



## Hysitron TI 980 TribolIndenter

- World's Most Advanced Nanomechanical and Nanotribological Testing

# Hysitron TI 980 TriboIndenter

Accelerate Nanomechanical Research to the Next Level

Bruker's Hysitron TI 980 TriboIndenter® operates at the intersection of maximum performance, flexibility, reliability, usability, and speed. It builds upon decades of Hysitron® technological innovation to deliver new levels of extraordinary performance, enhanced capabilities, and ultimate versatility in nanomechanical characterization. The Hysitron TI 980 is everything a superior nanomechanical test instrument needs to be, achieving remarkable advances in control and throughput capabilities, testing flexibility, applicability, measurement reliability, and system modularity.



## Advanced Performech® II Control Module and Electronics

- Maximum performance with high-speed, closed-loop operation
- Industry-leading noise-floor performance
- Integrated multi-technique controls with auxiliary signal I/Os
- 500x faster mechanical testing

## Synchronized Multiscale Measurements

- Seamless measurement with multiple transducers, each fully optimized for the measurement at hand
- Powerful base configuration with nano-to-micro indentation, nanoscratch, nanowear, high-resolution in-situ SPM imaging, dynamic nanoindentation, and high-speed property mapping, with stunning 3D visualization

## Versatile System Control and Data Analysis Software

- Revolutionary new capabilities with TriboScan™ 10 control software, including XPM™ ultra-fast nanoindentation, SPM+ in-situ SPM imaging, dynamic surface finding, enhanced sample navigation, automated system calibrations, and innovative automated testing routines
- Powerful data processing, analysis, and graphing Tribo iQ™ software with programmable data analysis modules and automatic, customizable report generation

## Maximum Flexibility and Future-Proof Characterization Potential

- Multi-layered enclosure delivers superior environmental isolation with integrated access ports for future technique expansion
- Universal sample chuck provides mechanical, magnetic, and vacuum mounting capabilities to accommodate the widest range of samples

# ● Stay at the Forefront of Materials Discovery and Development

Since 1992, the Hysitron brand has been the worldwide leader in the fields of nanomechanical and nanotribological characterization. In close collaboration with researchers and engineers that use these systems every day, Bruker is dedicated to understanding your unique characterization requirements and developing innovative technologies that help solve current and emerging material challenges. The Hysitron TI 980 TribolIndenter is the culmination of these endeavors and delivers unsurpassed performance to meet your evolving characterization needs.

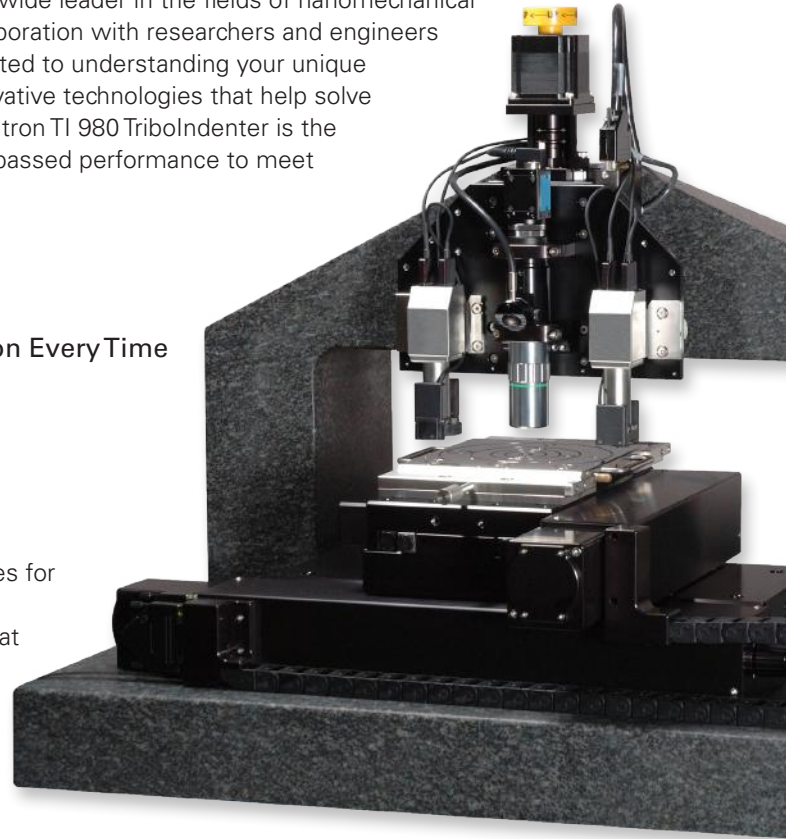
## Simplicity and Speed of Automation

### Automated System Calibrations for Perfection Every Time

- Tip-area function calibration
- Transducer calibration
- Tip-to-optics offset calibration

