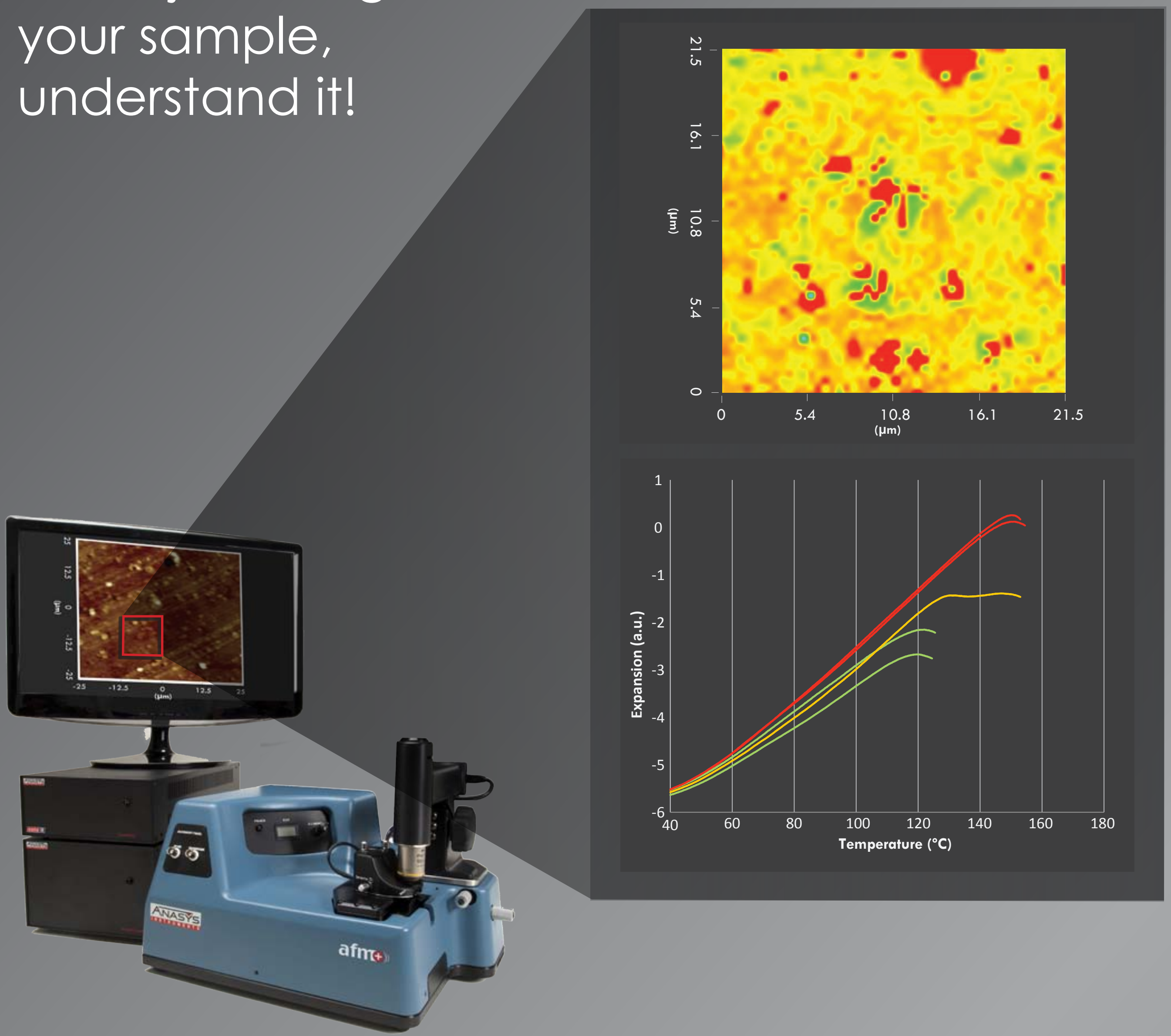
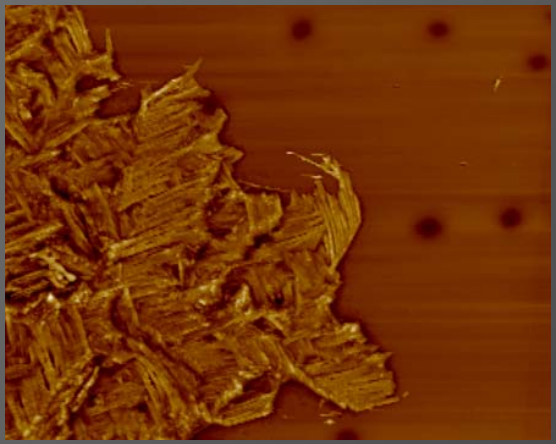
afm+™

Don't just image your sample, understand it!



