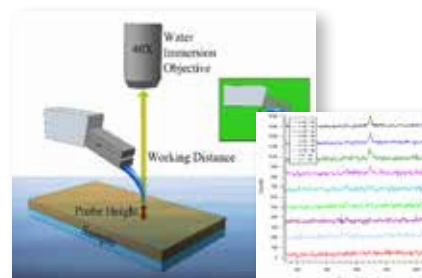
Scanning thermal conductivity image (SThM) of GaN nanowire with on-line Raman in vacuum environment (ACS Nano, Vol. 5, No. 1, 2011)

Nanolithography Raman



Fountain pen nanolithography demonstrating controlled deposition of single wall CNTs with Raman determination of the CNT alignment (Nano Lett. 2016, 16, 1517-1522)

SECM Raman



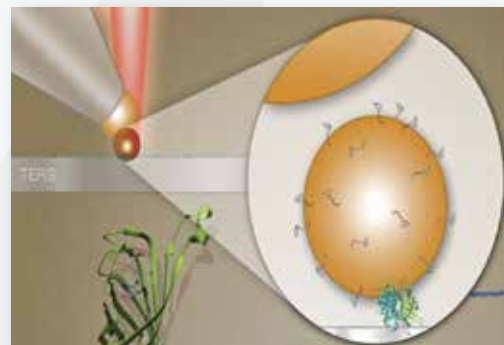
SECM with on-line Raman monitoring of Cu etching

See more publications at: <http://www.nanonics.co.il/publications-by-our-users>

TERS – Achieving the Raman Potential

Tip Enhanced Raman Spectroscopy (TERS) has yielded exciting results, overcoming a previously insurmountable obstacle in Raman spectroscopy. With TERS, the AFM-Raman integration can reach its full potential, enabling both stronger signal and nanometric sub-diffraction Raman resolution. Nanonics Imaging AFM-Raman systems are uniquely designed to achieve the most challenging TERS measurements with the highest resolution, with repeatable and user-friendly operation.

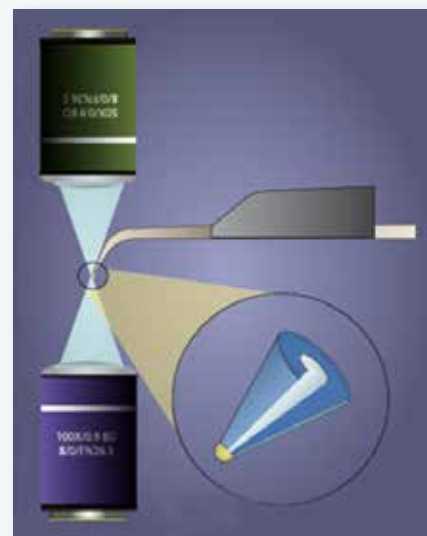
This sub-diffraction resolution is increasingly important in analyzing today's newest materials on the nanoscale.



Cover paper in *The Analyst* (vol. 138(11), 2013, 3150-3157) showing TERS measurements on protein ligand bindings

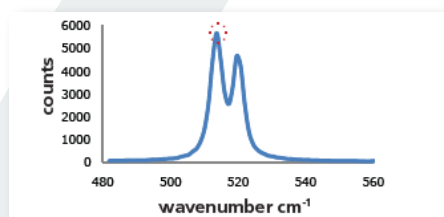
User-Friendly & Reliable TERS Operation

- TERS Hot-Spot "Lock-In": quick and easy finding of the TERS hot-spot
- Accurate TERS measurements on a variety of samples
- Highest quality TERS probes
- All TERS configuration possible with one system:
 - Reflection
 - Transmission
 - Side-Illumination
- Proven TERS operation on the widest spectrum of samples

