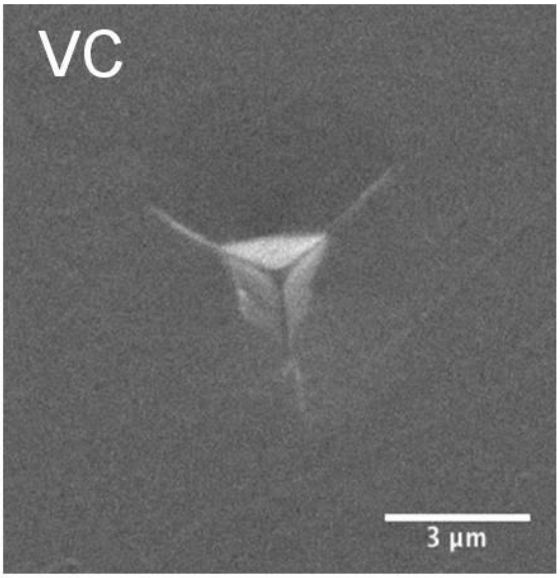
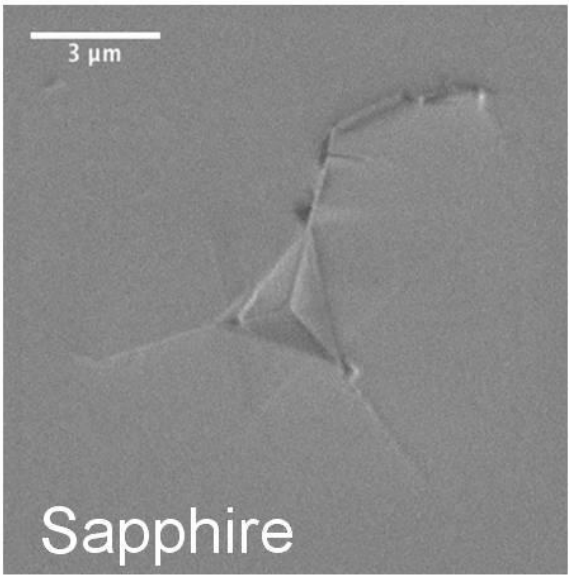
Application Notes

Nanomechanics Inc. is hard at work converting data and results from the many materials and devices we have tested, but we can only type so fast. The following application notes reflect a very small percentage of the materials we have tested. If you don't see your application on the list, please contact us. Chances are we've tested a similar specimen.

Measuring the Dynamic Elastic Properties of Polymers

Characterizing the viscoelastic properties materials like polymers is critical for damping and vibration control applications. The core technologies at Nanomechanics, Inc. can characterize the dynamic moduli of polymers as a function of applied frequency. Furthermore, this testing can be done on as-produced parts and does not require the large volumes and specific geometries of traditional DMA test equipment.

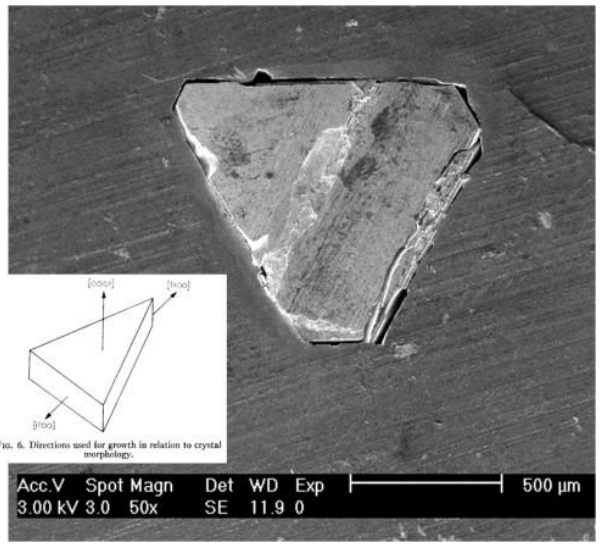




Indentation Fracture Toughness of Brittle Materials

The mechanical property that describes the resistance to crack growth in brittle materials is called “fracture toughness”. Traditionally, measuring this property can be time consuming and expensive due to sample preparation. Indentation testing with a cube corner indenter geometry facilitates the measurement of fracture by providing fast results and large data sets for enhanced statistics. Furthermore, indentation can provide information on the crack initiation load, which can be utilized for comparing different material processing conditions. This technique can also be applied to hard coatings, for which there is no standard fracture toughness geometry.

