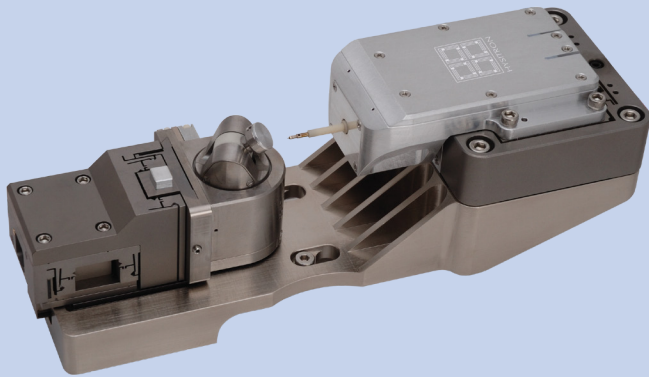


PI 87xR SEM PicoIndenter®



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5 Degrees of Freedom & Extended Range Mechanical Testing in One Complete System

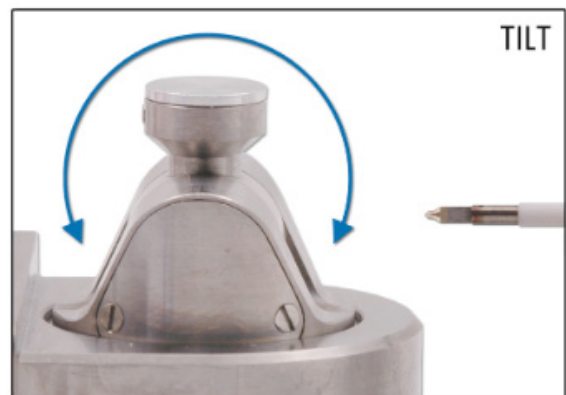
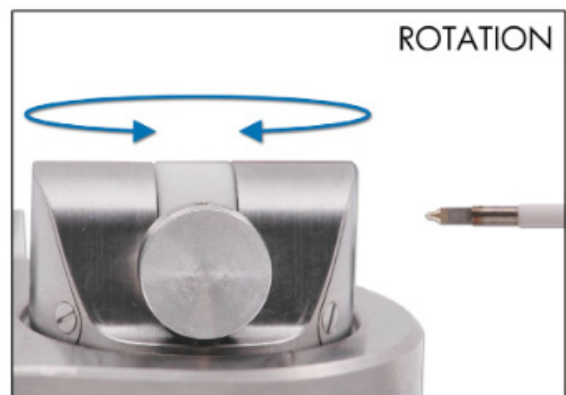
Hysitron's **PI 87 Series SEM PicoIndenter®** instruments are depth-sensing nanomechanical test systems that are specifically designed to leverage the advanced imaging capabilities of modern scanning electron microscopes (SEM, FIB/SEM). Flexible sample positioning with five degrees of freedom (X, Y, Z, tilt, rotation) provides the user with the ability to align the sample with an ion beam for sample preparation or supplementary detectors to obtain a deeper understanding of a material's mechanical response.

The **PI 87xR** offers an increased maximum load and displacement range over the standard PI 87 while maintaining unmatched, industry leading noise performance. With maximum applied forces >100 mN and a maximum displacement of 150 μm , the vacuum compatible PI 87xR bridges the gap between nano- and micro- scale mechanical testing, with the flexibility to comprehensively evaluate material deformation and transformation processes.

With the innovative combination of piezo actuation and capacitive displacement sensing, the PI 87xR is able to accommodate multiple avenues of materials research and a variable load frame allows for the optimization of the experimental setup for your specific testing regime; high force testing for failure generation and yield analysis on hard materials, high displacement testing with a higher sensitivity force measurement for ultra-compliant materials, and a standard range setup for true nanoscale testing.

Flexibility and Scale Connectivity

The flexible sample positioning of the PI 87xR allows for the alignment of the sample before, during, or after a mechanical test with additional detectors (EBSD, EDS, WDS, etc.) or ion beam to provide additional insight on sample deformation, or to perform sample modification. With the addition of the enhanced force range, much larger loads can be applied to samples for evaluation of material changes such as crystal orientation or fracture propagation under extreme loading conditions. Without the need to break vacuum and expose samples to ambient conditions for further preparation or re-alignment between mechanical tests, sample integrity is preserved and the research process is streamlined saving researchers valuable instrument time and significant cost.



The sample can be easily rotated or tilted to access an ion beam or various other detectors (EBSD, EDS, or WDS, etc.) for powerful complementary analyses.

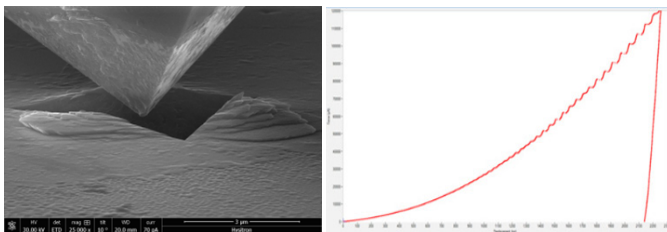
Additional Features

The PI 87xR 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 38 kHz. In addition, the mechanical coupling of the sample stage and the transducer provides a stable, rigid platform for nanomechanical testing.

The comprehensive **TriboScan**[™] v.9 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 with >8 mm range 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.

The PI 87xR is also compatible with a full suite of complementary testing modules for the PicoIndenter[®] line of instruments including **Tip/Sample Heating** (400 °C and 800 °C), **Electrical Characterization Module (ECM)**, **Push-to-Pull (PTP)**, and **Electrical Push-to-Pull (E-PTP)**.

The example below shows a 120 mN indentation of a $\text{Cu}_{45}\text{Zr}_{45}\text{Al}_{10}$ bulk metallic glass using a cube corner probe. Shear band formation is clearly visible at loads >50 mN, both in the mechanical data as well as the pile-up observed at the edge of the indentation.



Shear band formation resulting from a 120 mN indentation on a bulk metallic glass using a cube corner probe. ($\text{Cu}_{45}\text{Zr}_{45}\text{Al}_{10}$).

Highlights

- Quantitative measurement of nanomechanical properties including hardness, stiffness, and elastic modulus
- Extended load and displacement range for inducing yield in large and/or hard structures
- Freedom to align the sample to the ion beam or other detectors
- Improved range, resolution, and linearity in X, Y, and Z
- No exposure to atmosphere between operations
- Drastically reduced analysis time
- Unique piezo loading/capacitive sensing system with superior stability and low thermal drift
- Modes of mechanical testing include indentation, compression, bend, and tensile
- Proprietary Q-Control mode actively dampens transducer oscillation in vacuum
- Optimized for SEM with a vacuum compatible transducer and electrically conductive probe
- Interchangeable probes available in a variety of geometries to meet the demands of different test types
- Compact platform for maximum stage tilt and minimum working distance
- Upgradeable with a full complement of advanced PicoIndenter testing modules (400 °C & 800 °C Heating, Push-to-Pull (PTP), Electrical Push-to-Pull (E-PTP), Electrical Characterization Module (ECM))

Specifications

Maximum Load: >100 mN

Maximum Displacement: 150 μm

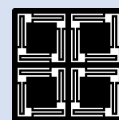
X-Axis: >12 mm Y-Axis: >16 mm Z-Axis: >8 mm

Tilt: 180°

Rotation: 180°

Tilt Accuracy: <0.33°

Rotation Accuracy: <0.12°



HYSITRON[®]