

Revolutionary Agilent Express Test Option for the Nano Indenter G200

Data Sheet

Features and Benefits

- Award-winning, high-speed Express Test option compatible with all Agilent G200 indentation DCM II and XP heads, and stages
- Ultrafast testing capabilities (up to 100 indents at 100 different surface sites in as little as 100 seconds)
- True mechanical-properties maps
- Controlled-force or controlled-displacement mode
- Performs area-function calibration in minutes
- Rapidly evaluates Young's modulus and hardness with robust statistics
- Histograms automatically generated
- Simple "point-and-shoot" testing
- Negligible thermal drift

Applications

- Metals
- Glasses
- Ceramics
- Structural polymers
- Thin films
- Low-k materials

Express Test Overview

A recent recipient of the prestigious R&D 100 Award, the Agilent Express Test option enables the world's fastest

nanindentation for mechanical-properties mapping. This award-winning technology, which has been designed and optimized for exclusive use with Agilent Technologies' popular Nano Indenter G200, delivers high-precision data on a wide variety of materials. The Express Test option is compatible with all G200 indentation DCM II and XP heads and translation stages.

Methods enabled by Express Test are ideal for applications involving metals, glasses, ceramics, structural polymers, thin films, and low-k materials. With Agilent NanoSuite >6.2 software, users can automatically generate histograms and 3D mechanical-properties maps. Graphs and supporting data are easily exported to Microsoft Excel.

Express Excellence: Nothing Else Compares

The Nano Indenter G200 utilizes electromagnetic actuation to achieve unparalleled dynamic range in force and displacement. Agilent's innovative Express Test option enhances the reputation of the G200 as the world's most accurate, flexible, and user-friendly instrument for nanoscale mechanical testing.

Express Test allows the Nano Indenter G200 to be operated in controlled-force or controlled-displacement mode. Testing is simple, just "point" and "shoot". Area-function calibration can be performed in minutes, Young's modulus and hardness can be rapidly evaluated



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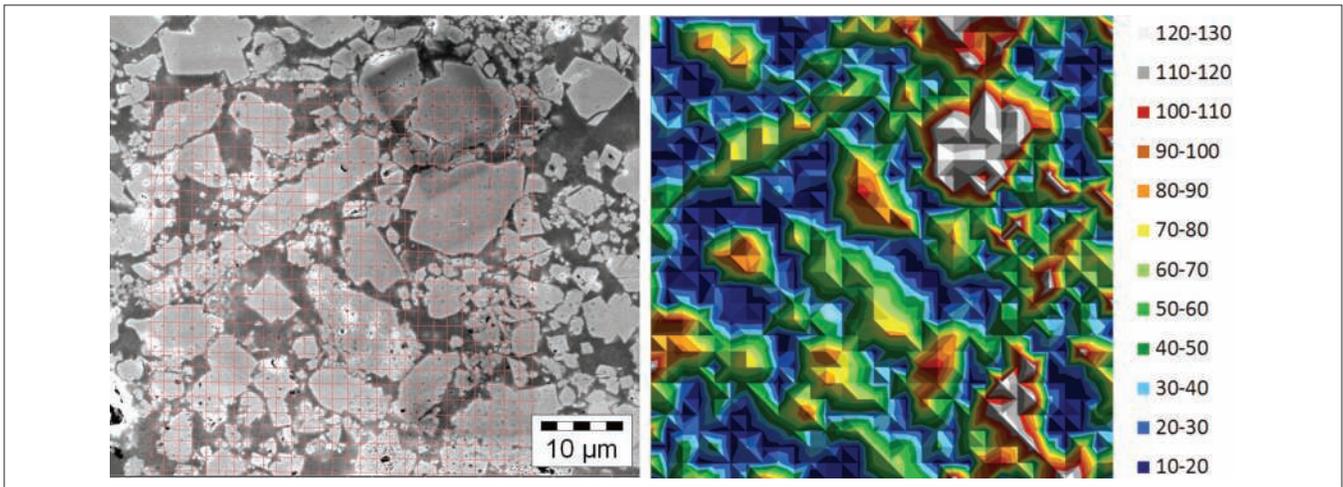


Figure 1. (Left) Surface of a Lithium/polymer battery cathode; grid identifies indentation sites. (Right) Express Test modulus, in GPa. Testing via DCM II and NanoVision (1 indent/sec).

with robust statistics, and quantitative maps of mechanical properties can be generated in record time. Thermal drift is negligible thanks to Express Test's unprecedented speed.

