SPM+ High Resolution Imaging

In-Situ SPM Imaging for Superior Nanomechanical and Nanotribological Characterization

In-Situ SPM Imaging

Hysitron is the pioneer of in-situ Scanning Probe Microscopy (SPM) imaging, which directly couples nanomechanical and nanotribological characterization with high-resolution SPM imaging. The in-situ SPM technique utilizes the same probe to image the sample surface as is used to conduct the test, allowing images to be quickly gathered on-site without leaving the test location. Hysitron's in-situ SPM imaging inherently increases accuracy, repeatability, and speed of testing since ex-situ imaging methods, such as operating an AFM in parallel, requires additional time in moving the sample to another imaging location and presents significant challenges associated with reliable positioning on the desired testing sites.

Hysitron's in-situ SPM imaging provides an imaging resolution on the same length scale as the testing, enabling truly quantitative and accurate characterization at the nanoscale. Pre-test SPM imaging of the testing site enables direct measurement of surface morphology (e.g. microstructure, topography, roughness) with nanometer resolution and is critical for avoiding surface defects prior to testing. High precision ±10nm test position accuracy streamlines testing of multiphase materials and allows the correlation of microstructure (e.g. shape, size, or distribution of domains) to mechanical properties. Additionally, post-test SPM imaging provides quantitative characterization of material deformation behavior (e.g. fracture, pile-up) and verification of the test placement. An overview of in-situ SPM capabilities can be found in Figure 1.

SPM+ Features

- Nanometer resolution in-situ Scanning Probe Microscopy imaging enables quantitative characterization of pre-test surface morphology and post-test deformation behavior
- High-precision test placement accuracy of ±10nm maximizes data accuracy, reliability, and repeatability when testing at the nanoscale
- Top-down, probe scanning system architecture allows imaging of samples with broad range of geometries and masses
- A 70nN imaging contact force provides reliable imaging of soft materials and delicate surface structures
- User-definable imaging resolutions from 64 x 64 (fast scan) to 4096 x 4096
- Customizable rectangular scans for imaging high aspect ratio features with maximum pixel density with resolutions up to 16384 x 512

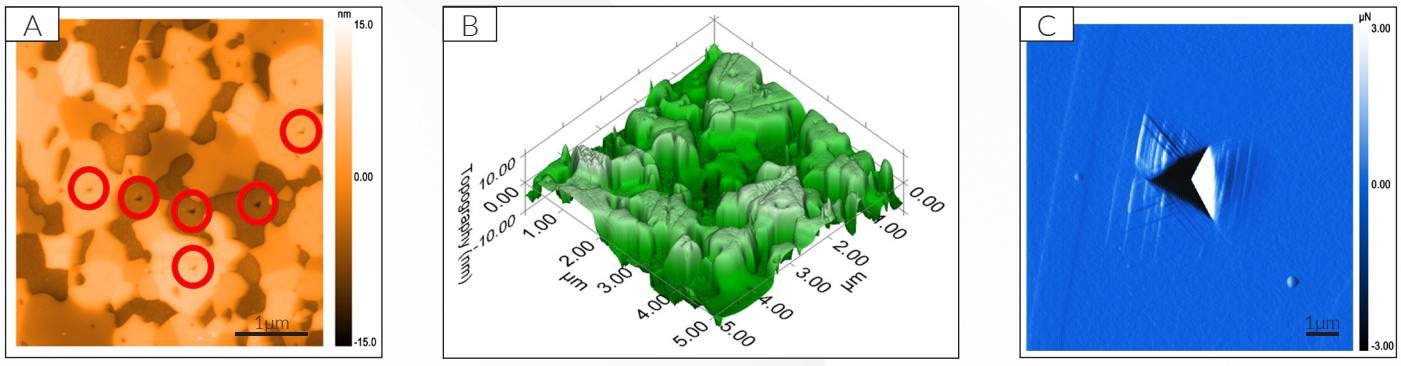

Figure 1: A.) 5µm scan size, 512 x 512 resolution, topography image of a magnetic storage medium material with indent placements circled in red. Individual grains have been targeted for nanomechanical testing. B.) The corresponding 3D rendering of the magnetic storage medium. C.) 10µm scan size, 1024 x 1024 resolution, gradient image of Inconel 625, a nickel-chromium alloy after indentation. Slip lines of the crystal structure are visible surrounding the indent.