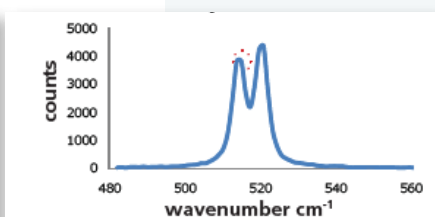


All TERS configurations are available with the same AFM Raman system

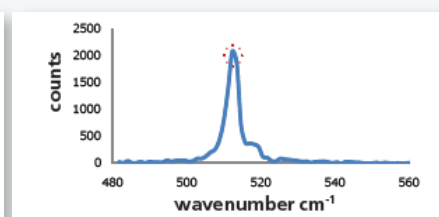
Tip In



Tip Out



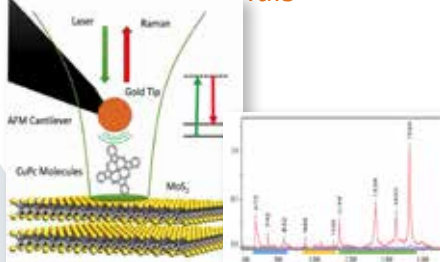
Difference



3 point TERS measurement on a sample comprised of a thin layer of strained Si on bulk Si. Automated 3 point Raman measurements allow for mapping both the far-field and TERS effect at each point, as well as their difference. The difference map shows the pure TERS effect without any contribution of the far-field background

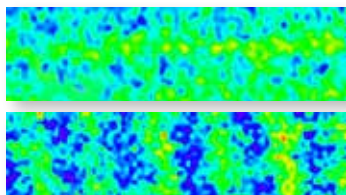
Real TERS on Real Samples

TERS of 2D Materials



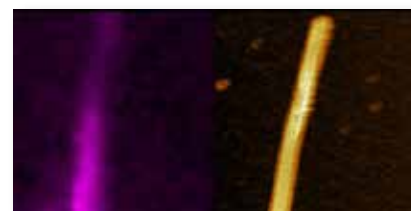
TERS of CuPc molecules on MoS₂ substrate (*Journal of Selected Topics in Quantum Electronics*, vol. 23, no. 2, 2017)

TERS of Strained Si



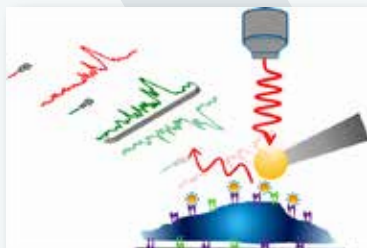
TERS of strained SiGe pattern on bulk Si. The thin SiGe lines are not visible in the far-field but are clearly seen with TERS (bottom half), demonstrating features down to 40 nm. (*Proc. of SPIE* vol. 9424)

TERS of Si Nanowire



TERS of 50 nm Si Nanowire (*arXiv preprint arXiv:1705.08622* (2017))

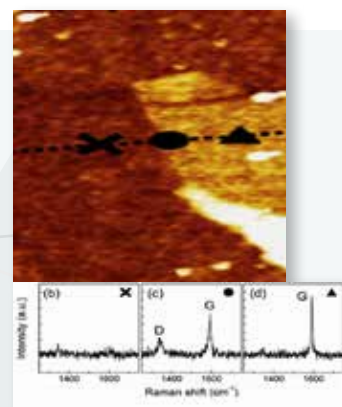
TERS of Cells



TERS for selective detection of RGD-Integrin binding in cancer cells (*Anal. Chem* 2016, 88, 6547-6553)

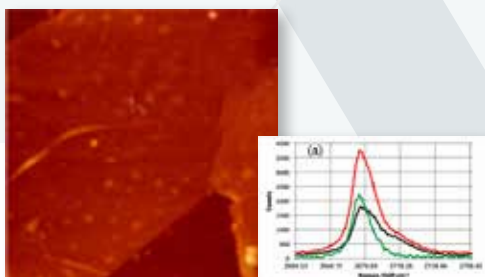
Proven TERS results on a variety of samples, with nearly 2 decades of illustrious academic publications

TERS of Graphene



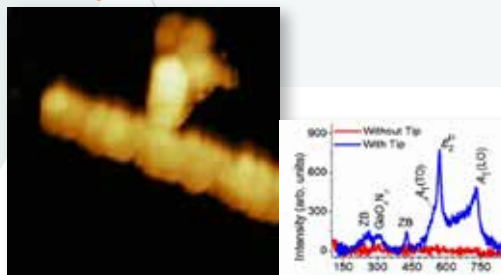
D-band monitoring of the doping distribution in mono-layer Graphene flake on SiO₂/Si substrate by TERS (*Carbon* 111, 2017, 67-73)

TERS of Single Layer Graphene



Difference TERS for identifying single layer Graphene

TERS of GaN Nanowire



Study of impurities in single GaN nanowires by TERS (*Appl. Phys. Lett.* 107, 123108 (2015))

Key Features

The SpectraView is designed to generate exceptional results from both the AFM and the on-line Raman. Featuring VISTA (Vivid Imaging Soft Touch AFM), the system enables AFM imaging with the highest resolution. The SpectraView is the only AFM designed for natural Raman integration, not requiring any modification to the Raman optical path.

