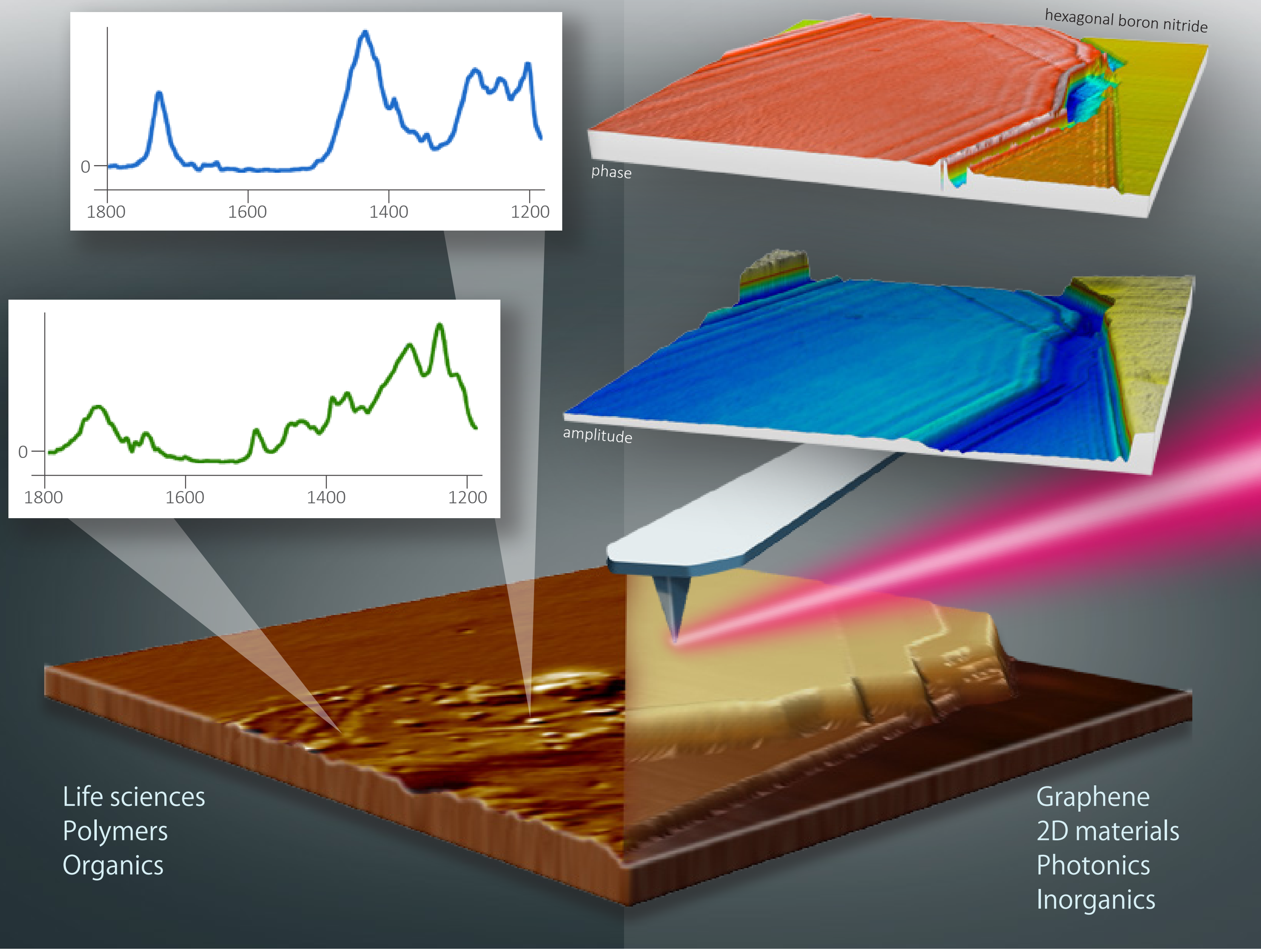
nanoIR2-s™

The Only Nanoscale IR Spectroscopy and Imaging Platform with both:

AFM-IR + s-SNOM

AFM-IR
True model-free IR absorption spectroscopy

s-SNOM
Sub-20 nm complex optical property imaging



ANASYS INSTRUMENTS
The nanoscale analysis company

From the world leader in nanoscale IR spectroscopy

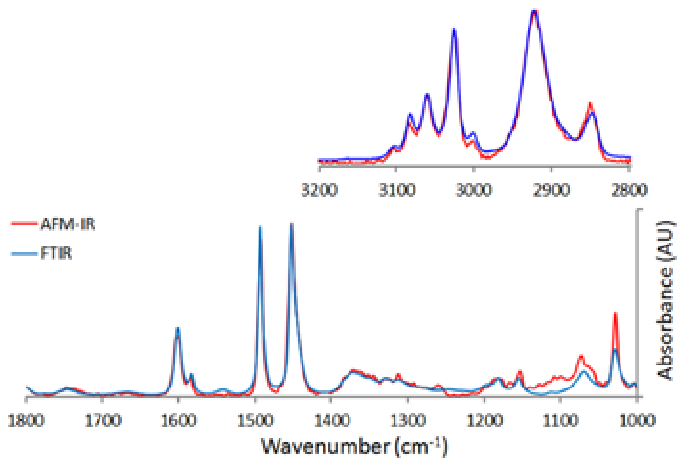
AFM-IR: Breakthrough nanoscale infrared spectroscopy for organics, polymers and life sciences

AFM-IR spectroscopy reveals chemical composition of crucial nanostructures across a diverse range of applications, including protein secondary structure of single fibrils, sub-cellular composition, and polymer blend interfaces. This breakthrough capability has led to rapid adoption of AFM-IR by leading academic, government, and industrial researchers worldwide.

AFM-IR: The clear choice for true, artifact free IR absorption spectroscopy

Our patented AFM-IR technique is the only nanoscale method that provides true model-free IR absorption spectroscopy. Scattering-based techniques suffer from band shifts, peak distortions and other artifacts caused by complex dependences on tip material and geometry, sample thickness. In contrast, AFM-IR provides a direct, unambiguous measurement of infrared absorption. For that reason, the AFM-IR spectra correlate well to conventional FTIR spectra and are highly interpretable. Peak positions are very accurate, enabling detailed analysis of band shapes, subtle peak shifts, secondary structure, and orientation effects. AFM-IR spectra are readily searched against spectral libraries for identification of unknown chemical components.

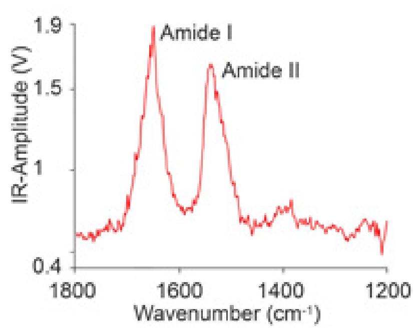
Excellent correlation to FTIR spectra

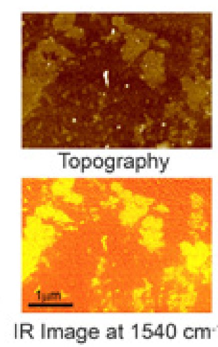


Nanoscale IR spectroscopy and imaging from the team that invented it

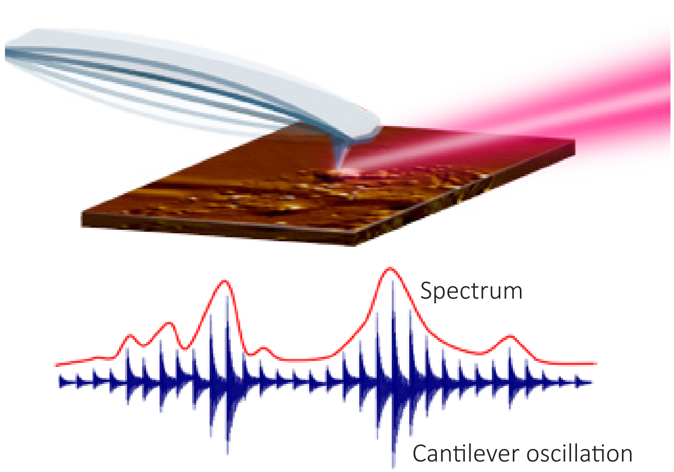
Anasys Instruments and our scientific collaborators pioneered the field of nanoscale infrared absorption spectroscopy and imaging. Our team is focused on providing robust chemical analysis with nanometer scale spatial resolution.

Monolayer Sensitivity





Halobacterium Salinarum deposited on a Au substrate, membrane is ~ 5 nm, thick.