ANASYS INSTRUMENTS

Atomic force microscopy (AFM) is a powerful tool for nanoscale research. Over the past several years, Anasys Instruments has expanded the reach of AFM to provide widely applicable analytical capabilities, enabling researchers to make new discoveries and solve real-world problems.



*The **afm+** delivers high-quality AFM performance with a closed-loop 100µm x 100µm XY scan stage and a motorized XY stage to accurately position the probe.*

Anasys Instruments, the company that pioneered nanoscale thermal analysis and nanoscale IR spectroscopy using an AFM, is pleased to introduce a brand new, easy-to-use research and analysis tool!

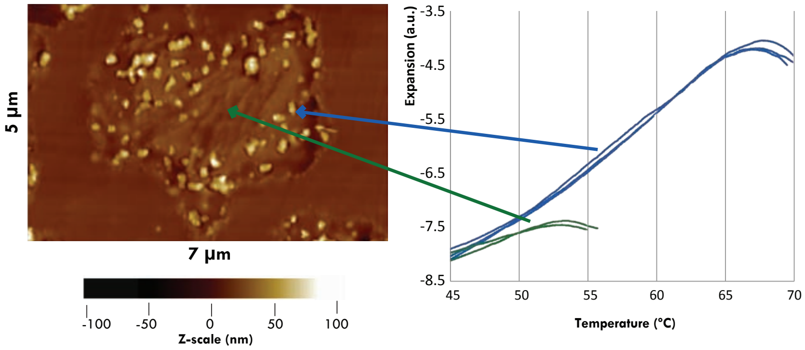
Our **afm+** is the first fully integrated AFM platform to offer these key analytical capabilities:

- **Nanoscale thermal analysis** to provide glass transition temperatures (T_g) and melting temperatures (T_m)
- **Transition temperature microscopy** (TTM™) to quantify and map thermal transitions in heterogeneous materials
- **Fully upgradeable** to perform nanoscale infrared spectroscopy for measuring and mapping chemical composition on the nanoscale

AFM + Thermal Analysis

Nanoscale Thermal Analysis (nano-TA)

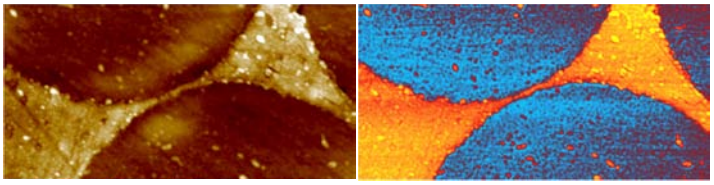
Based on our proprietary thermal probe technology, the **afm+** allows you to obtain transition temperatures on any local feature of your sample or to obtain a transition temperature map.



An AFM image with nano-TA data of a toner particle. The particle was embedded in epoxy and microtomed. The topography of the sample shows variations in structure, which can then be analyzed using nano-TA. Toner particles include a number of components (wax, resin, dye, etc.) that exhibit different transition temperatures.

Scanning Thermal Microscopy (SThM)

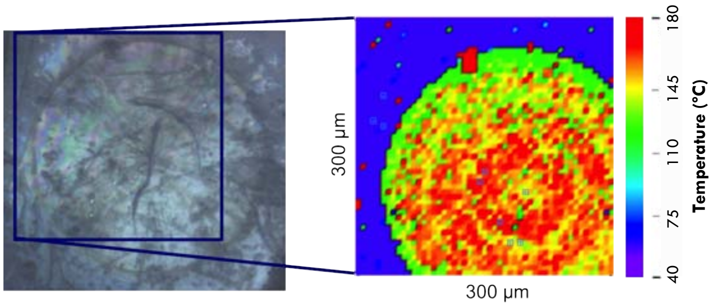
This mode of the **afm+** allows you to map relative thermal conductivity and relative temperature differences across your sample.



*The 4µm x 8µm image shown here utilizes the scanning thermal microscopy (SThM) functionality of the **afm+** system on a carbon fiber – epoxy composite sample. The sample was cut and polished to form a smooth surface. The height image (left) shows a number of carbon fibers, while the SThM image (right) shows the change in probe temperature on the two materials due to their differences in thermal conductivity. This sample demonstrates the high lateral-resolution capability of the SThM technique.*

Transition Temperature Microscopy

Transition temperature microscopy (TTM) is a fully automated mode in which an array of nano-TA measurements are rapidly performed and each temperature ramp is automatically analyzed to determine the transition temperature.

