NANOSCALE IR SPECTROSCOPY

Dimension IconIR Polymer

The All-In-One AFM-IR Solution for Correlative Nanoscale Chemical and Mechanical Property Analysis of Polymers

Correlating chemical information with structure and property data enables more advanced polymer research for both process improvement and materials development. The Dimension IconIR Polymer system is a comprehensive package for polymer research that provides the ideal toolkit for correlative investigations and building a full material understanding.

Photothermal AFM-IR spectroscopy combines the high spatial resolution of atomic force microscopy (AFM) with the chemical identification capability of infrared (IR) spectroscopy. The well-understood physics of this process allows for the chemical characterization of samples in nanoscale detail. Chemical information is easy to interpret and can then be correlated with topographical and property data using standard and emerging AFM techniques.

This Comprehensive Polymer Solution for Your Research Includes:

IconIR

With a laser to cover the fingerprint region of organic materials

Bruker's large-sample Dimension IconIR system combines nanoscale IR spectroscopy and scanning probe microscopy (SPM) on one platform to deliver the most advanced spectroscopy, imaging, and property mapping capabilities available.

PeakForce QNM

For quantitative measurements of local mechanical propertiess

PeakForce QNM® maps and distinguishes between nanomechanical properties—including modulus, adhesion, dissipation, and deformation—down to atomic resolution for topography and simultaneous nanomechanics.

AFM-nDMA

For full correlative viscoelastic mapping

AFM-nDMA™ uses several Bruker proprietary technologies to provide measurements of storage modulus, loss modulus, and loss tangent in the rheological frequency range of 0.1 Hz to 20 kHz—directly matching the range of bulk DMA and indenter-based measurements.

Chemistry-Structure-Property Correlation

Since polymers tend to have a lot of nanoscale variation, polymer research often hinges on gaining an understanding of how local chemistry and structure relate to properties. With Bruker's all-in-one polymer solution, such correlative evaluations are made possible within a single system.

Case Study: SBR with a Silicate Filler

Styrene butadiene rubber (SBR) is a synthetic rubber widely used for automobile tires. In a sample of SBR with silicate filler, certain areas had intermediate adhesion and mechanical properties not consistent with either SBR or silicate. AFM-IR spectra of the locations with intermediate properties revealed the presence of amide IR absorption bands (1656 and 1536 cm^{-1}), consistent with a polyurethane.

The combination of nanoscale mechanics and chemistry enabled the identification of these areas of unknown composition:

- Mechanical mapping revealed the presence of areas with intermediate properties
- Chemical spectra were used to determine that the unknown material was a polyurethane

Together, nanoscale mechanical and chemical data provide a more complete material understanding than either one alone.

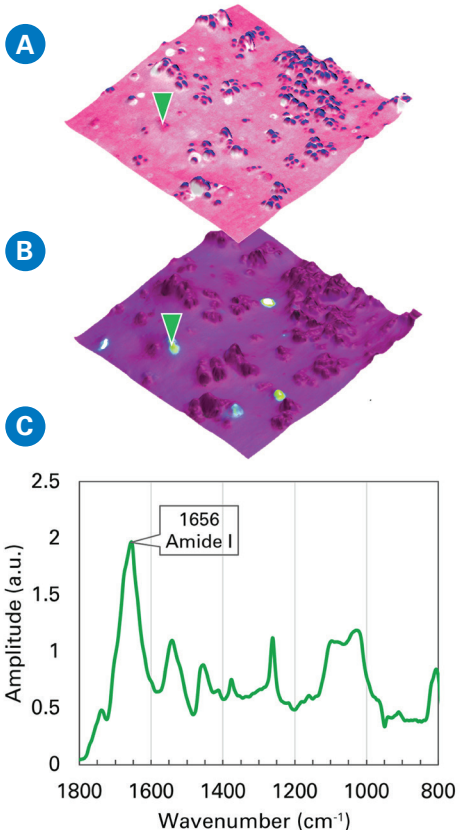

FIGURE 1.
Correlated imaging on SBR with silicate filler: (a) topography with adhesion map overlaid; (b) 3D topography with IR chemical map at 1656 cm^{-1}; (c) IR spectrum at marked location highlighting the presence of amide-containing species (polyurethane).

IconIR Polymer Specifications

Laser	HyperSpectra QCL [800–1800 cm^{-1}]
XY Scan Range	90 x 90 µm typical; 85 µm minimum with Dimension AFM scanner
Z Range	10 µm typical in imaging and force curve modes; 9.5 µm minimum
AFM Vertical Noise Floor	≤50 pm RMS
Sample Size	150 mm diameter vacuum chuck (full sample access); <15 mm thick
Optional Accessories	Contact Resonance; nanoTA/SThM; FastSpectra OPO [2700-3600 cm^{-1}]
Purging Hood	Available for purging environment using CDA
Probe Recommendations	**AFM-IR**: PR-UM-CNIR-B-10; PR-UM-TNIR-D-10 **QNM or AFM-nDMA**: SAA-HPI-30; RTESPA-150-30; RTESPA-300-30

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