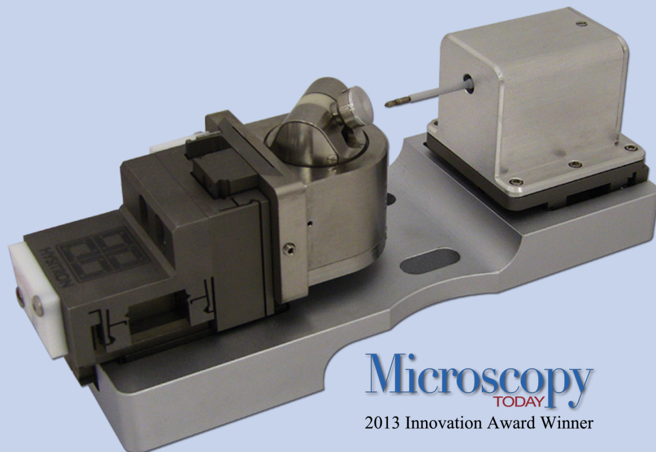
PI-SERIES

HYSITRON®

PI 87 SEM PicoIndenter®



PI 87 SEM PicoIndenter

Featuring 5 Degrees of Freedom

The **PI 87** is a **depth-sensing mechanical test instrument** that is designed to be interfaced with a scanning electron microscope (SEM) or FIB/SEM. This system will perform quantitative nanomechanical testing while simultaneously imaging with the SEM. Furthermore, sample positioning with **five degrees of freedom** (X, Y, Z, rotation, and tilt) gives the user the freedom to align the sample with an ion beam for sample prep/ modification or various detectors for advanced analysis.

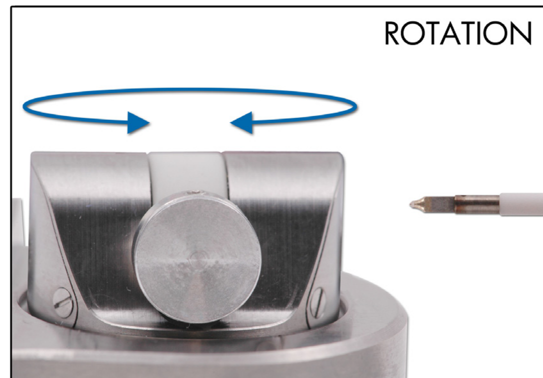
This system is specifically designed for the SEM, with a vacuum-compatible transducer and an electrically conductive probe. With Hysitron's patented capacitive transducer technology, force is applied electrostatically and displacement is measured capacitively. This low-current design provides low thermal drift and industry-leading stability and sensitivity.

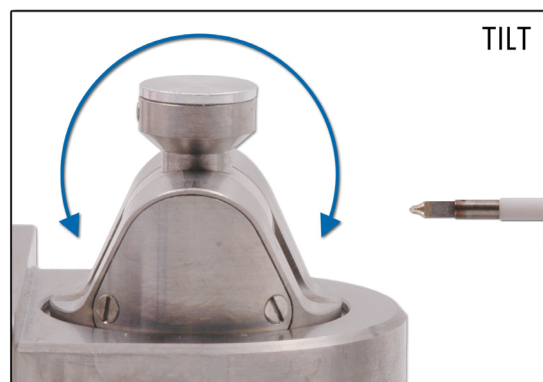
The **PI 87** system is ideal for characterizing fracture onset and crack propagation, delamination, and pile-up. The pairing of nanomechanical testing with electron microscopy provides unique insights into the mechanisms responsible for material's behavior.

The **PI 87 SEM PicoIndenter** offers the most advanced *in situ* nanomechanical testing flexibility inside your SEM or FIB/SEM.

Flexibility Redefined

The advanced positioning capabilities of the **PI 87** enable an unprecedented level of flexibility inside the SEM. Specifically, the tilt and rotation stages ensure that additional detectors (EBSD, EDS, WDS, etc.) are effortlessly within reach for advanced analysis **before, during, or after** the mechanical test. Through seamless pre- and post-test EBSD mapping, researchers can correlate the applied stress with changes in crystal orientation. Through a simple 90° tilt, the sample can also be aimed directly at the e-beam for top-down imaging. All this is accomplished without ever breaking the vacuum and exposing the sample to atmosphere, which can be critical in avoiding the oxidation of certain materials. This enhanced flexibility also drastically reduces analysis time as compared to conventional means, saving valuable time on the microscope.

