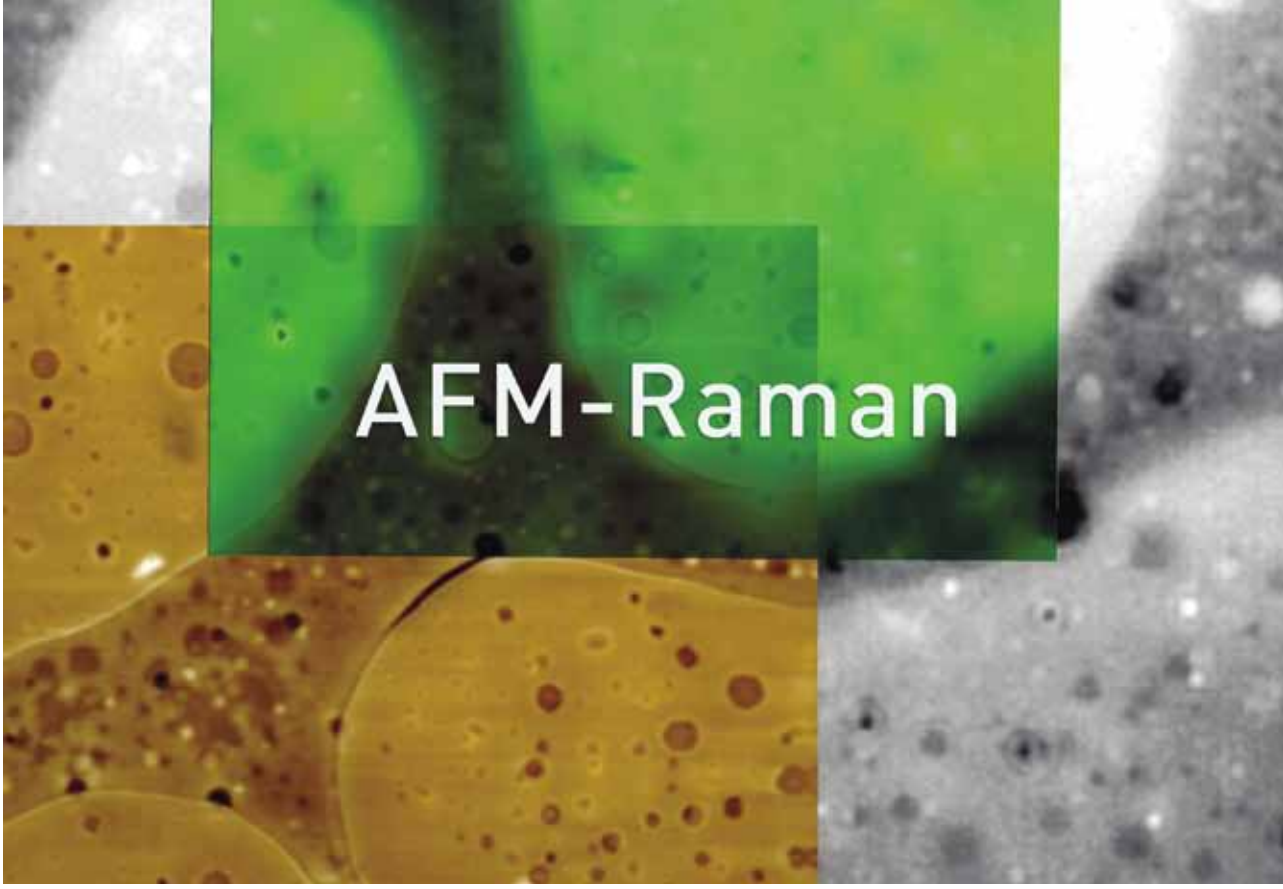
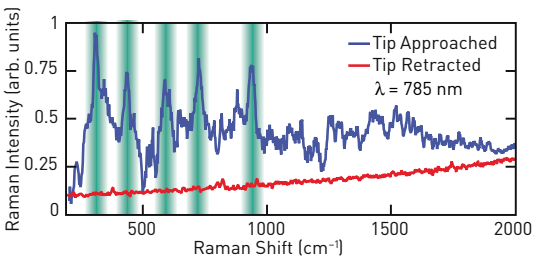




