Nanoindentation Agilent Nano Indenter G200

Materials & Surface Science Institute

Introduction

Nanoindentation is a technique for measuring mechanical properties such as hardness and elastic modulus of small volumes of materials. A tiny tip of very precise geometry (Figure 1a) is made to press into a sample using a small load in order to make minute indentations on the sample. The load applied and the depth of penetration of the tip into the surface are measured in real-time during the indentation process (Figure 1b). As the geometry of the indenter tip is known, the data recorded can be analysed to determine the indentation area. From these analyses, the mechanical properties of the sample can be measured.

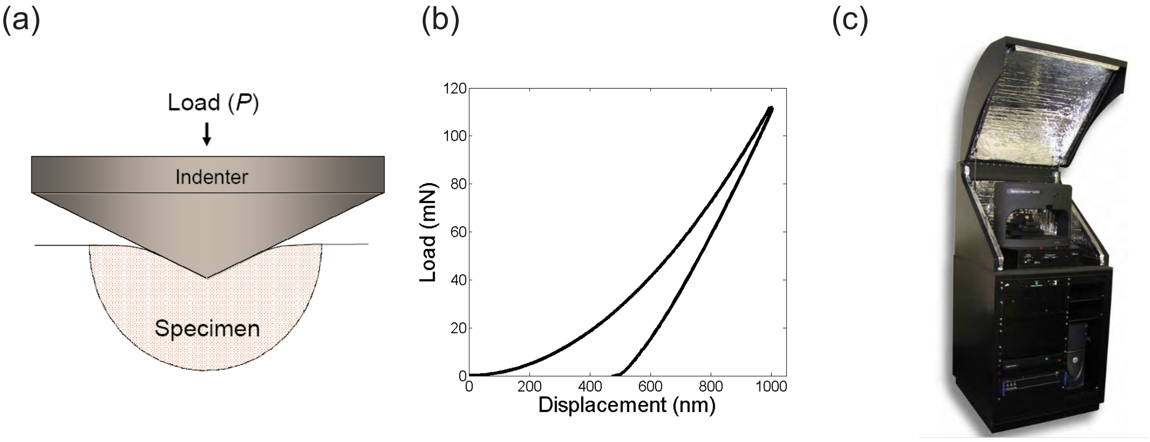

Figure 1: (a) Schematic of sharp indenter tip penetrating the specimen, (b) Typical load-displacement curve for a nanoindentation experiment, (c) Agilent Nano Indenter G200.

MSSI's Agilent Nano Indenter G200 (Figure 1c) is an instrumented indentation tester for measuring the mechanical properties of a wide variety of materials including metals, composites, ceramics, polymers, fibres, thin films, coatings etc. Indentation test sites on the sample can be targeted with nanoscale precision. The load capabilities of the Nano Indenter G200 can be expanded from 500 mN with the standard option to 10 N with the High Load option. Continuous Stiffness Measurement (CSM) can be used for continuous measurement of contact stiffness as a function of depth, thus allowing for mechanical properties to be calculated as a function of depth (Figure 2).

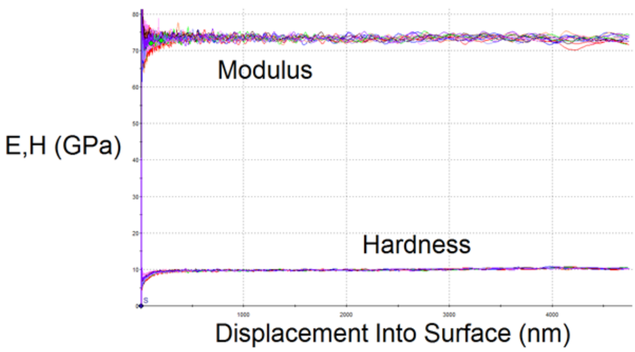

Figure 2: CSM data showing Elastic Modulus and Hardness vs Penetration depth for a fused silica sample (Courtesy: Mark Hardiman, MSSI).

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The Lateral Force Measurement (LFM) helps to provide three-dimensional quantitative analysis for scratch and wear testing. The NanoVision stage option can be used to probe the surface of a sample, generating a 3D map of the surface, as well as allowing for indentations to be positioned to within an accuracy of 2 nm.

(a) (b)

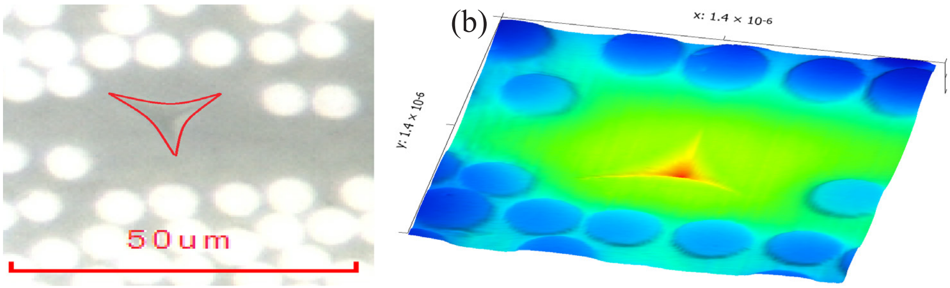

Figure 3: Nanoindentation of HTA/6376 carbon fibre composite (a) Micrograph and (b) Scanning image of in-situ matrix indent showing residual indent and fibre-matrix relief (Courtesy: Mark Hardiman, MSSI).

Technical Specification

Standard XP Indentation Head

Displacement resolution:	<0.01 nm
Total indenter travel:	1.5 mm
Maximum indentation depth:	>500 µm

Loading capability

Maximum load (standard):	500 mN
Maximum load with High Load option:	10 N
Load resolution:	50 nN
Contact force:	<1.0 µN

Indentation placement

Useable surface area:	100 mm x 100 mm
Positioning accuracy:	1µm
Useable surface area with Nanovision:	100 µm x 100 µm
Positioning accuracy with Nanovision:	<2 nm

Temperature: at room temperature only.

Additional Features

Scratch and Wear testing with Lateral Force Measurement.

A variety of different indenter tip geometries (Berkovich, Vickers, Knoop, Spherical and Cube-Corner).

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