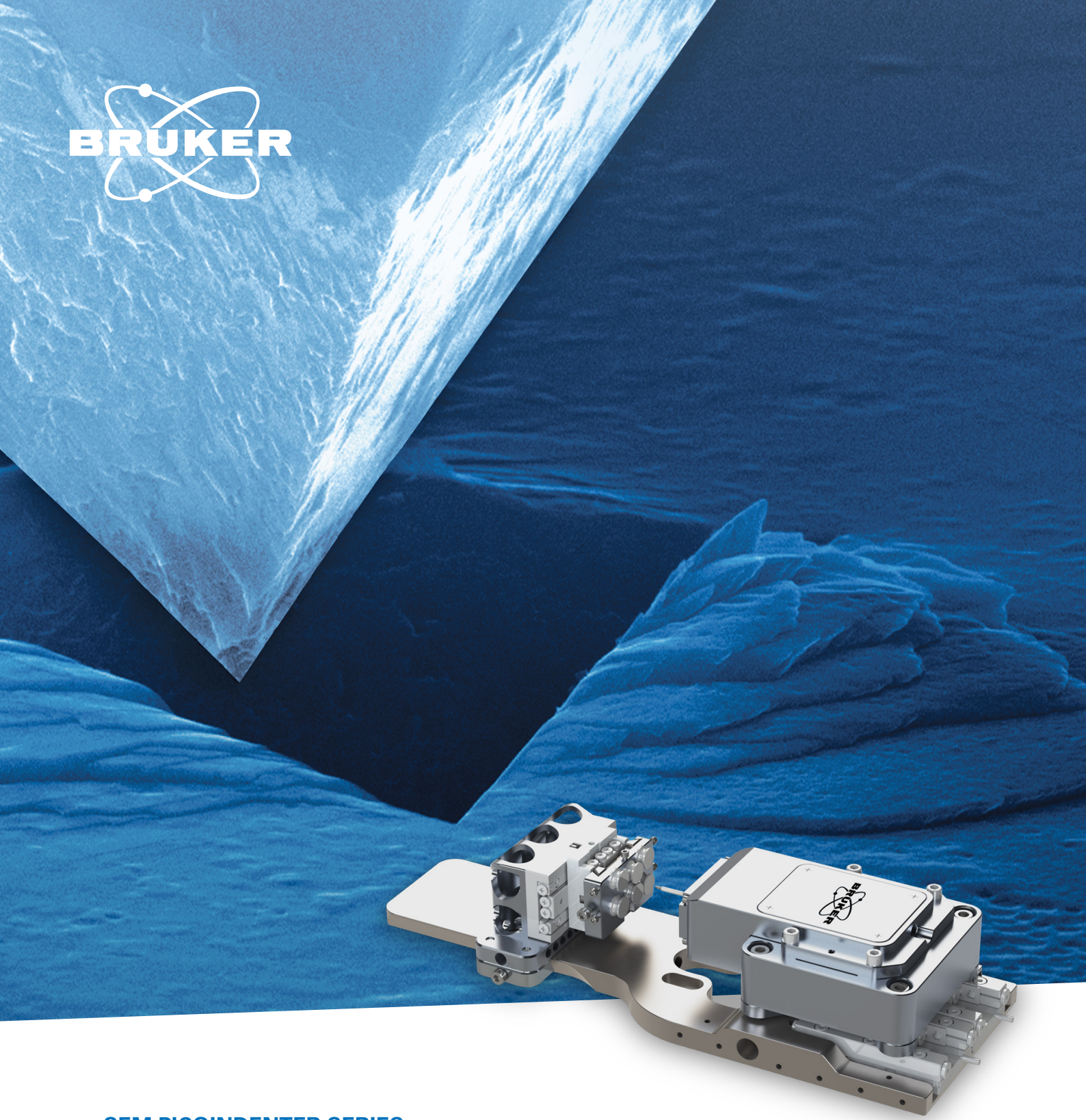


SEM PICOINDENTER SERIES

Hysitron PI 89 SEM PicoIndenter

Robust, Precise, and Modular
In-Situ SEM Nanomechanical Test Instrument

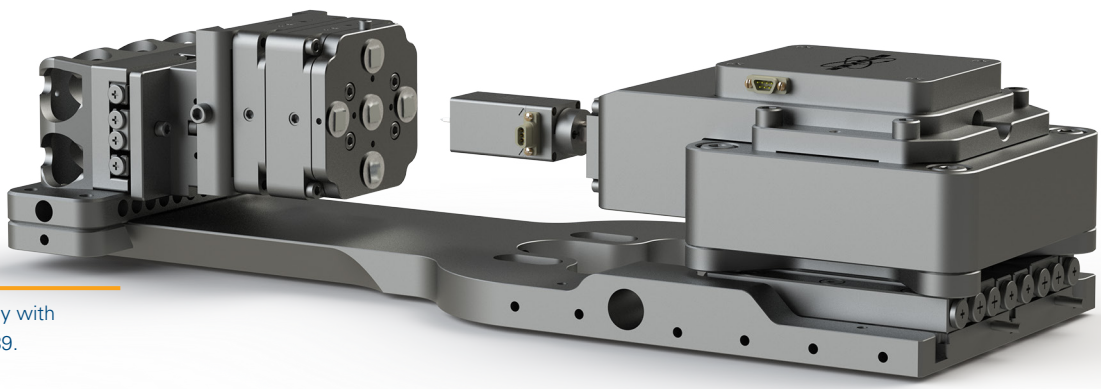
Hysitron PI 89

Unprecedented Range and Flexibility for In-Situ Nanomechanical Testing

The Hysitron PI 89 SEM PicoIndenter leverages the advanced imaging capabilities of scanning electron microscopes (SEM, FIB/SEM) to enable quantitative nanomechanical testing during imaging. Featuring Bruker's leading-edge capacitive transducer technology and 1 nm encoded stages, PI 89 is the next-generation descendant of the first commercial, market-leading in-situ SEM nanomechanics platforms. Hysitron PI 89 has a high-stiffness frame that mounts easily to the microscope stage without being a permanent fixture in the microscope. Its compact design allows for maximum stage tilt and minimum working distance, ensuring optimal imaging during testing. A future-proof modular design allows for upgradability of in-situ testing techniques, including 1000°C heating, cryogenic cooling, scratch testing, electrical characterization, scanning probe microscopy imaging, property mapping, and high frequency fatigue testing. Bruker also offers an automated version, PI 89 Auto, which is specifically designed for high-throughput testing.

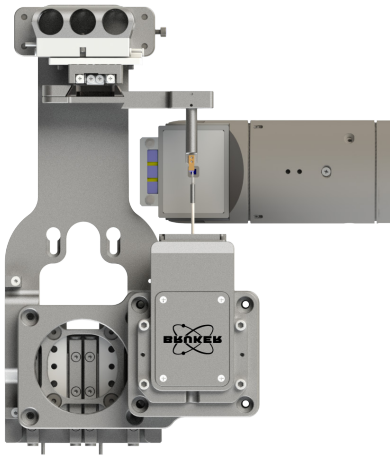
Only Hysitron PI 89 features:

- Proprietary interchangeable robust transducer technology with extended force-range from 10 mN to 3.5 N
- Advanced Direct Drive and Mechanically Amplified flexure options offer extended displacement, lower noise, reduced drift, and intrinsic displacement-controlled testing