Catalyst-IRIS and Innova-IRIS AFMs

Seamless Integration of Atomic Force Microscopy and Raman Spectroscopy

- Easy-to-Use AFMs for Spectroscopy in Materials and Life Sciences
- Highest Performance, Most Complete AFM Capabilities
- TERS-Ready AFM-Raman System Integration
- True Nanoscale Spectroscopy Targeted to Your Application

BRUKER

think forward

Catalyst-IRIS and Innova-IRIS AFMs

Combine AFM and Spectroscopy without Compromise

Many of the recent advances in research are coming from the effective combination of multiple advanced techniques. Unfortunately, configuring interdependent equipment and correctly integrating the data can often be expensive, cumbersome and error-prone. Working with the leading Raman spectroscopy suppliers to tackle these challenges, we have developed seamlessly integrated AFM-Raman systems. The Bruker Integrated AFM-Raman Imaging System (IRIS) Module enables researchers to easily and affordably combine chemical or crystallographic information from Raman spectroscopy at high spatial and spectral resolution, with the most advanced nanoscale mechanical, electrical, and thermal AFM characterization.

EASIEST TO USE AFMS FOR SPECTROSCOPY IN MATERIALS AND LIFE SCIENCES

- ScanAsyst™ Imaging Mode revolutionizes bio-AFM and makes in situ liquid imaging dramatically easier, while retaining best force control for the most delicate samples
- Ergonomic hardware and intuitive software deliver research quality results instantly
- Experiment selector distills decades of knowledge into preconfigured settings, mitigating the complexity of traditional TERS setups

AFM-spectrometer integration example. This system leverages the unparalleled optical access of the BioScope to allow the most sensitive Raman detection. Courtesy of Aleksander Balter, Physics Department, UMK, Toruń, Poland.

HIGHEST PERFORMANCE, MOST COMPLETE AFM CAPABILITIES IN THE WORLD

- A fully featured suite of advanced electrical, mechanical, and thermal AFM capabilities enables collection of complete sample information
- System design for noise and drift elimination ensures highest resolution performance, revealing previously unseen detail
- Unique open-controller platform provides superior flexibility for custom experiments

BEST TERS-READY AFM-RAMAN SYSTEM INTEGRATION AVAILABLE

- Top-to-bottom integration design minimizes impact of AFM on Raman measurements and vice versa
- Modular system integration interface provides tools for most effective setup optimization, real-time control, and data acquisition
- Open and flexible system architecture offers the widest compatibility with leading Raman microscopy suppliers

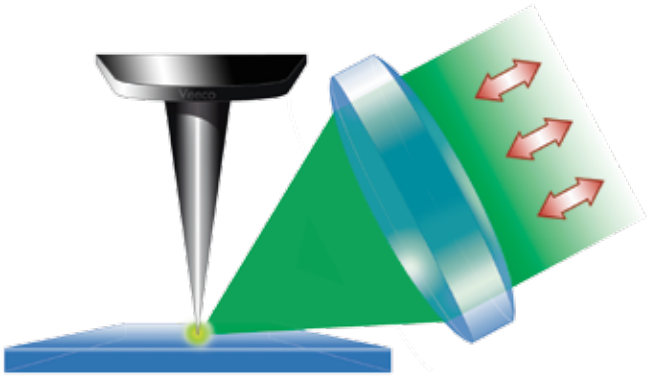
TRUE NANOSCALE SPECTROSCOPY TARGETED TO YOUR APPLICATION

- AFM/IOM integration with MIRO benefits Raman microscopy and all other complementary optical techniques, such as fluorescence
- IRIS Module design and available accessories tailor system to targeted applications, ensuring the most complete and productive solution
- Optimized optical access enables capture of weak Raman signals for nanoscale chemical mapping, even on challenging samples

ONE SYSTEM, MANY OPTIONS

The IRIS Module supports both Bruker's Innova and BioScope™ Catalyst™ AFM Systems, which have a published record of highest performance, lowest noise, and best force control in their classes. These systems preserve the probe tips and display the lowest drift, guaranteeing that alignment is preserved even over the optical integration times necessary to interrogate weak Raman scatterers. To create an AFM-Raman system perfectly tailored to your application, simply add a HORIBA Scientific, Renishaw, or Princeton Instruments Raman microscope. For life sciences applications, add an inverted light microscope from Zeiss, Leica, Olympus or Nikon. You will be surprised at how easy the IRIS Module makes it to perform the most sensitive, high-resolution, AFM-Raman studies.