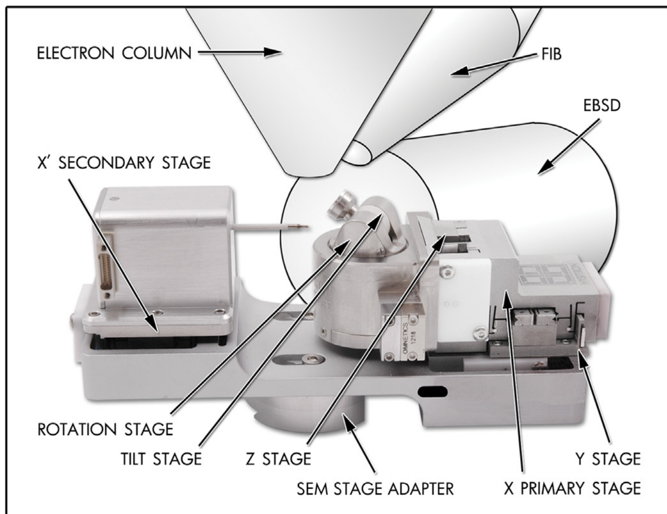




The sample can be seamlessly rotated or tilted to access an ion beam or various detectors (EBDS, EDS, WDS, etc.).

In Situ Sample Prep

On focused ion beam or FIB/SEM systems, the tilt and rotation stages allow easy access to the FIB for sample preparation or modification. Test structures such as micropillars can be created with the FIB and immediately tested by rotating the sample into position. Nanowires or thin films can also be prepared *in situ* for testing on Hysitron's **Push-to-Pull**™ (PTP) device. Using a nanomanipulator, the specimen can be harvested and placed onto the PTP device for subsequent testing.



Additional Features

The **PI 87** mounts easily to the SEM stage without being a permanent fixture in the microscope. The compact design of the instrument allows for maximum stage tilt and minimum working distance for imaging during testing. Through a custom feedthrough, the system connects to Hysitron's ***performech***® DSP-embedded controller, which boasts an ultra-low noise floor, a 78 kHz digital feedback routine, and data acquisition rates up to 39 kHz. In addition, the mechanical coupling of the sample stage and the transducer provides a stable, rigid platform for nanomechanical testing.

The comprehensive **TriboScan™** software package features integrated test setup, data analysis, sample positioning, and synchronization of mechanical data with SEM video. Automated routines are also incorporated for the tip/sample approach and for hands-off execution of indent arrays.

The XYZ translation stages provide precise sample positioning in three dimensions. Furthermore, a secondary X stage enables lateral motion of the transducer for even greater relative motion between tip and sample. For superior mechanical measurements, fine adjustment of the sample orientation can be performed to ensure proper alignment prior to indentation or compression testing.

Highlights

- Quantitative measurement of nanomechanical properties including hardness, stiffness, and modulus
- Hysitron's patented transducer provides electrostatic actuation and capacitive displacement sensing
- Freedom to align the sample to the ion beam and various detectors
- Improved range, resolution, and linearity in X, Y, and Z
- Superior sample alignment for mechanical testing
- Drastically reduced analysis time
- No exposure of sample to atmosphere between operations
- Proprietary Q-control mode actively dampens transducer oscillations (Patent pending)
- Interchangeable conductive probes in a variety of geometries

Transducer Specifications

- **Force Noise Floor:** <400 nN*
- **Maximum Force:** 10 mN**
- **Displacement Noise Floor:** <1 nm*
- **Maximum Displacement:** 5 µm

*Actual noise floors will depend on the SEM environment
**30mN extended force transducer also available

Stage Specifications

- **X-Axis:** >12 mm
- **X'-Axis:** >12 mm
- **Tilt:** 180°
- **Tilt Accuracy:** <0.33°
- **Y-Axis:** >16 mm
- **Z-Axis:** >8 mm
- **Rotation:** 180°
- **Rotation Accuracy:** <0.12°

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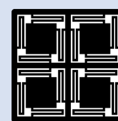

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