Nanoindentation with the NanoTest Vantage

The NanoTest Vantage offers a combination of industry-leading instrumental stability with excellent performance over a wide load range, 0-500 mN with the NanoTest. At the heart of the NanoTest is its Nanoindentation capability.
Compliance to industry standards - The NanoTest Vantage is fully compliant to relevant international nanoindentation standards including ISO14577 and ASTM E2546–07

How it works

Nanoindentation with the NanoTest Vantage uses electromagnetic force application and capacitive depth measurement to measure the elastic and plastic properties of materials on the nano-scale.

- Hardness
- Modulus
- Creep

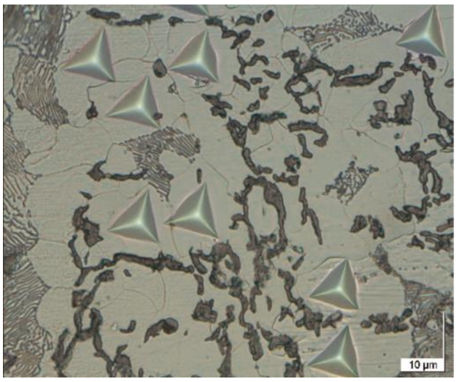


***Figure 1** shows specifically targeted indents in gray cast iron*

Additional features of Nanoindentation module with The NanoTest Vantage:

- Industry leading stability and long hold creep measurements
- Temperature control, environmental enclosure, anti-vibration
- Automated scheduling of experiments and mapping of surface properties
- Targeted area specific and multiple indentation modes
- Wide load range
- Depth profiling Load/partial-unload technique
- User friendly software with full flexibility

Upgrade options include: High strain rate Nano-Impact & Fatigue, Scratch & Wear, MicroTest loading head, Elevated Temperature Nanoindentation (750 °C), Cold Stage (-30 °C) , Liquid cell, Purging environments, 2D & 3D Imaging.

Nanoindentation results combined with results from another technique will give a fuller picture of the performance of a material under service conditions.

Wide load range

Low load/depth performance

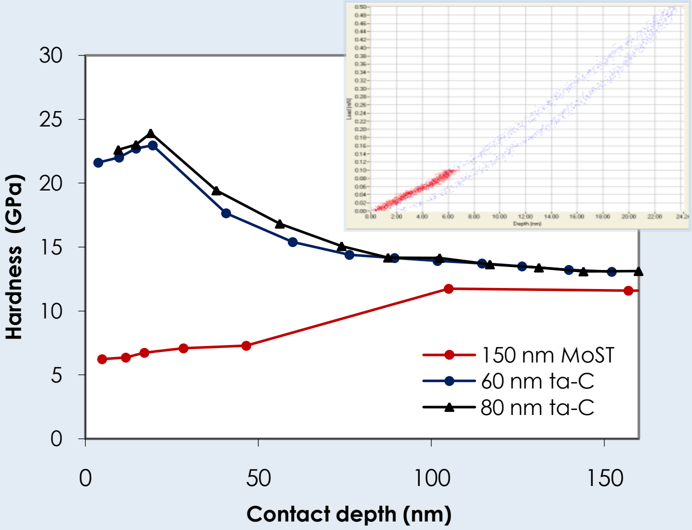


Figure 2 shows 0.1 and 0.5 mN indentations into an 80 nm ta-C film on Si. The Insert shows how the hardness and modulus vary for this and other thin films. For extremely small indentations into hard ta-C films contact is completely elastic but elasto-plastic at higher loads. The low noise floor and high sensitivity of The NanoTest Vantage enables accurate measurements of thin films for MEMS applications.