- Exclusive load- and displacement-controlled testing modes to enable nanoindentation, compression, tension, fatigue, or bending tests
- New PI 89 Auto for co-localized imaging and seamless switching between nanoindentation, standard SEM imaging, and EBSD/EDS analysis



Nanotribology with Hysitron PI 89.

Advanced Performance and Functionality



TKD- and STEM-compatible Hysitron PI 89.

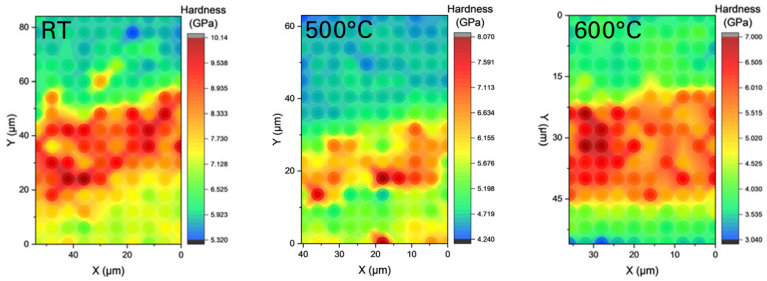
PI 89 incorporates proprietary and leading-edge technology to make in-situ nanomechanical testing easy and versatile. The system has a sliding stage mount that facilitates quick, simple adjustment of sample position relative to the transducer and accommodates the swapping of probes, stages, samples, and add-on options. The encoded linear stages allow for high repeatability during automated motions and when using a large travel range. Bruker's Performech® II advanced control module delivers 78 kHz feedback rate and data acquisition up to 39 kHz to capture transient events, such as fracture initiation.

Nanomechanics at Extreme Temperatures

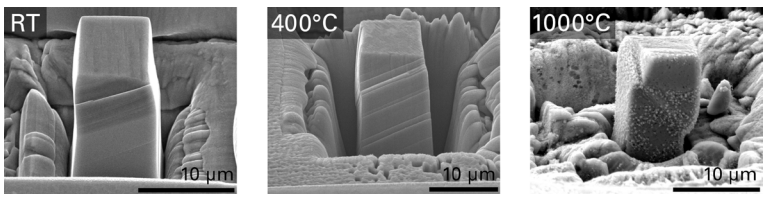
Environmental stage options enable the PI 89 SEM PicoIndenter to measure nanomechanical properties from 1000°C down to below -130°C, as shown below:

High Temperature

Accelerated property mapping (XPM) to visualize hardness distribution across interdiffusion zones of bond coatings. XPM can perform up to one nanoindentation measurement per second for comprehensive quantitative nanomechanical property maps.