### Automated Testing Routines

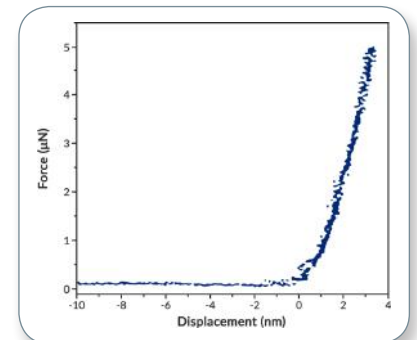
- Rapid, multi-sample automated testing capabilities for high-throughput characterization
- Smart automation routines validate probe shape at user-defined intervals
- High-resolution multiscale imaging with whole-sample optical surveying simplifies the testing process



## Lowest Noise Floors

### Quantitative Characterization to the Low End of Nano

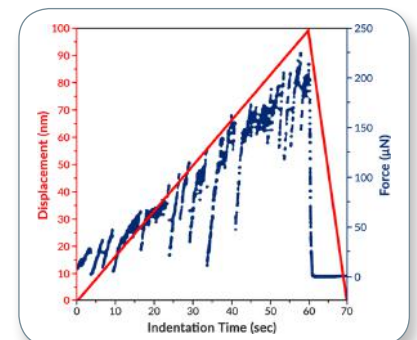
- Quantitative-scale connectivity from the microscale to the very bottom of the nanoscale
- Nanonewton force noise combined with displacement measurement capabilities smaller than diameter of 90% of atoms provide quantitative characterization of nearly any material in any form
- System is configurable to test over 6 orders of magnitude in force and 10 orders of magnitude in displacement
- Force and displacement noise floors are guaranteed at your facility at the time of installation



## Fastest Feedback Control

### Superior Control over the Testing Process

- Provides maximum accuracy, reliability, and repeatability for truly quantitative nanomechanical and nanotribological characterization
- Force and displacement feedback control algorithms developed specifically for the physics of Hysitron transducers
- Performs a full sense-analyze-control loop every 0.00013 seconds, enabling the system to measure and respond to fast transient events and dependably replicate user-defined test functions



# ● Powerful Base Configuration

Maximizing Your Characterization Potential

## In-Situ SPM Imaging

Dual piezo scanners deliver high-resolution sample surface topography imaging and nanometer precision test placement accuracy

## Optical Imaging

High-resolution, color optics enable easy sample navigation and course test positioning

## 2D Capacitive Transducer

Renowned low-noise 2D capacitive transducer technology enables quasistatic nanoindentation, nanoscratch, and nanowear characterization

## Test Stability

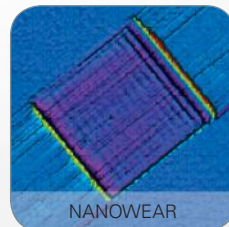
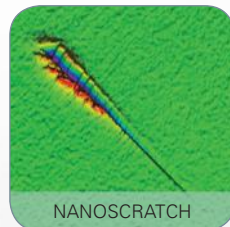
Metrology-grade granite framing assures superior instrument rigidity and test stability

## Vibration Isolation

Integrated active anti-vibration isolation system isolates the instrument from the environment

## Performech II

High-speed, low-noise, fast feedback and acquisition rates provide industry-leading control over the testing process



## Developed From the Bottom Up to Deliver



● **Environmental Isolation**

Multi-layered enclosure protects against thermal, acoustic, and temperature disturbances

● **Property Mapping**

XPM ultrahigh-speed nanoindentation delivers high-resolution, quantitative mechanical property maps

● **Dynamic Nanoindentation**

nanoDMA® III enables viscoelastic characterization, continuous measurement of properties as a function of depth, frequency, and time