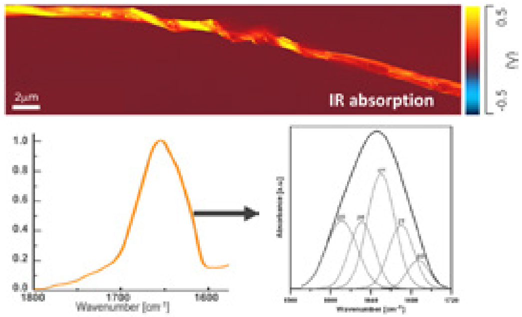


AFM-IR: How it works

Pulses of infrared laser radiation tuned to an absorbance band of a material causes an abrupt and short-lived thermal expansion. The rapid expansion excites resonant oscillation of the AFM cantilever in contact with the surface. The amplitude of the cantilever oscillation is directly proportional to the sample absorption coefficient. An AFM-IR absorption spectrum is created by measuring the cantilever oscillation amplitude while scanning the laser across the spectral range of interest. The resulting absorption spectrum is a unique chemical fingerprint of a nanoscale region of the sample under the AFM probe tip.

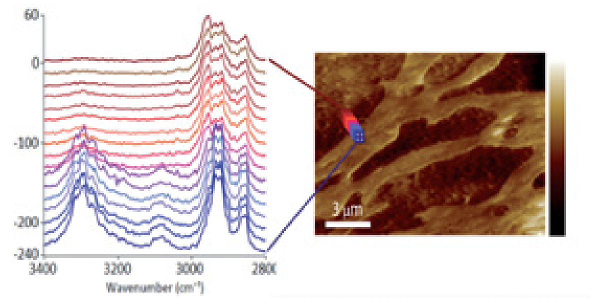
AFM-IR Applications

Protein secondary structure - single fiber



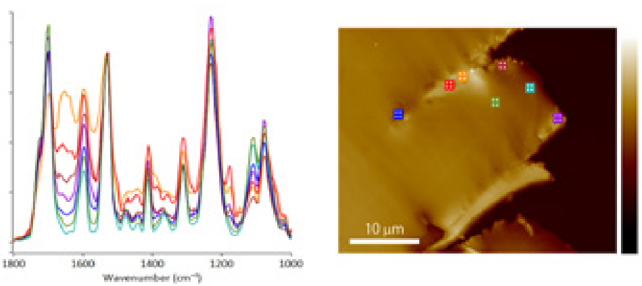
Amide I absorption of single collagen fiber.
Results courtesy of EPFL, Switzerland.

Polymer interface chemistry



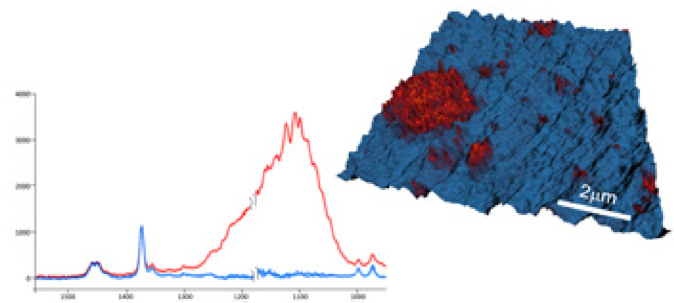
AFM-IR spectra (left) and morphology (right) of a polymer blend across a rubber/nylon interface.

Polymer degradation/failure analysis



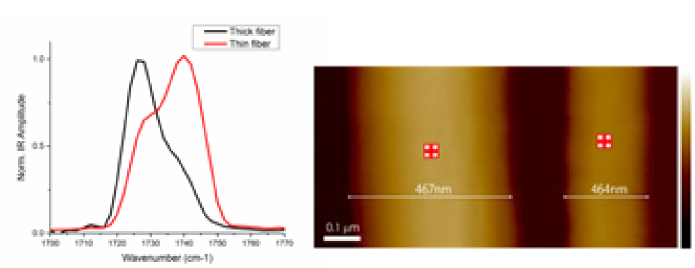
AFM-IR absorption spectra reveal evidence of localized nanoscale oxidation at failure point in polyurethane tubing.

Nanocomposites



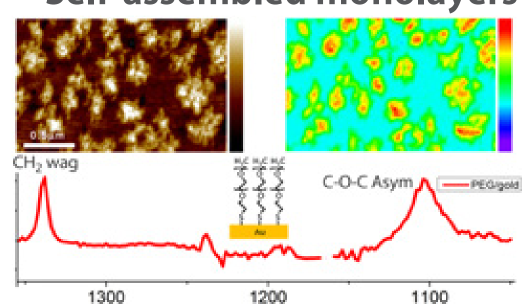
AFM-IR absorption spectra and imaging of SiO2 nano particles in polypropylene. Sample courtesy of IPF Dresden.

