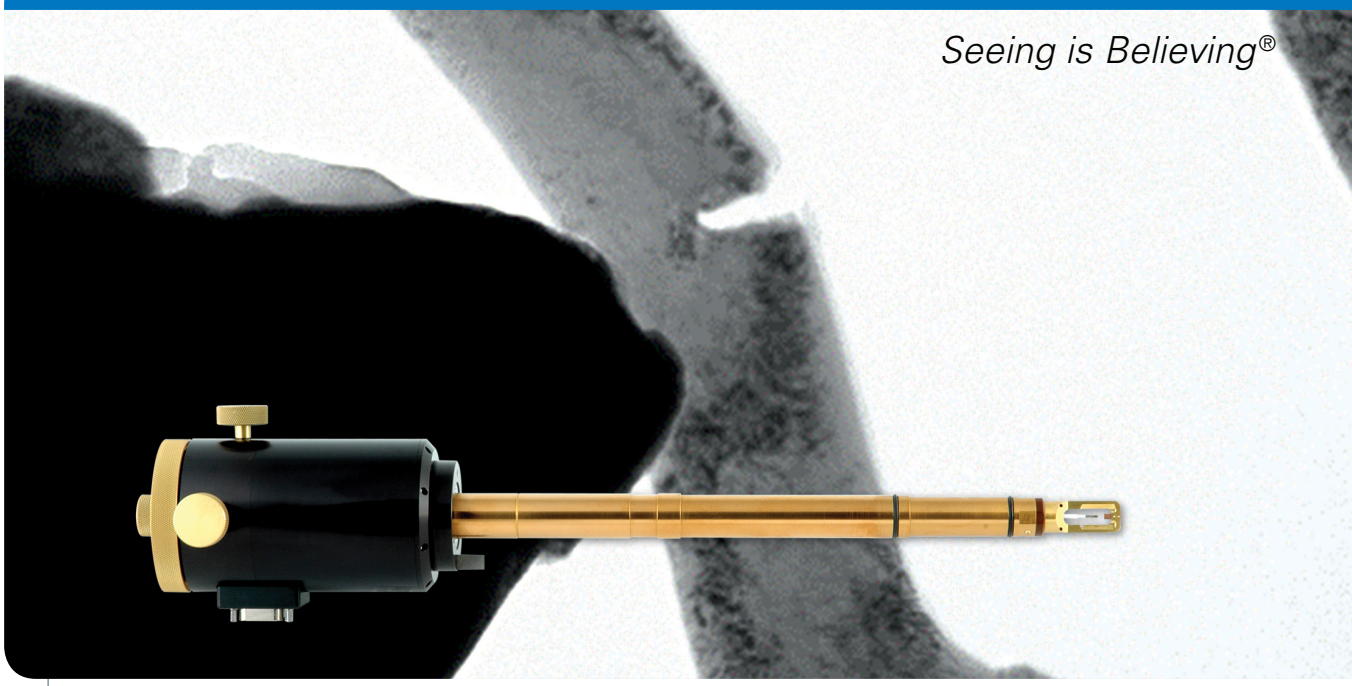
Seeing is Believing®



Hysitron PI 95 TEM PicoIndenter

Quantitative, Direct-Observation Nanomechanical Testing Inside Your TEM

Bruker's Hysitron® PI 95 TEM PicoIndenter® is the first full-fledged depth-sensing indenter capable of direct-observation nanomechanical testing inside a transmission electron microscope (TEM). With this side-entry instrument, it is not only possible to image the mechanical response of nanoscale materials, but also to acquire load-displacement data simultaneously. Further, an integrated video interface allows for time synchronization between the load-displacement curve and the corresponding TEM video.

Coupling a nanomechanical test system with the TEM allows the researcher to determine certain test parameters *a priori*, such as variations in chemical composition or the presence of pre-existing defects in the specimen. In addition to imaging, selected-area diffraction can be used to determine sample orientation and loading direction. Moreover, with in-situ mechanical testing the deformation event can be viewed in real-time rather than "*post mortem*". The pairing of these two high-resolution techniques provides the best of both worlds.

