

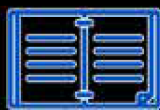
# NanoGuru™

NANOMECHANICAL EDUCATION SYSTEM



***For Every Discipline of Undergraduate Engineering Students***

**INDUSTRON**  
NANOTECHNOLOGY PVT LTD



Curriculum



Samples



Software



Hardware

# NanoGuru™

## Quantitative Characterization from the Microscale to the Nanoscale

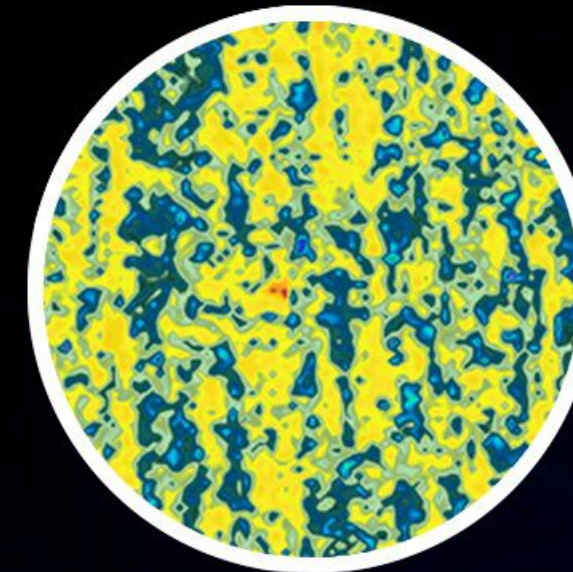
### Nano & Micro Indentation

Educate beyond traditional hardness testing with depth-sensing indentation, providing quantitative hardness, modulus, and fracture characterization over the nano and micro scales



### Property Mapping

Understand spatially resolved nanomechanical properties



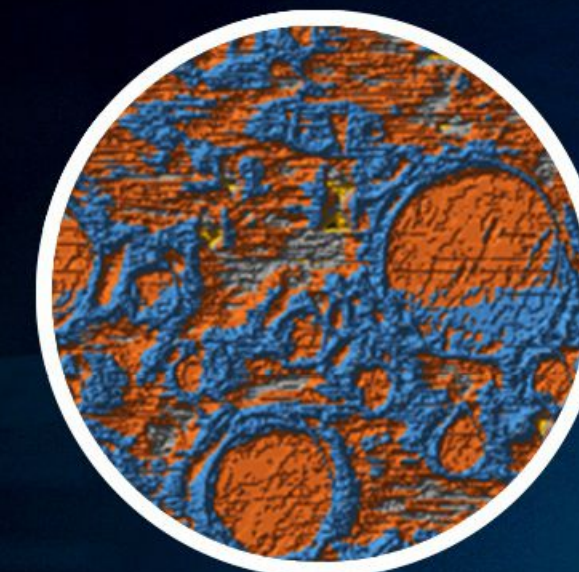
### Time Dependent Properties

Measure quantitative time dependent properties such as creep, stress relaxation, and viscoelasticity at the nanoscale