Nanofibers



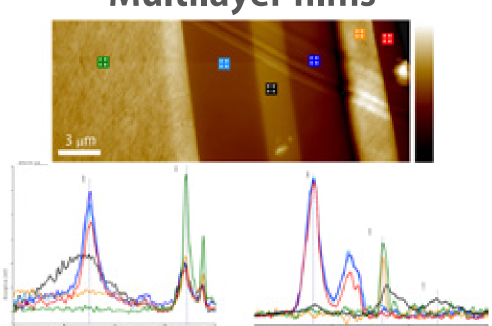
AFM-IR reveals variation in crystalline and amorphous structure among and within single nanofibers. Results courtesy of University of Delaware.

Self-assembled monolayers



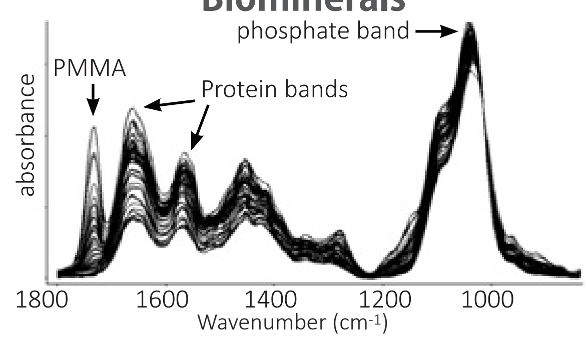
AFM imaging, AFM-IR imaging, and resonance enhanced AFM-IR spectroscopy of a monolayer island film of a PEG methyl ether thiol on gold.

Multilayer films



AFM-IR chemically distinguishes polyamide vs. polyethylene film components.

Biominerals



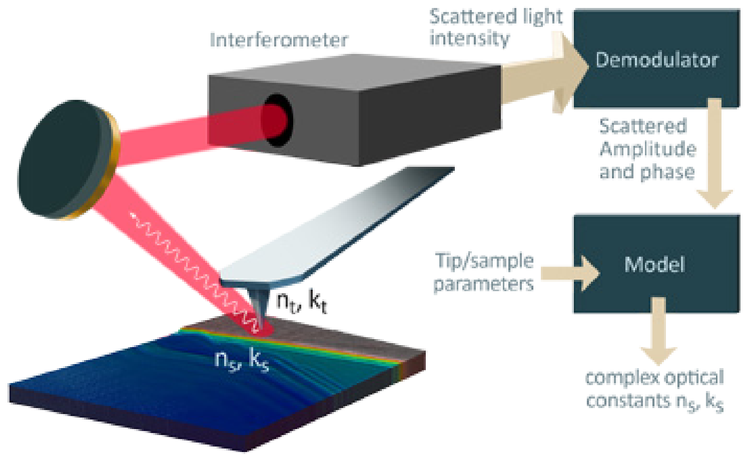
AFM-IR spectra reveal mineral/protein concentration and protein secondary structures in bone.

s-SNOM: Unparalleled imaging of nano-optical phenomena

s-SNOM is a universal probe of light-matter interactions at the nanoscale. It is a powerful technique for mapping complex optical properties and phenomena of materials with nanometer scale spatial resolution.

s-SNOM: How it works

The s-SNOM technique uses a metallized AFM tip to enhance and scatter radiation from a nanometer scale region of the sample. The scattered radiation is detected in the far field, but it carries information about the complex optical properties of the nanoscale region of the sample under the metallized tip. Specifically, both the optical amplitude and phase of the scattered light can be measured. With appropriate models, these measurements can estimate the complex optical constants (n, k) of the material under the tip. In some cases, the optical phase versus wavelength provides an approximation to a conventional absorption spectrum. The s-SNOM technique works best on hard materials, especially those with high reflectivity, high dielectric constants, and/or strong optical resonances.