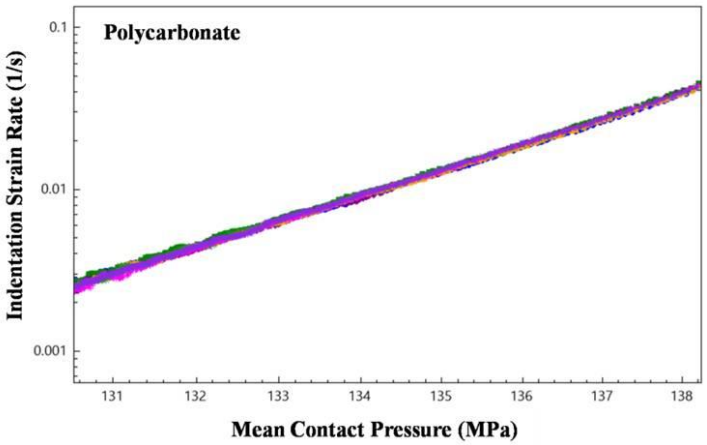
Indenter Tip Materials for High Temperature Testing



Nanomechanics offers single crystal tungsten carbide tips on a molybdenum holder for use in high temperature test applications. These tips are rated to over 1000°C and are available in a variety of tip geometries.

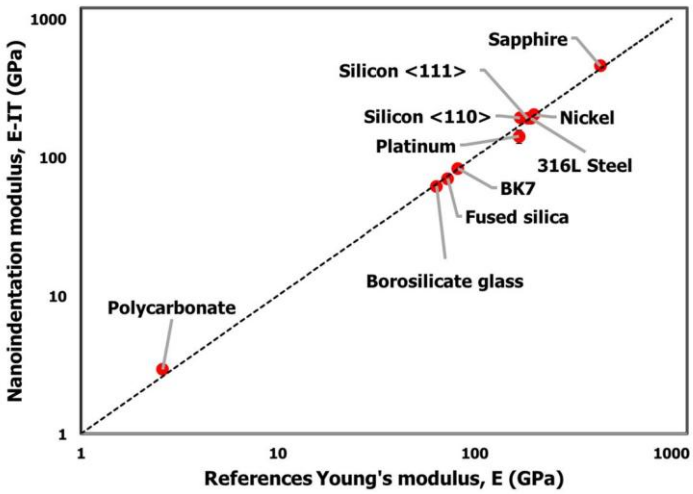
These tips also feature high electrical conductivity and so are suitable for use in both in-situ and ambient experiments.

Strain Rate Sensitivity of Polymers



Polymers often exhibit time dependent elastic deformation. In addition, polymers often have time dependent plastic deformation, i.e., creep. The instruments at Nanomechanics, Inc. are fully capable of characterizing the creep of polymers and other materials by applying strain-rates and measuring applied pressures. The information from these tests are extremely useful for formability and extrusion processes in plastic processing.

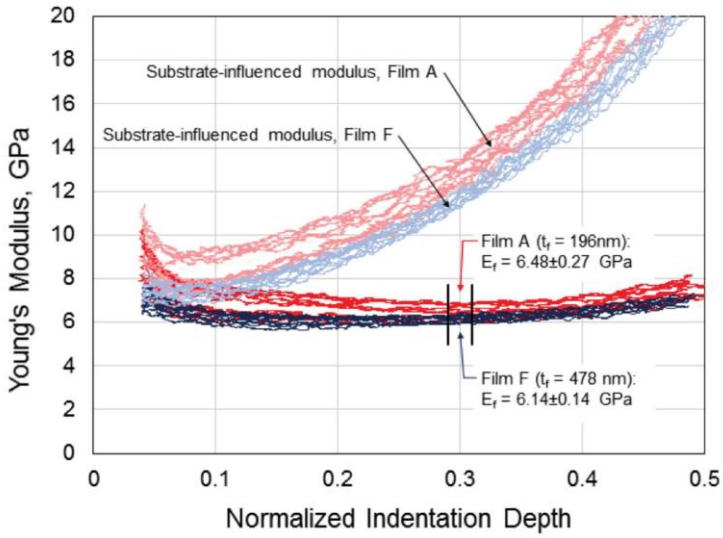
ISO 14577 Standardized Hardness and Elastic Modulus Testing



The iNano and iMicro nanoindenters from Nanomechanics, Inc. are compliant with ISO 14577 standardized hardness testing. Application of the standard test methodolgy results in extremely precise and accurate measurements of hardness and elastic modulus. For reference, some measured elastic moduli from indentation are plotted against traditional measurements of elastic moduli in the figure to the right for various materials ranging from polymers to metals to stiff ceramics.

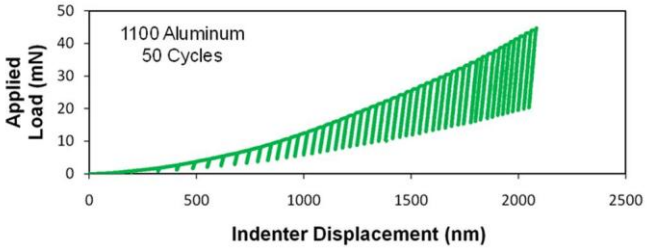
Thin Films: Substrate Independent Elastic Modulus Measurements

Knowledge of the mechanical properties of thin films is important for designing reliable components. Whether you have soft films on hard substrates, or stiff films on compliant substrates, Nanomechanics, Inc. has test methodologies for accurately characterizing substrate independent elastic moduli with indentation testing. Furthermore, we are pushing the limits of thin film testing by providing data below 20nm of thickness, and in some cases less than 10nm.