● **Modularity**

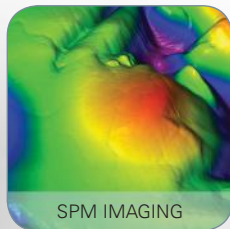
Customizable enclosure panels streamline system upgradability and technique integration

● **Versatile Sample Chuck**

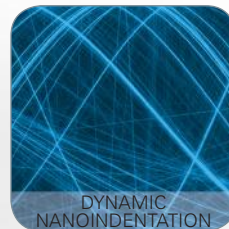
Rapid and reliable sample mounting options: magnetic, mechanical, and vacuum

● **Encoded Staging**

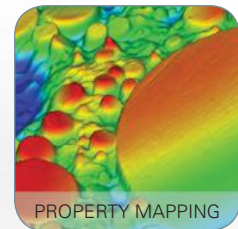
High-precision motorized staging system provides a large accessible test region and automated multi-sample testing



SPM IMAGING



DYNAMIC NANOINDENTATION



PROPERTY MAPPING

# World's Best Nanomechanical Testing

# ● Maximize Characterization Potential

## Performech II Advanced Control Module

### The Definition of Precision Control in Nanomechanics

- Industry-leading force and displacement noise floors deliver maximum measurement accuracy and repeatability
- Ultrafast feedback-control algorithms provide superior control over the testing process
- Peak control of Bruker's full suite of transducers tailors performance specifically to the required test
- Up to 24 channels of data acquisition with a simultaneous data sampling rate of 1.2 MHz on all channels



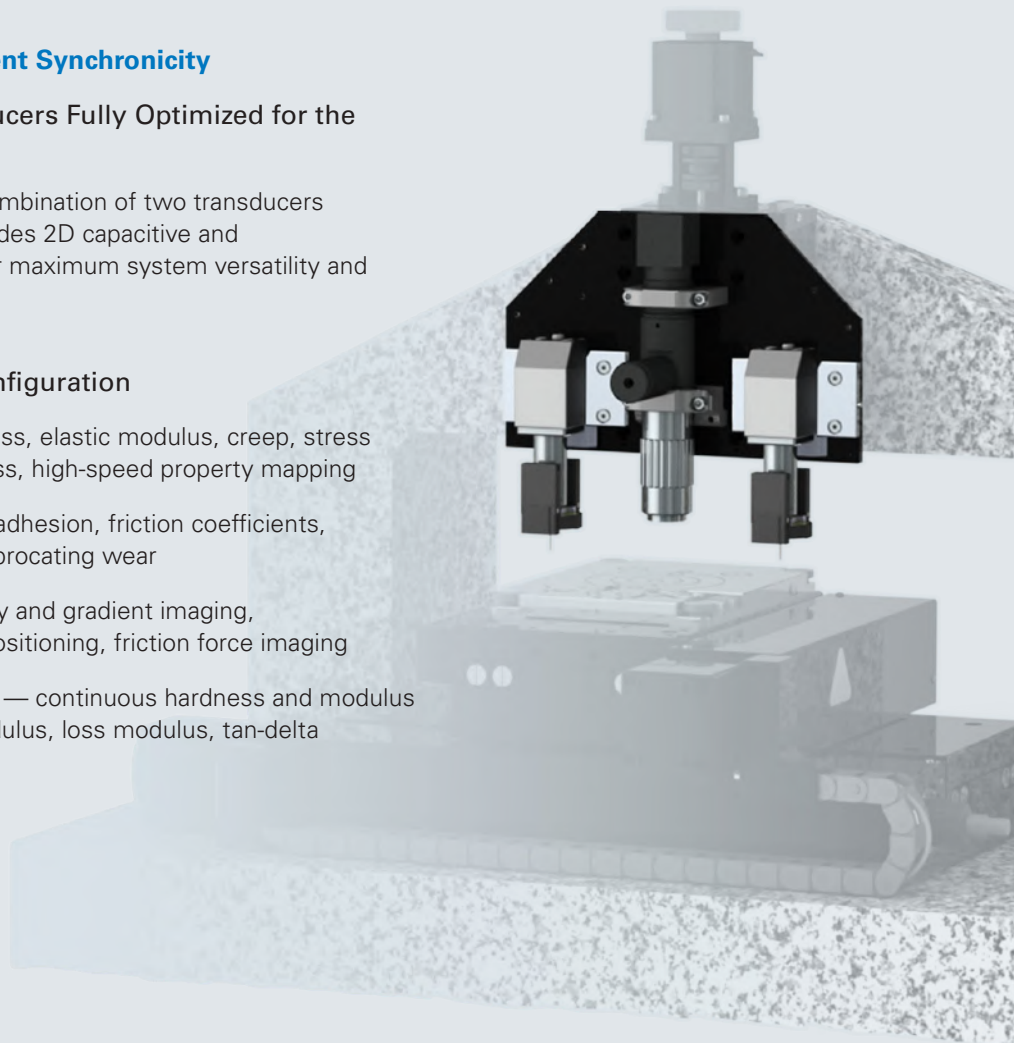
## Multiple Head Measurement Synchronicity