Scattered light depends on complex optical constants of tip and sample

s-SNOM: Now from the world leader in AFM-based spectroscopy

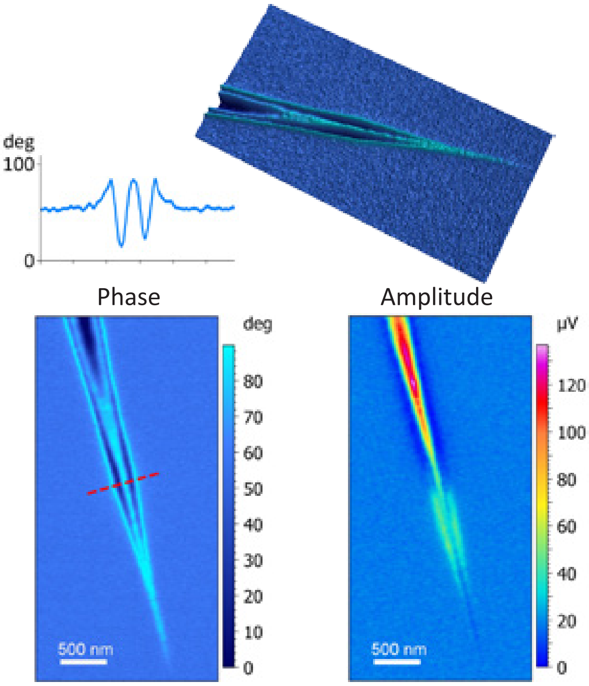
The Anasys Instruments nanoIR2-s builds on a heritage of technology leadership in AFM-based nano-optical characterization tools. Designed with an unmatched level of performance, integration, automation, and flexibility, the nanoIR2-s sets a new standard for research productivity and ease of use.

nanoIR2-s innovations:

- Exclusive technology enables rapid spectroscopy and imaging with a single tunable laser source at speeds >10X faster than spatio-spectral imaging (pat. pending)
- Patented adaptive beam steering and all reflective optics enables broad wavelength compatibility while eliminating realignment and refocusing at different wavelengths
- Patented dynamic power control maintains optimal power and signal over broad range of sources, wavelengths and samples
- Patented suppression of unwanted background scattered light that otherwise corrupts measurements of complex optical properties
- High NA focusing/collecting optics with full 25 mm diameter clear aperture through interferometer provides excellent light collection and superior signal to noise ratio
- Computer controlled source interface module supports multiple sources, including tunable and broadband lasers and synchrotron beamlines
- Modular and flexible optical design is readily adaptable to future experiments
- Pre-mounted probes and motorized tip, sample and source alignment eliminates tedious steps in probe installation and re-optimization

s-SNOM Applications

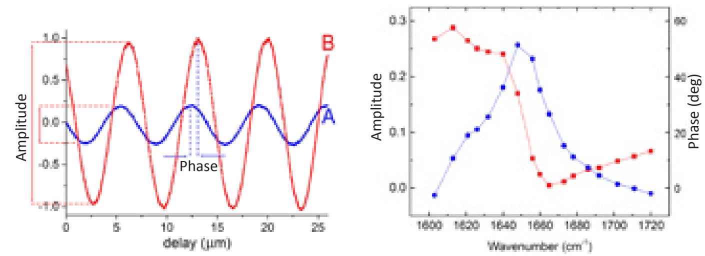
Graphene plasmons



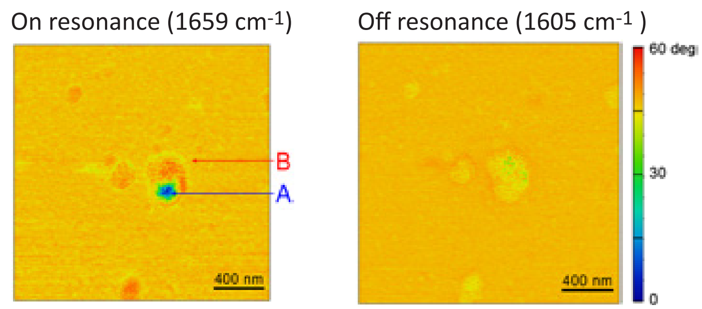
s-SNOM phase and amplitude images of surface plasmon polariton (SPP) on a graphene wedge. (left) s-SNOM phase with a line cross-section of the SPP standing wave; (right) s-SNOM amplitude. Top image is a 3D view of Phase image (left).