HYSITRON®

9625 WEST 76TH ST. MINNEAPOLIS, MN 55344
TEL: 1-952-835-6366 FAX: 1-952-835-6166
WWW.HYSITRON.COM

How SPM Imaging Works

The test probe attached to Hysitron's capacitive transducer is translated into contact with the sample surface via motorized staging until a user-definable imaging contact force setpoint is achieved. The probe-transducer combination is mounted to a high-precision 3 axis tandem tube piezo scanner. The X-Y piezo directions raster scan the probe over the sample surface, while the Z displacement of the piezo is utilized to maintain a constant imaging force. The synchronized X-Y-Z movement of the piezo results in a high-resolution topography map of the surface. The error in the actual load supplied to the sample relative to the setpoint, as measured by the transducer, is the gradient image. Typically, topography images are useful for actual physical measurements of the sample surfaces, whereas gradient images are generally more clear visually. Figure 2 illustrates the basic principles of the SPM technique.

The In-Situ Advantage

The versatility Hysitron's top-down in-situ SPM technique permits imaging and testing of most sample locations, sizes, geometries, and can be used to image multiple samples without user intervention via automated testing routines. In contrast to nanoindentation equipment that rasters the sample, Hysitron's top-down SPM imaging easily accommodates a broad range of dissimilar samples with no need to modify imaging feedback parameters. Additionally, in-situ SPM imaging overcomes the barriers of parallel imaging techniques that are spatially limited by optical resolution or motorized stage positioning accuracy. Hysitron's in-situ SPM imaging greatly increases the speed, precision, and reliability of nanomechanical and nanotribological testing.

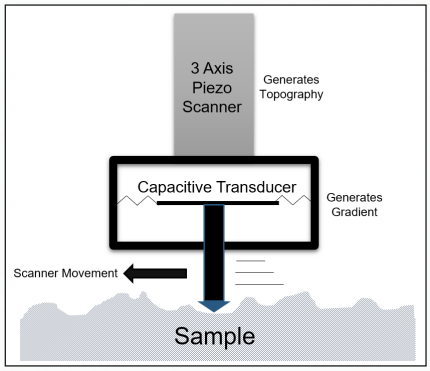

Figure 2: A schematic illustrating the basic principles of SPM imaging. The high precision 3 axis piezo scanner actively moves vertically to record the topography signal. The capacitive transducer passively measures error in the setpoint to generate the gradient image.

SPM+ High Resolution Imaging

Hysitron's new SPM+ brings nanomechanical SPM imaging capabilities to a whole new level. With SPM+, scan size and image resolution are fully customizable to meet your specific sample analysis needs. By adjusting the scan dimensions and/or scan resolution, the time required to produce high-quality images is significantly reduced. SPM+ offers user-definable X and Y scan resolutions for either a fast survey of a sample surface (64 x 64 low resolution mapping) or for a highly detailed imaging (4096 x 4096 high resolution mapping). Additionally, customizable X-Y scan dimensions enable imaging of high aspect ratio surface features with maximum pixel densities. Hysitron's Triboview image analysis software package with enhanced color pallets create publication-quality images minutes after being acquired.

Specifications

- Minimum Imaging Force: <70nN
- Scan Rate: 0.01Hz - 3.0Hz
- Fast Resolution: 64 x 64
- High Resolution: 4096 x 4096
- Maximum X, Y Scan Size: 75µm x 75µm
- Maximum Z Scan Size: 5µm
- Tip Positioning Accuracy: ± 10nm