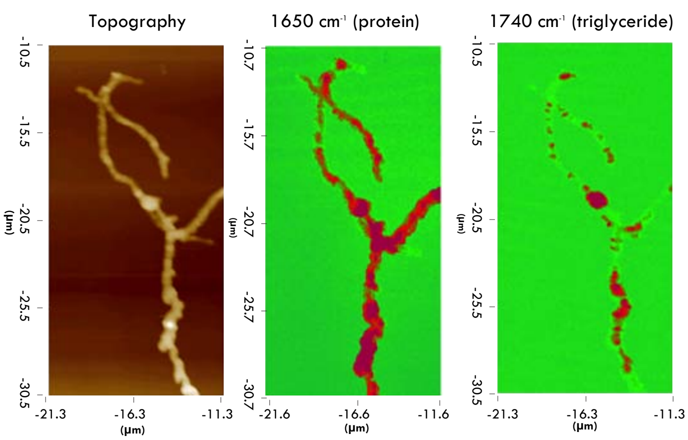


An optical image and a TTM map of a banded spherulite composed of poly (L-lactic acid) (PLLA). This TTM map was created by using the motorized XY stage. The blue areas in the TTM map are amorphous PLLA; the red and yellow areas are crystalline areas. The "onion-like" structure in the spherulite was created by stepping the temperature back and forth during the crystallization process to create regions with a higher or lower degree of crystallinity. Sample courtesy of J. Morikawa, Tokyo Institute of Technology.

Upgradeable Analytical Capabilities

AFM + IR Spectroscopy nanoIR™

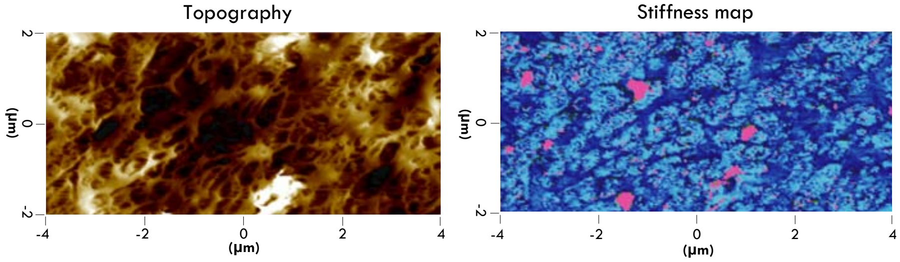
- Point-and-click nanoscale IR spectroscopy
- IR spectra that correlate to FTIR libraries
- Chemical imaging



Topography and IR images collected at 1650 cm^{-1} and 1740 cm^{-1} of Streptomyces bacteria. These bacteria form lipid-filled vesicles in later stages of growth. The location of these vesicles can be determined by imaging at 1740 cm^{-1}, an absorption band specific to the lipid. The vesicles can be resolved to sub-100nm resolution using the nanoIR.

AFM + Mechanical

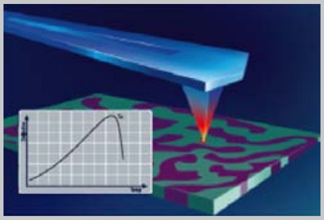
Mechanical properties of your sample can be collected using a contact resonance method to map stiffness variations simultaneously with the topography.



A 4µm x 8µm topography image and stiffness map of a three-component polymer blend. The stiffness map, which measures the variation in modulus by analyzing the contact resonance of the cantilever, clearly resolves the three materials.

The Science Behind the Solution

nano-TA



The Probe

Anasys Instruments ThermaLever™ probes for nano-TA are micromachined silicon probes that are similar in geometry to standard silicon AFM probes but incorporate a resistive heater at the end of the cantilever. These novel probes have the capability to image the sample surface with lateral resolution close to that of a standard AFM probe (i.e., significantly better than most thermal probes). Due to the fact that the heater portion of the ThermaLever probe is made of doped silicon, it can be heated repeatedly and reliably to higher temperatures than thermal probes made of thin metal films.

The Process

The nano-TA probe is used by the **afm+** to image with nanoscale resolution, which helps you identify the points where you would like to obtain local thermal property information.