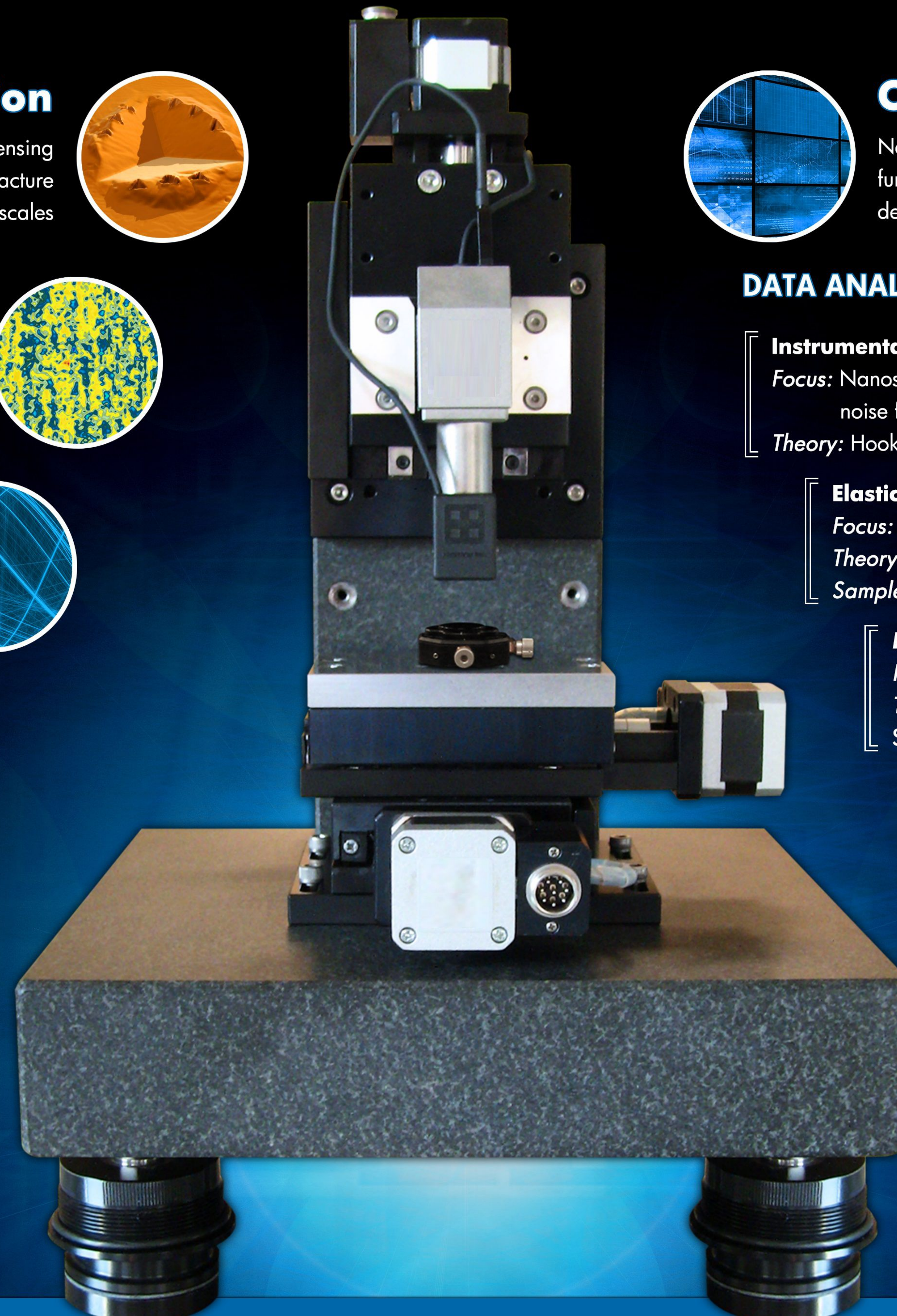


### Topography

Raster scan the test probe over the sample surface for in-situ characterization of surface roughness, identify material phases, and precisely position measurements



**An educational system to prepare engineers for the challenges of the 21<sup>st</sup> Century**



### Curriculum Supported

NanoGuru is supported by curriculum developed to help students understand fundamental principles of length-scale dependent mechanical properties and deformation mechanisms

#### DATA ANALYSIS • DESIGN OF EXPERIMENTS • CRITICAL THINKING

##### Instrumentation and Measurement Science

*Focus:* Nanoscale force, displacement, and stiffness measurements, SPM imaging, resolution, noise floor, accuracy, repeatability

*Theory:* Hooke's Law, measurement principles, optical microscopy, SPM

##### Elasticity, Hardness, and Instrumented Indentation

*Focus:* Depth sensing nanoindentation

*Theory:* Strength of materials, contact mechanics, hardness and modulus

*Samples:* Fused Quartz, Al, Polycarbonate

##### Modulus Measurements for Different Crystalline Orientations

*Focus:* Modulus dependence on crystal orientation, anisotropy

*Theory:* Atomic bonding strengths, atomic packing factor, interatomic spacing

*Samples:* Al and Si  $-(100)$   $(111)$   $(101)$

##### Structure Property Correlation

*Focus:* Deformation mechanisms, scale dependence, understanding localized properties/measurements

*Theory:* Crystal structure versus microstructure, defect density, basic processing

*Samples:* Cu, Steel (1018, 1024)

##### Thin Film Mechanical Properties

*Focus:* Protective coatings, composites

*Theory:* Stress field interaction, interfaces

*Samples:* Al on Si, Au on Sapphire, TiN coatings on steel/glass

##### Time Dependent Mechanical Properties

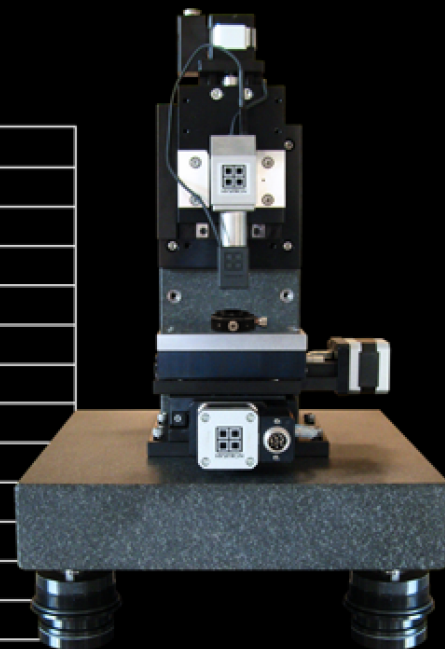
*Focus:* Time dependent mechanical properties

*Theory:* Viscoelasticity and creep

*Samples:* PMMA, In

# NanoGuru™ Specifications

Force Noise Floor	<150nN
Force Resolution	1nN
Displacement Noise Floor	<1nm
Displacement Resolution	0.006nm
Displacement Range	5µm
Force Range	10mN
In-Situ SPM Imaging	
SPM Image Size	50µm x 50µm
SPM Image Resolution	256x256
Positioning	
X,Y,Z Stage Travel	50mm x 50mm x 50mm
XY Step Resolution	50nm
Z Step Resolution	10nm



## *Teaching Engineering Concepts at the Nanoscale*

### NanoGuru Highlights

- Depth sensing nano and micro indentation testing for teaching engineering concepts of elasticity, plasticity, strength, stress, strain, ductility, viscoelasticity, brittleness, toughness, adhesion, and roughness
- Properties can be measured at a single location, in an automated array of multiple locations, and as a function of indentation depth
- In-situ Scanning Probe Microscopy Imaging for micro/nano structural analysis, surface roughness analysis, pre and post indent analysis, structure property correlation, and site specific selection with a lateral resolution of 10nm
- Optional metallurgical optical microscope with calibrated sample translators for optical imaging, microstructure analysis and micro/macro scale structure property correlation
- Built-in vibration isolation for smaller foot print and portability with environmental enclosure to isolate the noise from measurement
- 24 bit DSP based controller for data acquisition and control
- Includes curriculum and samples, training, and collaboration for curriculum development

### Contact Information

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