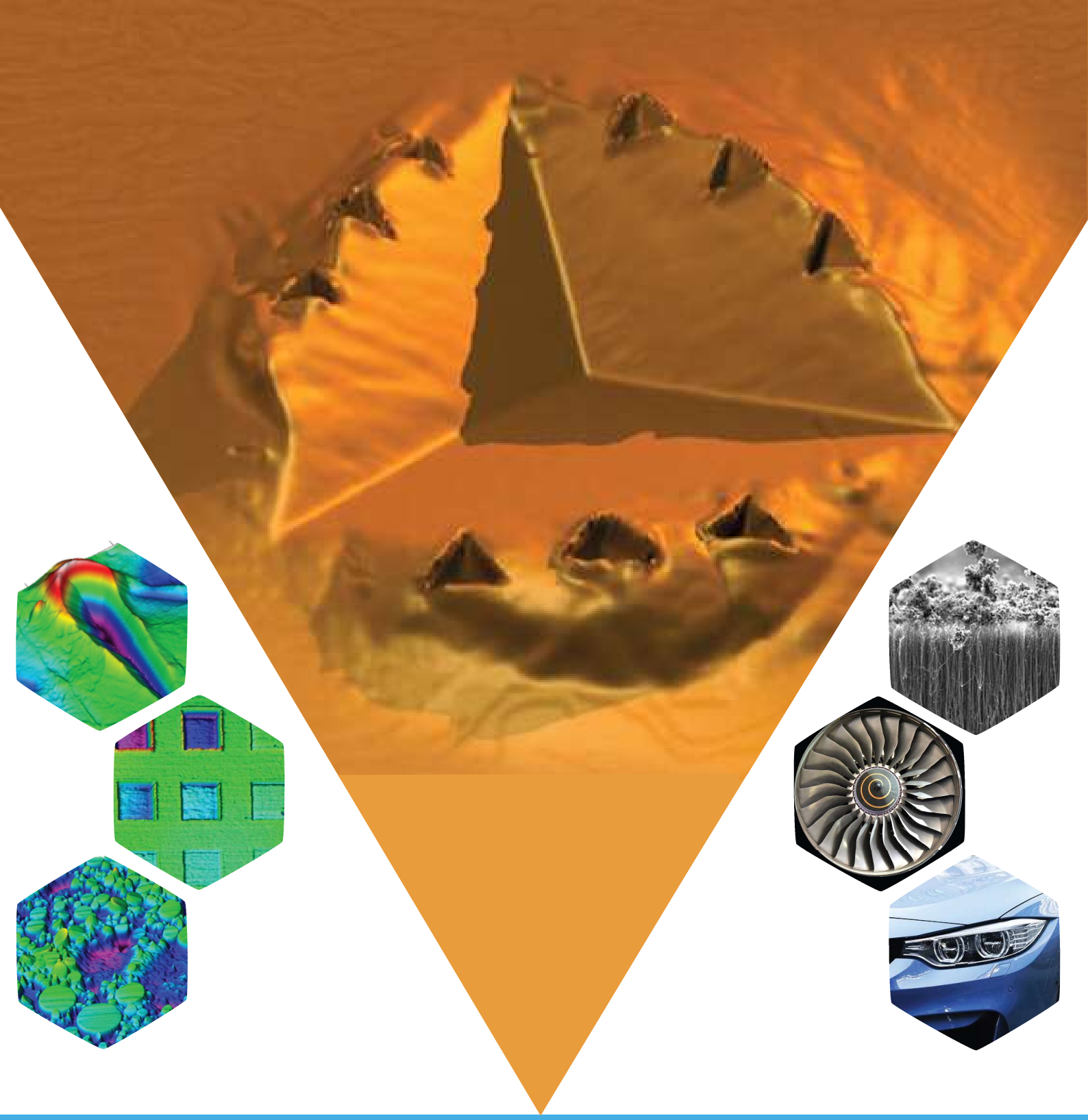


ADVANCED MATERIAL TESTING

from *nano* to *micro* scale

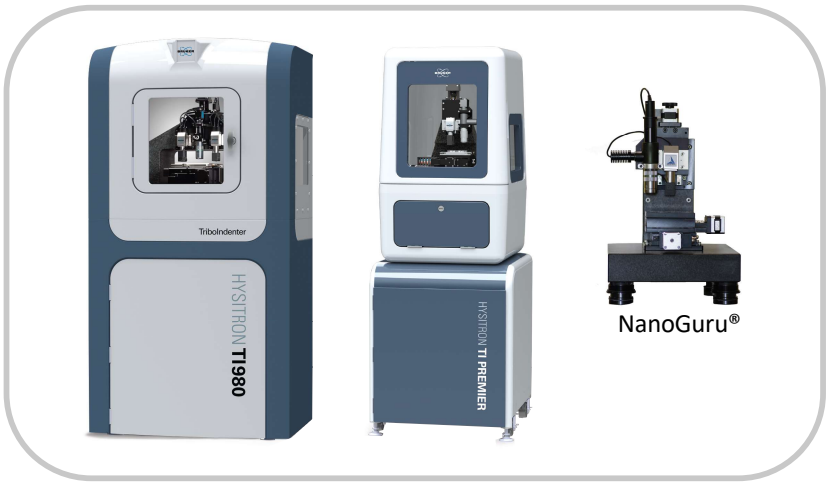
INDUSTRON®

Introduction

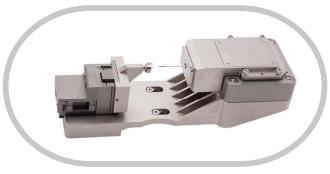
Industron Nanotechnology (Formerly known as Hysitron Nanotechnology India) is a scientific instrumentation company involved in the development and commercialization of nanomechanical test instruments. It was founded in 2011, as the R&D center of Hysitron Inc., to develop hardware and software for Hysitron product line and to facilitate technical and scientific collaborations with Indian academic institutions and industries. Since its inception, many products have been developed and commercialized, and sold by Hysitron(now Bruker) worldwide and many research collaborations were accomplished. Two notable products are BioIndenter, which received the R&D 100 award in 2014 and NanoGuru®, which was released to the worldwide market in 2016.

Our Research and Development division has been recognized as in-house R&D unit by Department of Scientific and Industrial Research (DSIR), government of India, since 2017. One of Industron's commitments and core competencies is to promote knowledge in the field of nanomechanics. We do this through collaborations with academic institutions, exhibiting and participating in conferences, meetings, workshops and tradeshows throughout the year. "Nanoyantrika" is one of the flagship events organized by Industron every two years, which mainly focuses on nanomechanical testing.

In the spirit of supporting and working together with the Indian scientific community Industron is pleased to announce the access of the sample testing facility "Nanomechanics Research Lab" on chargeable basis to the academic and industrial research community.



NanoGuru®



Picoindenter

xSol 800^{O}C Heating Stage

Applications of Nanoindentation

Steel Industry

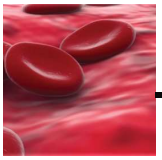
+ Nanoindentation & Tribology
+ Property Mapping
+ Scanning Probe Microscopy

Pharmaceutical

+ Mechanical Properties of Molecular Crystals
+ Property Mapping

Foundry, Metal Forming, Joining

+ Nanoindentation & Tribology