s-SNOM point spectroscopy

Wavelength dependent complex optical property mapping

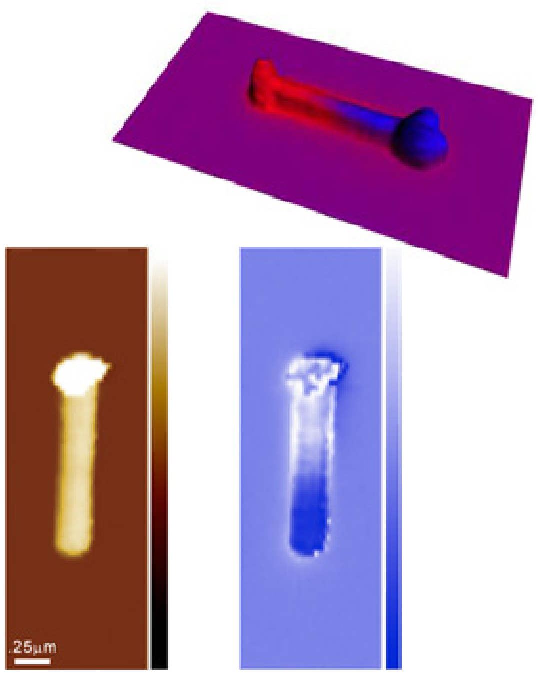


Wavelength dependent optical imaging



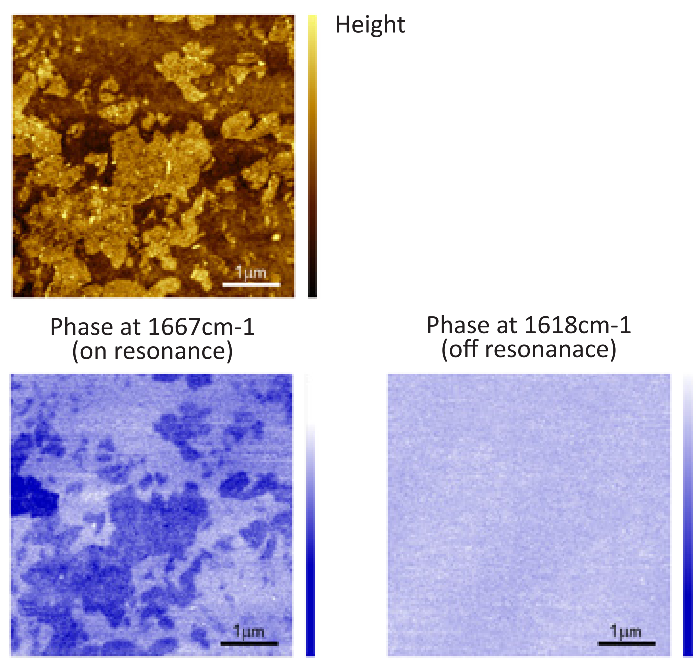
Optical spectroscopy and imaging with s-SNOM. Point spectrum of s-SNOM gives complex optical property of the sample (top right), with both amplitude and phase of scattered light from interferometric detection (top left). s-SNOM phase image of a defect on-resonance and off-resonance (bottom).

Nanoantennas



AFM image (bottom left) and s-SNOM image (bottom center) of a bar antenna. The s-SNOM image reveals the dipole-like scattering from the bar antenna. Overlay image (top) showing s-SNOM image overlaid on topography.

Life sciences



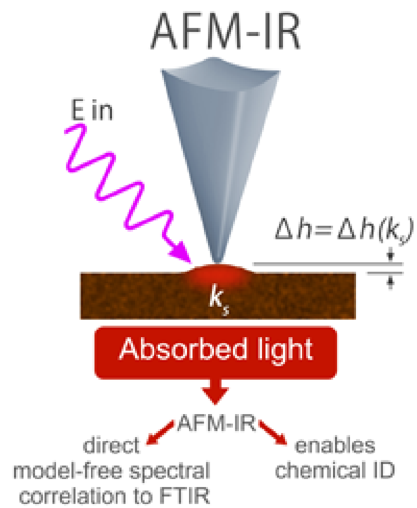
s-SNOM measurements of purple membrane reveal distribution of protein within the lipid membrane. AFM height (top); s-SNOM phase image with IR source tuned to the amide I absorption band (bottom left); s-SNOM phase image off-resonance (bottom right).

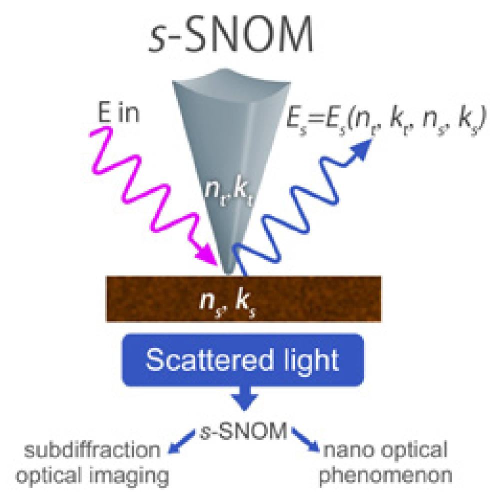
Apply the best technique for your research – without compromise

AFM-IR and s-SNOM are complementary techniques with different strengths. With the nanoIR2-s, you can choose a configuration that has one technique or both, depending on your sample and measurement needs.