INTEGRATED SYSTEM FOR OPAQUE SAMPLE RESEARCH



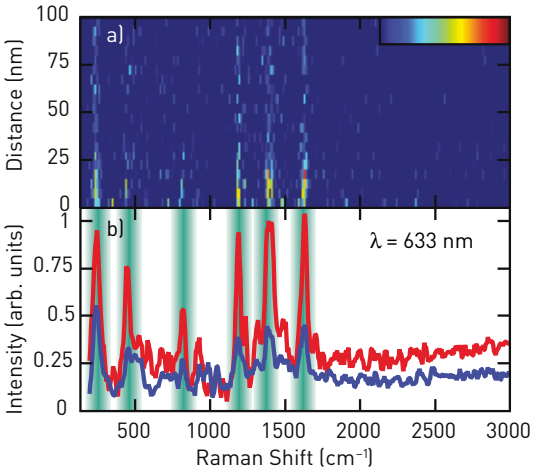
Schematic view of optical configuration for TERS on opaque samples. Only the Innova-IRIS allows for the implementation of the ideal optical path free of obstructions and without compromising AFM capabilities.

To combine AFM and Raman spectroscopy techniques successfully for use on opaque samples, or to be able to explore the full capabilities of tip-enhanced Raman spectroscopy (TERS), the AFM platform must fulfill a set of fundamental requirements. First, optical access to the tip-sample junction is needed, maximizing light capture while fully accounting for tip-shadowing and polarization effects. The publication record proves that these critical requirements are best addressed with high numerical aperture and off-axis access from the front side of the probe. Second, the optical "hot-spot" alignment must be retained during scanning (i.e., a stationary tip system).

INNOVA-IRIS SYSTEM FOR MATERIAL SCIENCES

Innova is designed from the ground up to fulfill all of these requirements. Its unique open head geometry provides exceptional easy setup and use, even with the full AFM-Raman integration in place. The system also exhibits the stringent performance required for both advanced atomic force microscopy and Raman spectroscopy, while preserving the tip to enable tip-scattering optical techniques. Modular integration software ideally coordinates the actions of the Innova AFM and spectrometer to allow combined experiments without technique interference. The result is a uniquely capable instrument for applications requiring the highest sensitivity.

Superior integration offers the off-axis access required for Raman (red objective) while the tip-viewing optics are in place.



TERS detection of Malachite Green monolayer, enabled by the Bruker Innova-IRIS with Princeton Instruments LS-785 using lambda=633nm illumination. (a) Spectra as function of tip-sample distance. (b) Average of the approached (red) spectra clearly showing enhancement of the characteristic Malachite Green Raman modes compared to retracted spectra (blue). Courtesy of S. Berweger and M. B. Raschke (University of Washington, Seattle).

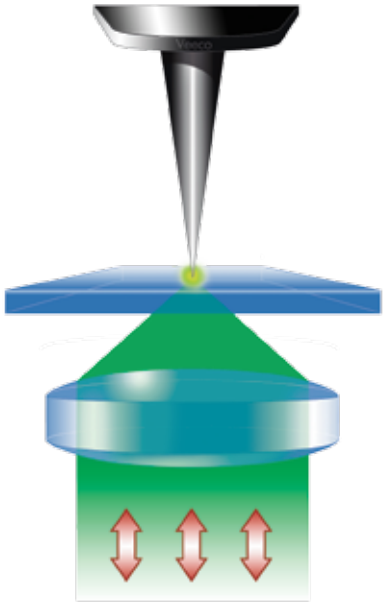
At the same time, the hardware and software of the Innova-IRIS System preserve the full power and flexibility of both AFM and spectrometer, providing the most complete characterization possible. Combining Raman spectroscopy with AFM-based nanoscale electrical, mechanical, thermal characterization on the same sample is fast, simple, and effective.