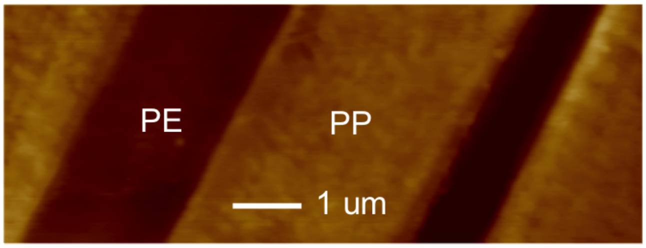
The probe is moved to the first point selected and placed on the surface of your sample. The temperature of the tip is then ramped linearly with time while the degree of bending is monitored. At the point of phase transition, the material beneath the tip softens and the probe penetrates into the sample; this provides the nanoscale equivalent of a bulk thermo-mechanical analysis experiment, whereby you can measure the phase transition temperatures of your sample (such as T_g or T_m).

Once you have identified the regions of thermal interest on your sample, you can then use the nano-TA mode to obtain quantitative measurements of phase transition temperatures at sub-100nm resolution.

Multifunctional Nanoscale Measurement Suite

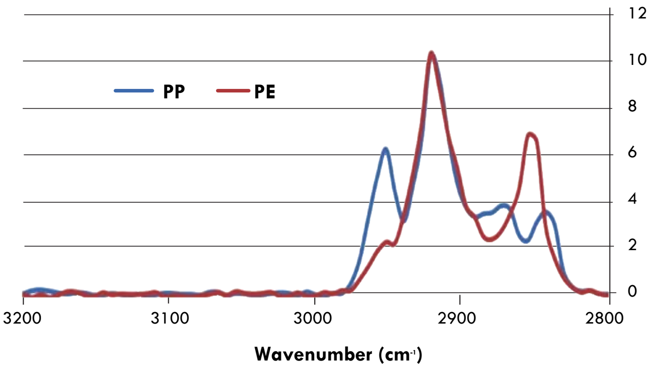
The new **afm+** is fully upgradeable to our nanoIR system, a probe-based measurement tool that utilizes infrared spectroscopy to reveal chemical composition at the nanoscale. The nanoIR also provides high-resolution characterization of local topographic, mechanical, and thermal properties. Potential application areas span the realms of polymer science, materials science, and life science, including detailed studies of structure-property correlations.

Topographic

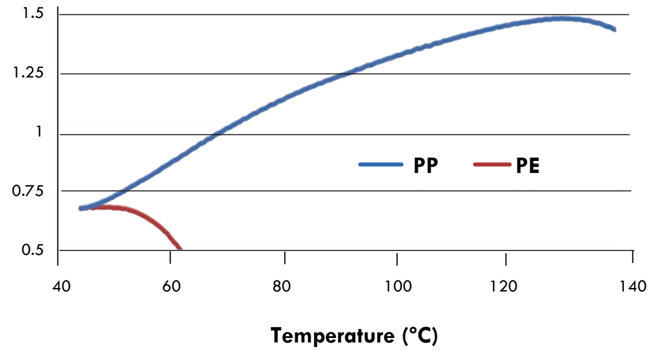


Mechanical

Spectroscopic



Thermal



An example of the multi-property measurement capability of the nanoIR system. The sample is a multilayer film composed of polyethylene and polypropylene. The two materials can be clearly identified by their unique absorption bands. In addition, the difference in stiffness and transition temperature of the two materials can be measured.

About Anasys Instruments

Anasys Instruments Corporation was founded in 2005 by an experienced team of AFM industry pioneers and scientists with the goal of creating innovative analytic tools that enable a better understanding of structure, property, and function at the nanoscale. The Santa Barbara, California-based company has already developed and introduced three award-winning technologies: nanoscale thermal analysis (nano-TA), transition temperature microscopy (TTM), and nanoscale infrared spectroscopy (nanoIR).

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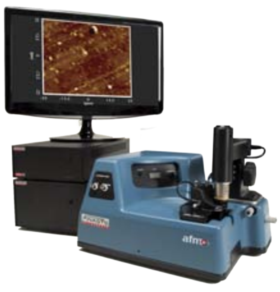

Front cover:

Monitor display: High-resolution AFM image of a partially miscible blend of polybutadiene (PBD), styrene acrylonitrile copolymer (SAN), and polycarbonate (PC) showing distinct phases.

Inset, top: TTM map of the blend. Red and green regions correspond to SAN- and PC-rich domains, respectively. The continuous phase in orange is an intermediate phase resulting from partial miscibility of the polymer blend.

Inset, bottom: nano-TA curves capture the softening transitions of two pure polymer domains (red/green curves) and a mixed polymer domain (orange curve).

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