Express Elements: G200 Configurations

Express Test is compatible with all Agilent Nano Indenter G200 indentation heads and stages! Each element of the G200 has been optimized to facilitate ultrafast performance. Among the many benefits of the G200 design are convenient access to the entire sample tray, excellent sample positioning

accuracy, easy viewing of the sample position and sample work area, and simplicity in sample height adjustment to speed throughput.

The standard G200 configuration uses an Agilent XP indentation head. To extend the range of load-displacement experimentation to the surface contact level, the G200 can be equipped with Agilent's Dynamic Contact Module II (DCM II) indentation head.

The DCM II offers G200 users loading capability up to 30mN, easy tip exchange for quick removal and installation of application-specific tips, and a full 70µm range of indenter travel. The

DCM II also provides the ability to measure deformation over four orders of magnitude — from nanometers to tens of microns. Real-world testing shows that its noise levels are typically less than an angstrom, ensuring the best resolution of any indenter on the market today. The DCM II has the lowest noise floor of any instrument of its type.

The Nano Indenter G200 can be configured with either a standard stage or Agilent's NanoVision option, which integrates a high-precision closed-loop positioning system and image-analysis software. The NanoVision stage moves the sample quickly and accurately from one position to the next under the

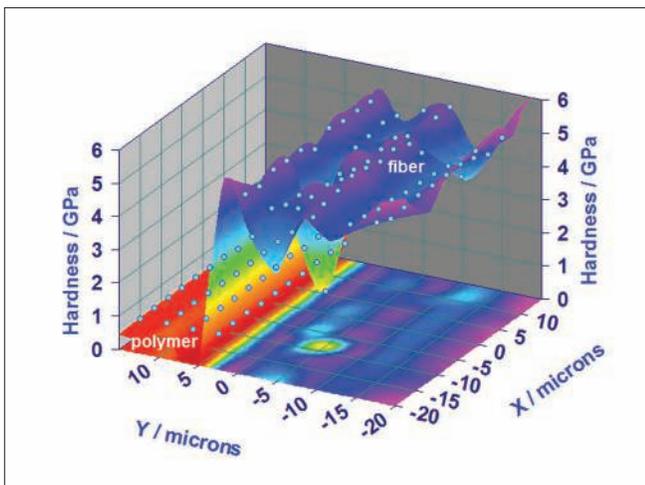


Figure 2. Hardness of fiberglass via Express Test. Purple striations distinguish three individual fibers in the bundle. Testing done with DCM II head and NanoVision (1 indent/sec).

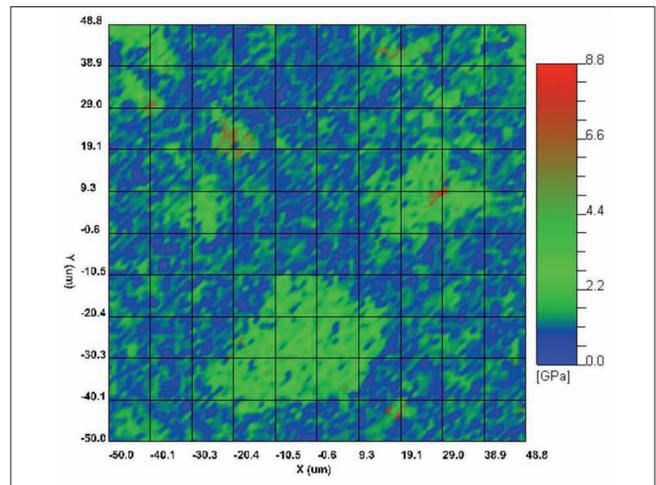


Figure 3. Hardness map of cement paste done with Express Test, Using DCM II head and NanoVision (1 indent/sec).