High load/depth performance

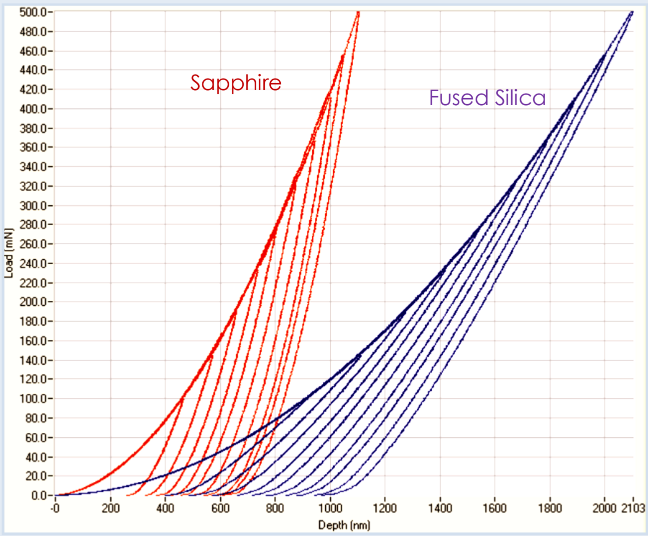
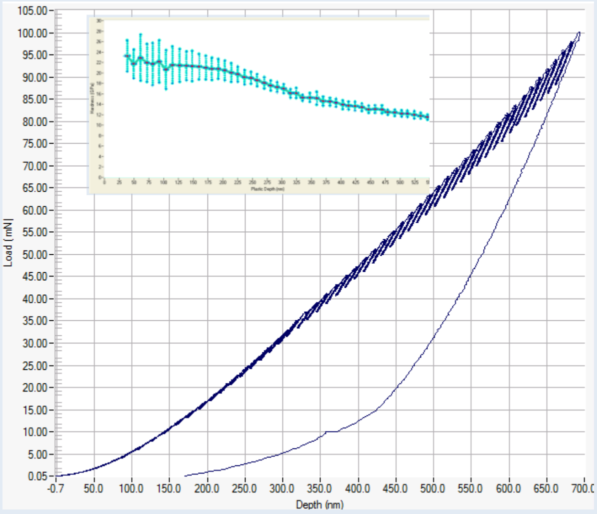


Figure 3 shows 10 indentations to peak loads of 100-500 mN on fused silica and sapphire.

Mapping and Profiling: building up a 3D profile of mechanical properties



Mapping and profiling with the NanoTest Vantage is the ideal tool to study the variation in mechanical properties across surfaces and with increasing penetration into the material. The distribution of mechanical properties can be mapped at high resolution.

Modulus (GPa) **Hardness (GPa)**

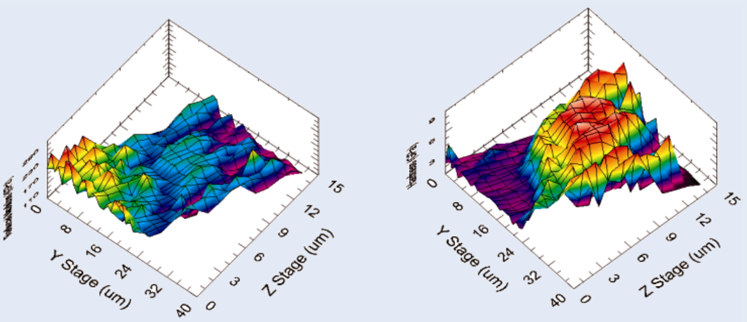


Figure 4 the load-partial unload (multicycle) technique, for the rapid profiling of hardness and elastic modulus variation, on a hard amorphous carbon film on a softer substrate.
The inflexion point in the multi-cycle indentation marks the transition to substrate-dominated load support.

Figure 5 shows a large (15 x 25) indent array with 1 µm pitch mapping distribution of hardness and stiffness of intermetallic phases in a solder bond.

- **Industry leading stability and long hold creep measurements**
- **Wide load range**
- **Targeted area specific and multiple indentation modes**
- **Temperature control, environmental enclosure, anti-vibration**
- **Automated scheduling of experiments**
- **Depth profiling and mapping**
- **User friendly software with full flexibility**

Indentation Creep

In addition to providing reliable measurements of hardness and modulus, excellent system stability enables tests of longer duration such as indentation creep experiments which can be used to reliably extract properties such as the stress exponent or creep compliance and, in conjunction with the High Temperature module, the activation energy for creep processes.

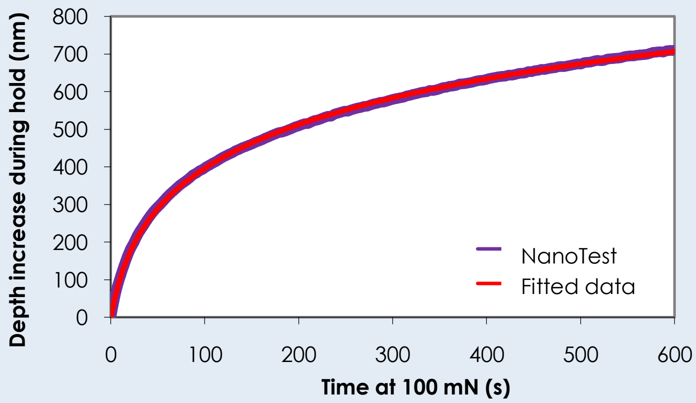


Figure 6 shows excellent agreement between fitted and experimental data for the creep of PMMA during a 600 s hold at 100 mN in determining of the viscoelastic properties of polymers.

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NanoTest Vantage