+ Property Mapping
+ Scanning Probe Microscopy



Biomaterials

+ Nanoindentation & Tribology
+ Viscoelastic Property Measurement
+ Dynamic Mechanical Analysis

Automotive and Aerospace

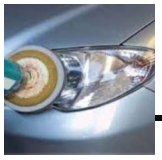
+ Nanoindentation & Tribology
+ High Temperature Property Mapping
+ Scanning Probe Microscopy
+ Creep

Polymer and Plastic

+ Dynamic Mechanical Analysis: Viscoelastic Property Measurement
+ Time/Frequency Dependent Properties
+ Temperature Sweep / Glass Transition Time-Temperature Superposition

Food & Beverages

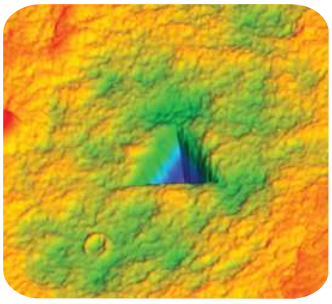
+ Adhesion Strength of Thin Films
+ Mechanical Characterization of Corrosion Resistant Coatings
+ Wear Testing



Surface Protection & Paint Coatings

+ Adhesion Strength of Coatings
+ Continuous Depth Dependent Property Measurement
+ Thin Film Property Measurement (Thickness From 1nm)

Techniques



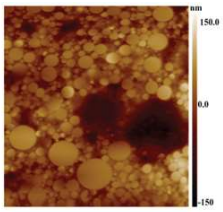
Nanoindentation is an instrumented mechanical property measurement technique to measure properties such as Hardness and Modulus at nanometer length scale.

Nanoindentation gives localized mechanical properties quantitatively by applying a force to drive the indenter probe into a sample surface and measuring the depth of indent during loading and unloading.

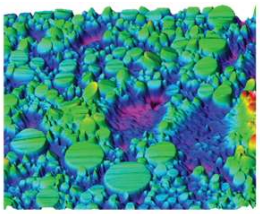
Test can be performed in either load-controlled or displacement controlled feedback mode.

Scanning Probe Microscopy

The unique feature which gives a nanometer resolution 3D topographical image of the surface by raster scanning the sample surface with the indenting probe. In-Situ SPM functionality enables researchers to select and perform site specific indentation experiments with an accuracy of +/- 10nm



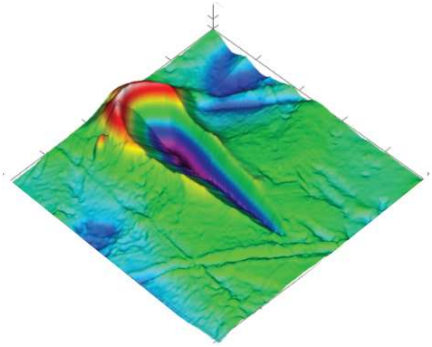
40x40 μm SPM Image
Glass Beads in Polymer Matrix



3D Image
Glass Beads in Polymer Matrix

Nanoscratch

Quantify scratch resistance, critical delamination forces, and friction coefficients with simultaneous normal and lateral force and displacement monitoring. Provides quantitative force and displacement data for tribology, coating thickness, interfacial adhesion, and friction studies.