AFM-IR directly detects light absorbed by the sample using the AFM probe tip to sense thermal expansion. This thermal expansion depends primarily on the sample's absorption coefficient, ks, and is largely independent of other optical properties of the tip and sample. The AFM-IR technique is thus preferred for measurements where an accurate absorption spectrum is desired. AFM-IR excels for soft matter studies owing to the high thermal expansion of these materials.

s-SNOM detects light scattered by nanometer scale regions directly under the AFM probe tip. The scattered field depends on the complex optical constants of both the tip and sample and contains rich information about nano-optical phenomena. Reference samples (e.g. gold or silicon) are required to separate the sample response contributions from the source and tip. Modeling support may be needed to interpret the results. s-SNOM is a compelling technique for imaging nanoscale contrast in optical properties, with diverse applications in advanced materials, devices and fundamental light/matter interactions. s-SNOM works best for hard materials that interact strongly with light.





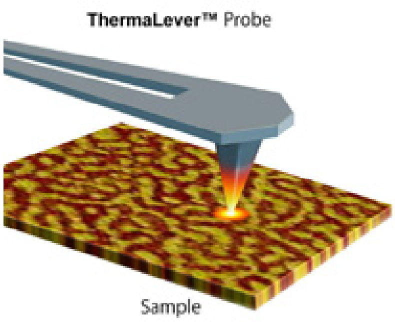
Capability	AFM-IR	s-SNOM	AFM-IR+ s-SNOM	Notes
Polymers, blends, composites	●	◐	●	AFM-IR is the best technique for soft matter samples with large thermal expansion
Organics, life sciences	●	◐	●	
Graphene/boron nitride/2D materials		●	●	s-SNOM is the best technique for hard matter samples that efficiently scatter light
Nanoantennas/photonics	◐	●	●	
Inorganics, semiconductors	◐	●	●	
IR absorption spectroscopy	●	◐	●	AFM-IR provides true model-free IR absorption spectroscopy without band distortions and peak shifts
Correlation to FTIR	●	◐	●	
Unknowns analysis	●	◐	●	
Wavelength dependent complex optical properties		●	●	s-SNOM accesses real and imaginary optical properties
Chemical compositional imaging	●	●	●	Both configurations support imaging and spectroscopy with a single source
Rapid point spectroscopy	●	●	●	
Surface sensitivity/ultimate spatial resolution	◐	●	●	s-SNOM spatial resolution and depth sensitivity set by tip radius

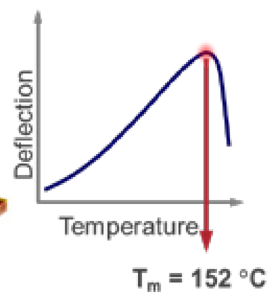
nanoIR2-s – Beyond spectroscopy

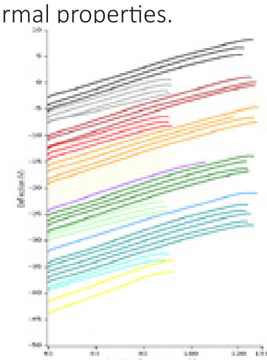
Exclusive multifunctional material property measurements and a full featured AFM

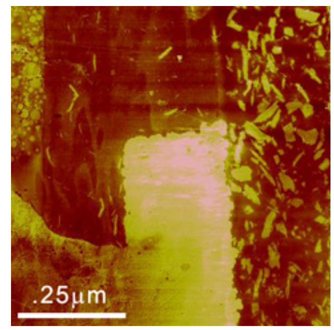
Nanoscale Thermal Analysis (nanoTA)

Developed by Anasys Instruments, this award-winning technology uses Anasys ThermaLever™ probes to locally ramp the sample's temperature to measure and map thermal transitions and other thermal properties.