### Complete Suite of Transducers Fully Optimized for the Task at Hand

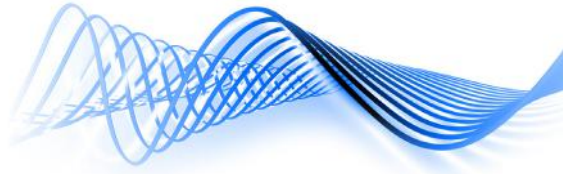
- Seamlessly test with any combination of two transducers
- Standard configuration includes 2D capacitive and nanoDMA III transducers for maximum system versatility and performance channels

### Powerful Base System Configuration

- **Nanoindentation** — hardness, elastic modulus, creep, stress relaxation, fracture toughness, high-speed property mapping
- **Nanotribology** — thin-film adhesion, friction coefficients, scratch/mar resistance, reciprocating wear
- **SPM Imaging** — topography and gradient imaging, nanometer-precision test positioning, friction force imaging
- **Dynamic Nanoindentation** — continuous hardness and modulus depth profiling, storage modulus, loss modulus, tan-delta



# • Take a Leap Forward in Nanomechanical Testing



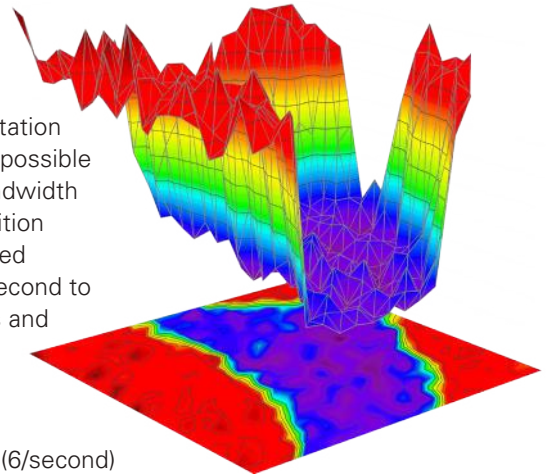
## nanoDMA III – Dynamic Nanoindentation

Bruker's nanoDMA III is a powerful dynamic nanoindentation technique to provide a continuous measurement of elastic-plastic and viscoelastic properties as a function of indentation depth, frequency, and time.

- Universally applicable technique for comprehensive characterization of materials—from soft polymers to hard coatings
- Coupled AC and DC force modulation for reliable and quantitative nanoscale dynamic characterization from the initial surface contact
- Reference frequency in-situ drift correction capabilities deliver maximum accuracy during long test cycles

## XPM – Accelerated Property Mapping

Bruker's XPM sets a new industry standard for nanomechanical testing throughput paired with measurement resolution and accuracy. With XPM, more data can be taken in a single afternoon than could be collected in an entire year using traditional nanoindentation methodologies. These exclusive performance capabilities are made possible by the coupling of three industry-leading technologies: 1) a high-bandwidth electrostatically actuated transducer, 2) fast control and data-acquisition electronics, and 3) top-down in-situ SPM imaging. These synchronized technologies can perform six nanoindentation measurements per second to achieve comprehensive quantitative nanomechanical property maps and property distribution statistics in record time.