Hysitron PI 95 Features

- Unique miniature and MEMS transducer technologies designed specifically for quantitative nanomechanical testing in most major TEM models
- Load or displacement controlled testing modes for nanoindentation, compression, tension, bending, or scratch testing
- 3D piezoelectric actuator for fine control of test placement and tip-sample alignment in all three directions
- User-changeable conductive probes available in a wide variety of geometries
- Performech® Advanced Control Module with 78 kHz feedback rate and data acquisition up to 38 kHz to capture transient events, such as dislocation bursts
- Proprietary Q-Control mode to actively dampen transducer oscillations in the vacuum environment
- Mechanical data synchronization with TEM video via the TriboScan™ software suite

Unparalleled Performance

The Hysitron PI 95 utilizes three levels of control for tip positioning and mechanical testing. In addition to a three-axis coarse positioner and a 3D piezoelectric actuator for fine positioning, the instrument is equipped with a transducer for electrostatic actuation and capacitive displacement sensing. Two transducer designs are currently available: a patented miniaturized transducer (JEOL compatible systems only) and a patented MEMS transducer. With these newly developed transducers, quantitative force-displacement curves can be acquired in-situ.

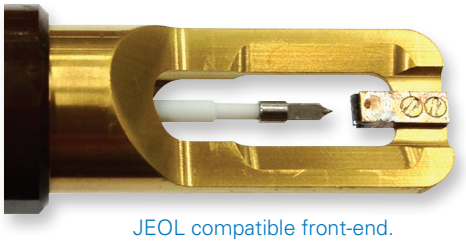
Unlike devices that rely on open-loop, piezo-controlled, series-loading mechanisms for indentation, which introduce unavoidable artifacts into the load-displacement curves, the Hysitron PI 95 transducer provides highly accurate depth-sensing capability. Furthermore, because of the electrostatic actuation aspect of the transducer, substantially larger forces can be realized without suffering a force sensitivity penalty.

Applications

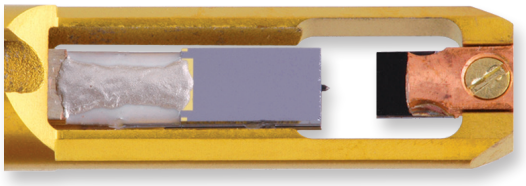
Hysitron PI 95 is uniquely suited for the investigation of nanoscale phenomena. Performing these types of studies in the TEM can provide unambiguous differentiation between the many possible causes of force or displacement transients, which may include dislocation bursts, phase transformations, spalling, shear banding or fracture onset.

When equipped with a miniature flat punch, the Hysitron PI 95 is highly effective for compression testing of individual nanoparticles, nanopillars, and other nanoscale structures. In this configuration, the TEM can be used to characterize the nanostructures before, during, and after the deformation event. Furthermore, the exact contact area is amenable to measurement for stress calculations.

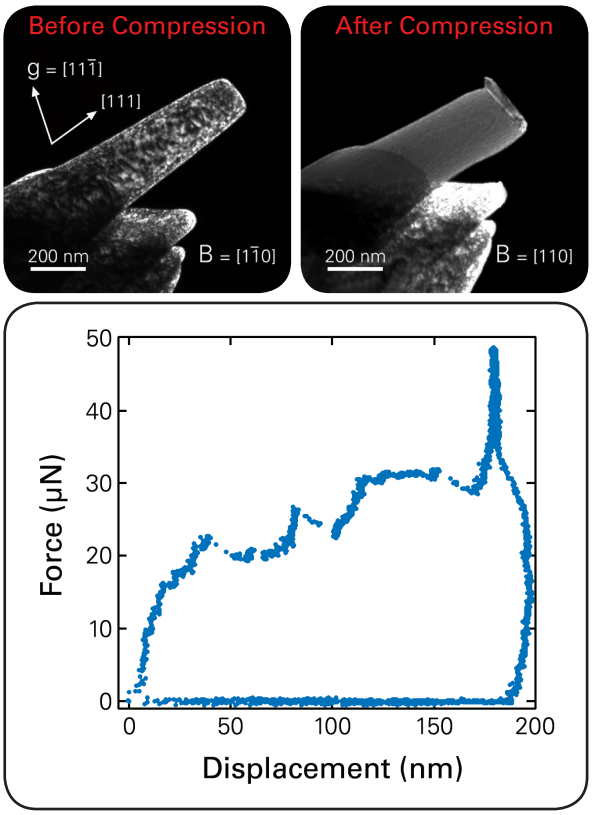
Compatible with JEOL, FEI, Hitachi, and Zeiss microscopes!



JEOL compatible front-end.



FEI / Hitachi / Zeiss compatible front-end with MEMS transducer.



Dark-field TEM images of a Ni nanopillar before and after compression. The high dislocation density initially observed in the pillar has disappeared upon compression.
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