Best Optical Integration

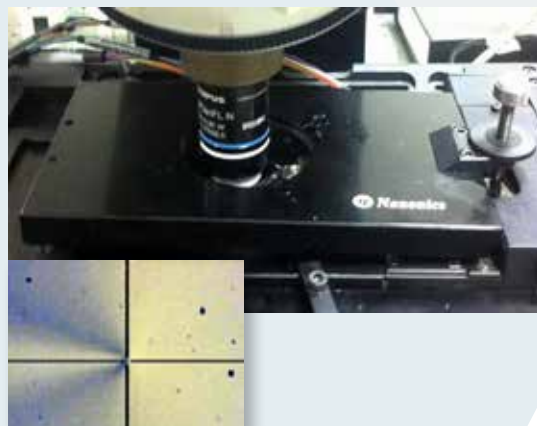
- True optical compatibility:
 - Operate with high NA objectives
 - Integrate with water and oil immersion objectives
- All optical configurations available in one configuration:
 - True upright integration
 - Side
 - Inverted

AFM Designed for Advanced Raman Integration

- Tuning fork feedback without any optical interference with Raman laser
- Advanced SPM measurements with on-line Raman
- Ultra large Z range
- Manipulation and lithography with online Raman
- TERS operation in a wide variety of applications
- VISTA for AFM imaging of the most challenging samples in air and liquid

Most Versatile System

- Scanning options: tip and sample scanning in one scanning head
- Optical integration options: Sit on microscope, separate, upright, inverted, side, or dual
- Large sample stage (optional)
- Compatible in a range of environmental conditions:
 - Vacuum
 - Liquid
 - Low temperature
 - SECM



Nanonics AFM-Raman system enables integration of water immersion objective from above for high Raman collection efficiency in liquid with on-line AFM.

Inset: Unobstructed image from above of sample and probe in liquid environment, highlighting Nanonics natural top-down integrations. The Nanonics system employs glass cantilevered AFM and TERS probes, providing for complete optical integration.



Nanonics single probe system allowing for top-side-bottom illumination in one setup for all Raman and TERS configurations

Configurations

Customize for YOUR research specifications and needs

Probe Quantity

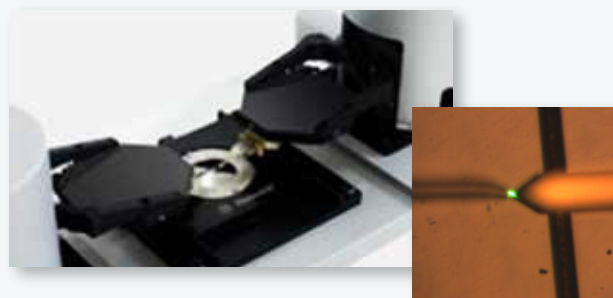
Single Probe SpectraView



- Developed for ease-of-use and flexibility for easy integration with any Raman
- Compact and flat design

Multi-Probe SpectraView

(Up to 4 SPM probes)



- Simultaneous probing of multiple measurements of your sample
- Probe station for conductive AFM measurements with on-line Raman
- On-line manipulation and characterization

Integration Options

Complete AFM-Raman-TERS Package

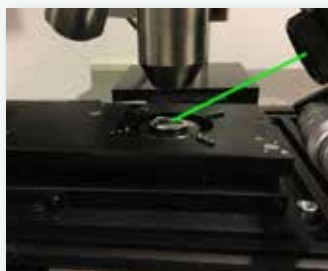
Nanonics offers a complete turn-key package – with complete AFM-Raman-TERS capability.

Upgrade Package

Already have a spectrometer?

Nanonics offers the broadest selection of hardware and software integration packages – compatible with all of the leading Raman providers

Multiple Configurations



Direct Integration on the stage of any Raman system



Integration with an additional optical microscope (up-right, inverted, dual)



Upgrade your own monochromator & CCD



Low temperature SPM system integrated with Raman microscope

*Contact a Nanonics
specialist today!*

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