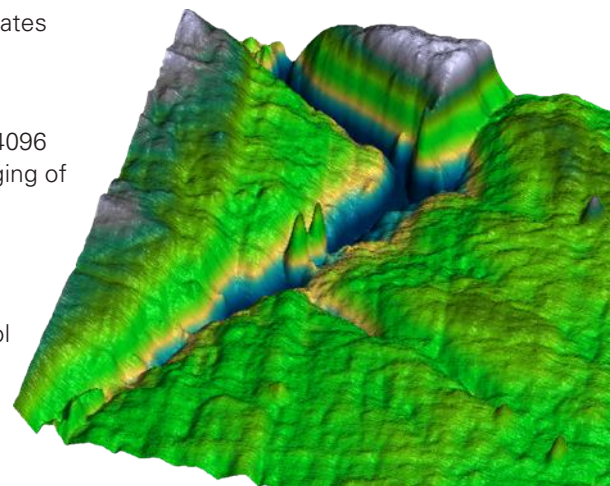
## Measure More in Less Time

- Ultrahigh-speed quantitative mechanical property measurements (6/second)
- Rapid, high-resolution spatial mapping of hardness and modulus with distribution statistics
- Robust tip-area function calibration within a minute
- 500x faster data acquisition than traditional nanoindentation testing
- xSol® environmental control stage compatibility for rapid testing throughput under extreme environmental conditions

## SPM+ Imaging for Superior Nanomechanical Testing Results

Bruker's pioneering scanning nanoindenters utilize the same probe to both raster the sample surface for topography imaging and to conduct the nanomechanical test. Using the same probe for imaging and measurement maximizes test placement accuracy, provides immediate post-test observation of material deformation behavior, and accelerates testing throughput.

- High-precision probe placement accuracy ( $\pm 10$  nm)
- Fully customizable SPM resolution options from 64x64 to 4096x4096
- Quick imaging of high-aspect-ratio features with rectangular imaging of any X-Y resolution combination
- Industry-leading nanomechanical SPM image resolution with enhanced color palettes
- Compatible with additional techniques, including lateral force imaging, nanoDMA III, nanoECR®, and xSol environmental control



## Powerful System Control and Analysis

### TriboScan 10 — Powerful Testing Flexibility for Unlimited Characterization Potential

- Full integration of Bruker's suite of testing techniques into a single, intuitive software package
- Tab-based software architecture makes software navigation simple and helps users easily follow the instrument operational sequence
- Flexible, segment-by-segment definition of the testing sequence provides greater control over the test parameters in all modes of operation



### Tribo iQ — Adaptable Data Analysis

- Easy-to-use interface, fully customizable to perform basic-to-advanced data analyses
- Intuitive data organization with simplified workflow and three-click-to-report functionality
- User-writable data processing and analysis modules for streamlined data analysis
- Open-architecture analysis modules make collaboration easy

## Hysitron TI 980 Upgrade Options

xSol Environmental Stage	Environmental stage enables quantitative nanomechanical and nanotribological characterization as a function of temperature, atmospheric composition, and humidity level
nanoECR	In-situ conductive nanoindentation correlates nanomechanical properties, material deformation behavior, and electrical contact resistance
xProbe	Rigid-probe MEMS transducer delivers the ultralow force and displacement noise floors typically associated with AFMs
iTF	Patented intrinsic thin film mechanical property solution that provides quantitative, substrate-free elastic properties of thin films and layered structures
3D OmniProbe™ and MultiRange NanoProbe™	Expanded force and displacement testing range transducers allow microscale mechanical and tribological testing
Synchronized Raman Spectroscopy	Synchronization provides correlation of mechanical and tribological properties with material structure and chemistry
Modulus Mapping™	Scanning dynamic nanoindentation mode provides quantitative, high-resolution maps of modulus distribution across a surface
Fluorescence Microscopy	Integrated fluorescence microscope enables fluorochrome-guided test placement
Electrochemical Cell	Cell enables the quantitative, in-situ study of nanoscale mechanical and tribological behavior under oxidizing and reducing conditions
Automated Probe Changer	Push-button exchange of testing probes provides maximum uptime, ease of use, and probe-customizable automation routines
Sample Chucks	Diverse range of magnetic, mechanical, and vacuum chucks secure almost any sample for testing, up to a 300 mm wafer
TriboAE™	Sensor allows in-situ, through-tip monitoring of acoustic signals generated from fracture and deformation events during the nanoindentation process
TribolImage™	Package enables time-resolved cyclic nanoscale scratch/wear characterization

## ● Bruker Nano Surfaces Division

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