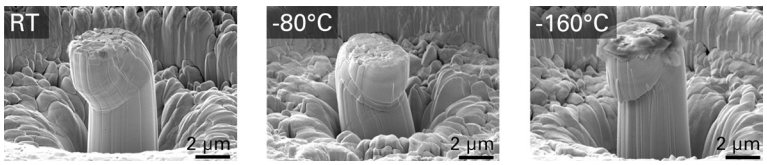


Pillar compression to understand mechanical properties and microstructural changes of bond coatings. In-situ SEM heating with minimal thermal drift is accomplished through use of a resistive sample heater and independent probe heater.

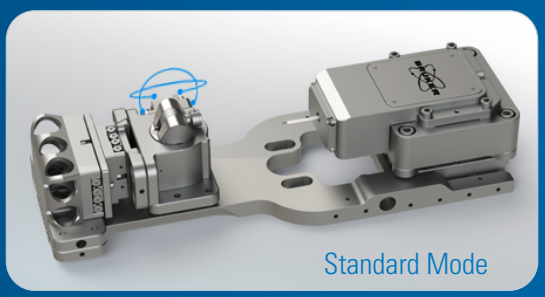


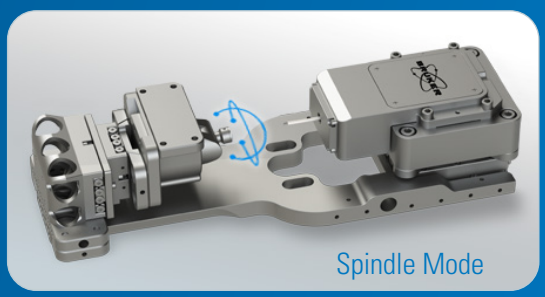
Cryo Temperature

Pillar compression to understand mechanical properties of tungsten under cryogenic conditions. PI Cryo features a proprietary stage design that enables reliable in-situ mechanical testing down to below -130°C.



Optional rotation/ tilt stage (standard on PI 89 Auto) with two configurations enables easy access to additional detectors.

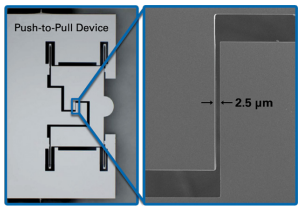




Full Suite of Testing Techniques

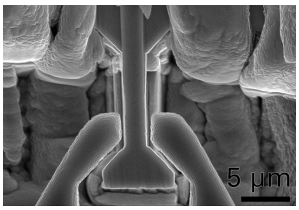
PI 89 utilizes Bruker's state-of-the-art xR transducers and is compatible with high-temperature, cryo-temperature, and rotation/tilt (R/T) stage options. Compatible mode options include XPM, SPM, TKD, EBSD, electrical characterization, direct-pull or push-to-pull tensile testing, nanoDynamic, and nanoScratch. This broad compatibility and flexible modularity enables a wide range of applications in industries like semiconductor, energy, automotive, and biomedical.

Some of our popular modes are:



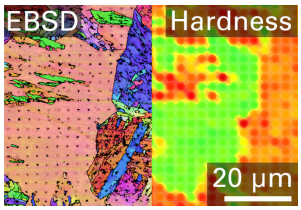
Push-to-Pull Tensile Testing

Test nanowires and thin films using a MEMS-fabricated Push-to-Pull device.



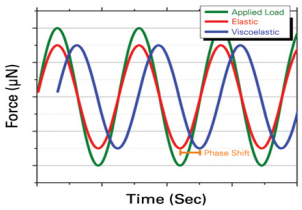
Direct Pull Tensile Testing

Observe deformation mechanisms while measuring tensile properties.



XPM Accelerated Property Mapping

Acquire co-localized EBSD and hardness maps using the R/T stage.



nanoDynamic Fatigue Testing

Measure viscoelastic and fatigue properties while applying an oscillating force.

Hysitron PI 89 Specifications

Max Force (transducer dependent)	10 mN; 0.5 N; >3.5 N
Force Noise Floor (inside an SEM, 60 Hz)	<0.4 µN; <5 µN; 30 µN
Force Noise Floor (in ideal environment, 60 Hz, 10 mN transducer)	<50 nN
Maximum Displacement	5 µm; 30 µm; 150 µm
Displacement Noise Floor (inside an SEM, 60 Hz)	<1 nm
Displacement Noise Floor (ideal environment, 60 Hz, 10 mN transducer)	<0.1 nm
Machine Stiffness	0.9 x 10^6 N/m
Sample Positioning Range and Sensitivity	12 mm x 26 mm x 29 mm (indentation axis); 1 nm (encoded)
System Size (base system)	68 mm x 42 mm x 191 mm (WxHxL); 550 g
Multi-Sample Mount	Yes
Automated Indentation/XPM with Stage	Larger area: (>1 mm x >1 mm)
Rotation and Tilt Stage (included with PI 89 Auto)	Standard and spindle configurations, each with 5 degrees of freedom

Bruker Nano Surfaces and Metrology

Minneapolis, MN • USA
Phone +1.952.835.6366

productinfo@bruker.com

www.bruker.com/Hysitron-PI-89