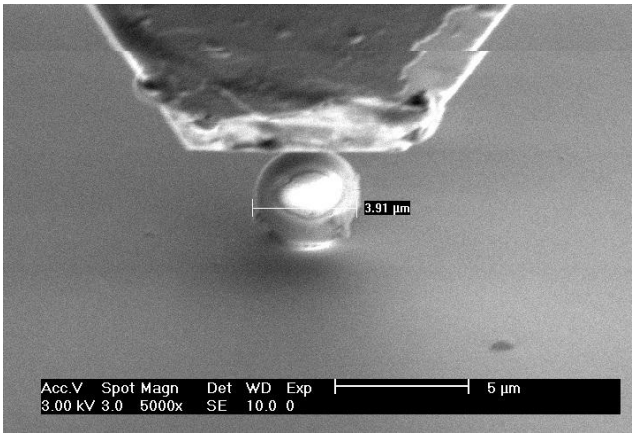


Cyclic Indentation Testing

In addition to dynamic measurements of properties as a function of depth, Nanomechanics, Inc. also offers the ability to perform cyclic indentation testing. Our advantage is speed, precision, and accuracy. Each load-unload cycle shown in the figure was done in 4 seconds, resulting is efficient measurements of accurate elastic modulus and hardness.



Nanomechanical Testing of Microspheres: Particle Crush Application

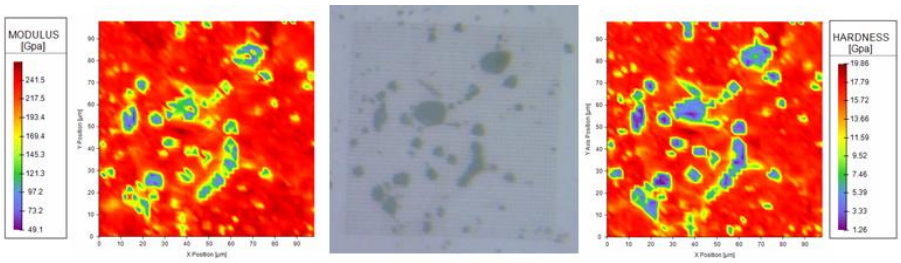


Microspheres have myriad uses in modern life. Hollow microspheres are used to lower the density of manufactured materials. In modern liquid chromatography, the analyte is forced through a column packed with glass microspheres, thus causing components of the analyte to separate based on the speed at which they can pass through the column. In electronic packaging, metalized polymer microspheres are packed together to create flexible, reliable connections. The glass microspheres tested in this work are incorporated into paints to enhance appearance and mar-resistance. In all these applications, knowing the mechanical properties of the microspheres is a critical aspect of design. With relatively minor changes in hardware and test procedure, the InForce 50 Actuator becomes a general small-scale compression testing system.

Complex Shear Modulus of Compliant Biomaterials

This application note demonstrates how the iNano nanoindenter is used to test biological materials, and explains the unique hardware, procedure, and analyses required for such testing. Edible gelatin is used for this demonstration, because it has properties comparable to tissue, but is widely available and can be prepared in a repeatable and controlled way.

High-speed Mechanical Properties of CoorsTek TTZ Zirconia and Single-Crystal Alumina



In this work, we used standardized and advanced instrumented indentation to measure the mechanical properties of two common technical ceramics: CoorsTek TTZ zirconia and single-crystal alumina. By means of standardized indentation, we measured the Young's modulus of the TTZ to be 249±9.7 GPa and the Vickers hardness to be 1600±65 kg/mm2; we likewise measured the Young's modulus of the alumina to be 435±14 GPa and the Vickers hardness to be 2820±100 kg/mm2. By means of a proprietary indentation technique (NanoBlitz 3D) we generated mechanical-properties maps of the TTZ which illuminate the mechanical distinction between the primary cubic zirconia phase and an inter-granular silica phase.

For In detail studies please read the following which may be downloaded at http://www.hightechpakistan/hd5.html

1. Complex Shear Modulus of Compliant Biomaterials
2. Dynamic Mechanical Analysis (DMA) of Polymers by Oscillatory Indentation
3. High-speed Mechanical Properties of CoorsTek TTZ Zirconia and Single-Crystal Alumina
4. Standardized Nanoindentation ISO 14577
5. Young's Modulus and Hardness of Thin Low-κ Films Using Nanoindentation
6. Youngs-Modulus-of-Glass-Microspheres