Nanoindentation

Overview

Nanoindentation testing, also referring to as Instrumented Indentation Testing (IIT) and Depth Sensing Indentation (DSI), is a technique for measuring the mechanical properties of materials. It is a development of traditional hardness tests such as Brinell, Rockwell, Vickers, and Knoop. Instrumented indentation testing is similar to traditional hardness testing in that a hard indenter, usually diamond, is pressed into contact with the test material. However, traditional hardness testing yields only one measure of deformation at one applied force, whereas during a nanoindentation test, force and penetration are measured for continuously as the indenter is in contact with the material. Nearly all the advantages of nanoindentation derive from this continuous measurement of force and displacement. Additionally, the Continuous Stiffness Measurement (CSM) method enables a continuous measure of mechanical properties during loading by superimposing a small oscillation on the primary loading signal and analyzing the resulting response of the system by means of a frequency-specific amplifier. This allows for full characterisation of location dependent properties in three dimensions.

The Keysight Nanoindenter G200, located at the Bernal institute, is a state-of-the-art indentation tested that allows for the characterisation of nanoindentation properties over six orders of magnitude (from nanometers to millimeters).

- In addition to indentation, capabilities extended to do quantitative scratch and wear testing, probe-based imaging, expanded load capacity up to 10N, and customisable test protocols.

- Measurement of deformation The maximum load possible with the standard XP Indentation head is 500 mN and with the High Load option is 10 N, with a load resolution of 50 nN.

- Two sample stages are available; a standard G200 stage with useable surface area of 100mm x 100mm and positioning accuracy of 1μm; a Nanovision stage with useable surface area of 100μm x 100μm and positioning accuracy of <2nm.

Technical Specifications

- Displacement resolution — < 0.01 nm
- Total indenter travel — 1.5 mm
- Maximum indentation depth — > 500 μm
- Load resolution — 50 nN
- Positioning accuracy — 1 μm / 2 nm (using Nanovision Stage)

Figure 1. Keysight Nanoindenter G200

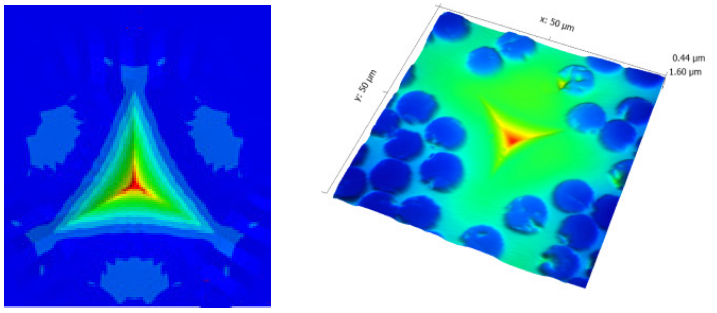

Figure 2. Numerical/Experimental comparison of a residual nanoindentation impression. The residual impression was measured using the G200's Scanning Probe Microscopy (SPM) capability. Material is courtesy of Dr Mark Hardiman

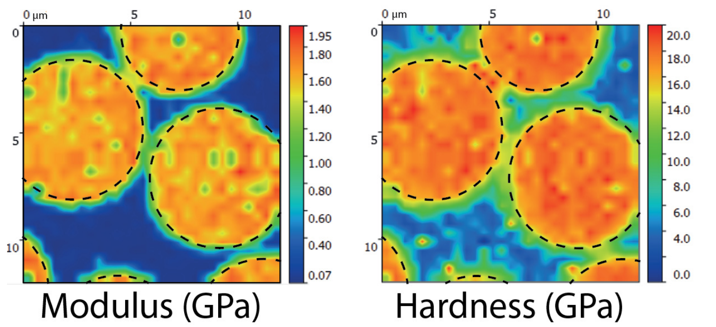

Figure 3. Mehcanical property map showing the variation of Modulus and Hardness across the surface of a Carbon Fibre Reinforced Polymer (CFRP) material. Material is courtesy of Dr Mark Hardiman

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