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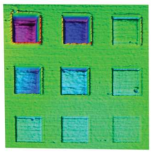
ScanningWear

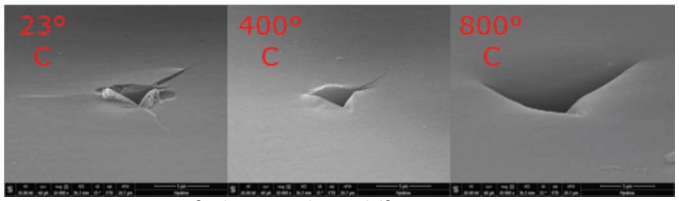
Helps to observe and quantify wear volumes and wear rate at sub microstructure level along with in-situ imaging capability. Multiple pass ScanningWear tests can be performed at different normal scanning force on the surface of the material being tested.



ScanningWear test on DLC coating on computer hard disk

High Temperature Testing

xSol High Temperature Stage enables quantitative, accurate, and reliable nano and micro mechanical characterization at elevated temperatures up to 800°C. The ability to understand nanoscale mechanical properties at high temperatures is imperative to developing materials capable of reliably performing in extreme operational environments. xSol stage offers high thermal stability and short stabilization time.



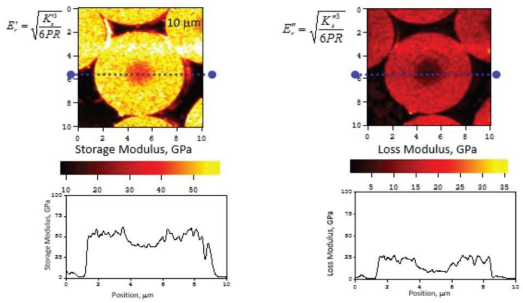
SEM image of Silicon at three different temperatures

Creep

With the help of nanoDMA III technique, reference creep testing permits measurement of the creep behaviour of small volumes of material, with the minimal effect of thermal drift. Reference creep test relies on the relationship between contact area and contact stiffness to calculate properties over time periods as long as several hours. Creep properties can be measured at temperature as high as 800°C.

Modulus Mapping

Modulus mapping, a DMA based mechanical property mapping technique, which quantitatively maps modulus (both storage and loss), stiffness and other visco-elastic properties from a single SPM scan. During the imaging process, the system continuously measures the stiffness and phase lag of the sample as a function of the position. The result is a set of 65,536 points (256 x 256) of mechanical properties from a single map.

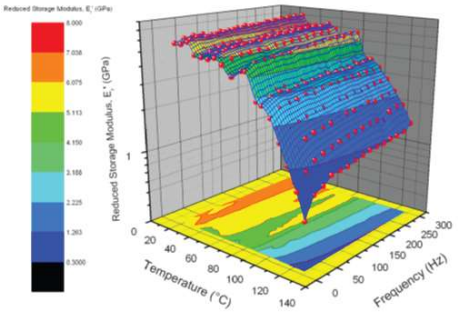


Modulus Mapping on Carbon Fiber-Epoxy Matrix

Dynamic Mechanical Analysis

Investigate the time-dependent properties of visco-elastic materials (Polymers and biomaterials) using a dynamic testing technique. During DMA experiment, sinusoidal AC force is superimposed to the quasistatic DC force.

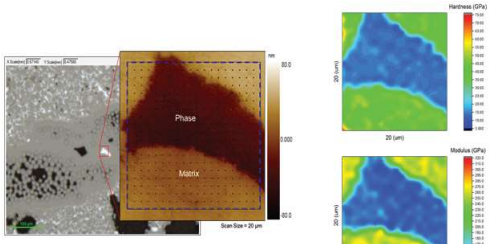
CMX algorithm is useful for quickly determining the mechanical properties of the thin film coatings by appropriately limiting the depth ranges to avoid substrate effect. Reference frequency sweep technique is a solution for the characterization of frequency dependent visco-elastic materials, in which the frequency of the dynamic load can be swept between 0.1 Hz to 300 Hz at constant quasi-static load and mechanical properties can be measured as a function of frequency.



3-D log plot of reduced storage modulus vs. temperature and frequency from frequency sweep

Accelerated Property Mapping

Accelerated Property Mapping (XPM), can be used for the quick mapping of localized mechanical properties. XPM is a technique for performing large numbers of indentations in user defined grids, in short span of time, up to six indents per second.



Optical – SPM – XPM Indentation
Ceramic Matrix Composite – SiC/SiC

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