INTEGRATED SYSTEM FOR TRANSPARENT SAMPLE INVESTIGATION

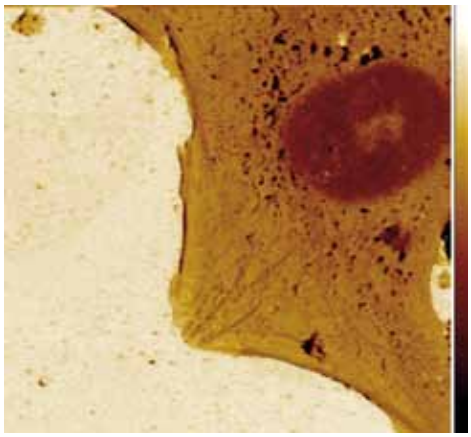
The creation of integrated AFM and Raman capabilities for transparent samples begins with the need for the AFM to function as integral part of an inverted optical microscope. Such a customized architecture can open the door to the full power of optical spectroscopy and imaging methods provided by the light microscope. Enabling TERS adds the fundamental requirement of retaining tip-sample alignment, thus scanning the sample. Finally, a well-designed system addresses compatibility with samples and their carriers.

BIOSCOPE CATALYST-IRIS SYSTEM FOR LIFE SCIENCES

The innovative open head of the BioScope Catalyst allows unmatched and virtually unrestricted optical and physical access from below and above the sample, maximizing objective and condenser choices. Designed from inception for operation on top of an inverted microscope, the Catalyst AFM exhibits the force control and stability required to preserve tip and alignment in biological, combined-setup environments. The system is built around a sample scanning geometry to retain alignment between tip and optics during imaging, which provides uncompromised performance for advanced tip-enhanced spectroscopies.



Schematic view of optical configuration for TERS on transparent samples, highlighting the need for high numerical aperture, bottom optical access. No other AFM comes close to the optical access provided by the Catalyst-IRIS.



In situ mechanical map of fixed MDCK cell in PBS buffer enabled by ScanAsyst and PF QNM on Catalyst-IRIS. The log DMT modulus channel directly reveals nanoscale differences in mechanical properties of underlying organeles and cell cytoskeleton (e.g., actin fibers on cell edges) with the same resolution as the concurrently acquired topography channel. Courtesy of A. Berquandt.

In addition, the Catalyst-IRIS System supports a number of accessories to provide the complete solution for your biological samples:

- The Perfusing Stage Incubator enables researchers to maintain ideal cell culture conditions for long-duration live cell studies,
- Proprietary MIRO (Microscope Image Registration and Overlay) Software utilizes optical images to guide AFM imaging and force measurements to targeted regions of interest, accurately registering optical and AFM images in real time, even when there are no obvious common features,
- The exclusive ScanAsyst Imaging Mode automatically adjusts scan parameters, such as setpoint, feedback gains, and scan rate, to make Bio-AFM imaging dramatically easier, even in fluids.

Top cover image: Overlaid AFM ScanAsyst image (brown), Raman chemical map (green), and optical image (grey) of a polymer blend containing polystyrene and low-density polyethylene. Enabled by an integrated Catalyst-IRIS and Horiba Scientific XploRA-INV system. Using MIRO to overlay the complementary data, combining the chemical map generated by Raman microscopy with the nanoscale AFM topographic and nanomechanical information obtained with ScanAsyst and PF QNM. Courtesy of J. Kindt (Bruker) and J. Schreiber (HORIBA).
Bottom-left: First near infrared TERS study. Enabled by Innova-IRIS with Princeton Instruments LS-785 spectrometer. Laser dye (IR-125), excited at λ = 785nm. Demonstrates identification of molecular adsorbate through TERS, not detected with far field illumination alone. Courtesy of S. Berweger and M. B. Raschke (University of Washington, Seattle).

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