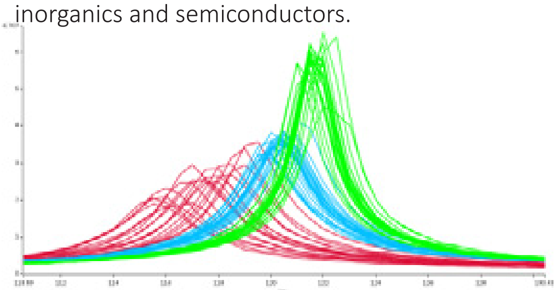


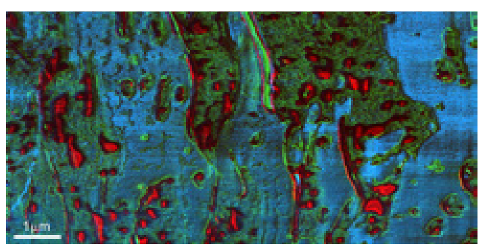


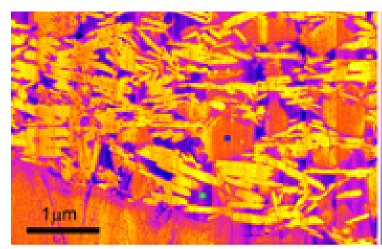
Left: nanoTA uses a heated AFM tip to measure glass transition and melt temperatures with nanoscale spatial resolution. Middle: Thermal transition curves on a 21 layer laminated polymer film. Right: Scanning thermal microscopy visualizes variations in temperature and thermal conductivity on a sectioned circuit board.

Mechanical Spectroscopy and Imaging

Broadband nanomechanical spectra utilizing Lorentz Contact Resonance (LCR) provides rich information about variations in material stiffness, viscosity and friction. LCR provides sensitive material contrast on materials ranging from soft polymers to hard inorganics and semiconductors.



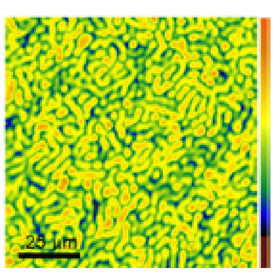




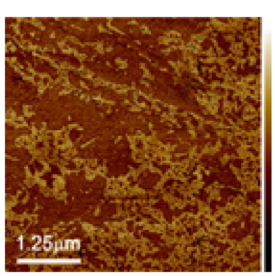
Nanomechanical spectra (left) discriminate materials on the basis of stiffness and damping. Examples of LCR stiffness maps on complex polymer blends (center) and high performance paper products (right).

Versatile, full featured AFM

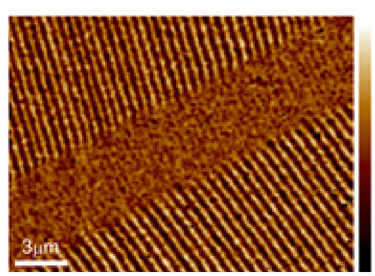
Every product in the Anasys Instruments family is built around our full featured AFM supporting many routinely used AFM imaging modes. These include tapping, phase, contact, force curves, lateral force, force modulation, EFM, MFM, CAFM and more.



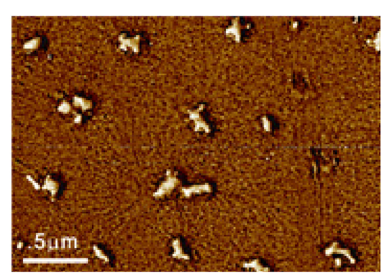
Tapping image of block copolymer



Force modulation of polymer blend



Magnetic force microscopy of a magnetic tape



Tapping phase image of polymer nanocomposite.

Anasys Instruments: The nanoscale analysis company

Anasys Instruments nanoIR™ products have been adopted by leading scientists at major research universities, national laboratories and leading chemical/materials companies worldwide. With an impressive and growing publication record, our customers have proven the ease of use and productivity in real-world applications. Our third generation nanoIR2-s™ instrument draws on a legacy of award winning products and represents the state of the art for nanoscale spectroscopy, imaging and materials analysis.

afm+™

nanoIR™

nanoIR2™

nanoIR2-s™

Learn more...

We invite you to further explore how we can put our advanced technology to work on your research endeavors. Our technical experts are ready to discuss and show the value of nanoscale spectroscopic and properties measurements on your samples. Please contact us by email at info@anasysinstruments.com, or telephone at (805) 730 3310.

Visit our Publications page for an up-to-date list of applications:
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For complete information on the nanoIR2-s, please visit
www.anasysinstruments.com/nanoir2s

Awards and Recognition

2014
Ernst Abbe Award

Anasys CTO Dr. Craig Prater congratulating AFM-IR inventor Prof. Alexandre Dazzi, recipient of the 2014 Ernst Abbe Award.

R&D 100 2010

2011 Microscopy Today Innovation Awards

R&D 100 Awards 2007 WINNER

Micro Nano 25 2007 WINNER

R&D 100 Awards 2008 WINNER

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nanoIR™ products are covered by multiple U.S. and international patents. See www.anasysinstruments.com/patents