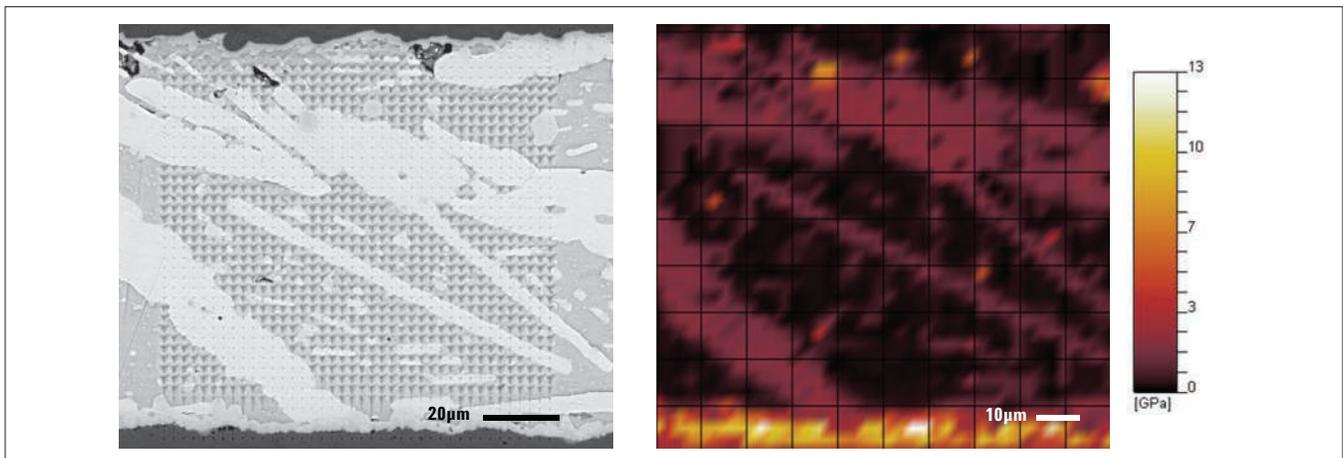


Figure 4. (Left) Aged SAC 305 solder with Au plating, manifesting bulk and boundary intermetallic compounds. (Right) Hardness map via Express Test, with XP head and NanoVision (1 indent/3 sec).

indenter with minimal change in elevation. Over its range of motion (100µm x 100µm) the NanoVision stage maintains planarity to within 10nm. Because of the superior flatness of stage travel, the indenter can hover just over the surface, thus minimizing surface-approach time.

Seamlessly orchestrating these complementary system components is NanoSuite Professional, a premium-performance software package designed by Agilent to give G200 users the ultimate combination of speed, flexibility, and ease of use.

Whether you work in an academic or an industrial setting, Agilent Express Test is ready to revolutionize your research today.

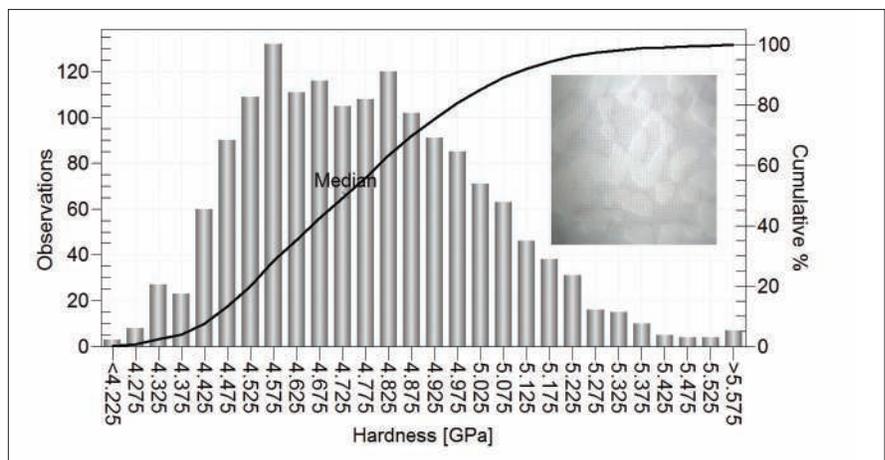


Figure 5. Express Test histogram tested with DCM II head and NanoVision of 1600 hardness measurements on 2205 duplex steel. The histogram was automatically generated in Nanosuite. Data was captured at one indent per second. Insert shows residual indentation array. Bimodal distribution manifests austenitic (dark) and ferritic (light) grains.

Material	Force	No. of Valid Indents (of 100)	Testing Time*	Displacement (1 Std. Dev.)	Hardness (1 Std. Dev.)	Modulus (1 Std. Dev.)	Modulus Reference
	mN		Seconds	nm	GPa	GPa	GPa
Polycarbonate	1	94	322	517 (7.2)	0.223 (0.007)	3.18 (0.07)	2.6
Pyrex	1	97	359	92.5 (0.7)	7.33 (0.18)	62.8 (1.1)	63.3
Fused Silica	1	100	316	84.2 (0.8)	9.54 (0.29)	70.8 (1.3)	72.1
2205 Stainless Steel	4.5	97	342	211.2 (6.7)	4.47 (0.31)	201.5 (9.5)	200
Nickel	5	92	349	175.5 (1.0)	7.57 (0.10)	215.8 (6.5)	200
Silicon <111>	5	95	302	153.4 (0.8)	11.3 (0.17)	185.0 (4.3)	188
Sapphire (C-Axis)	5	96	327	95.4 (0.4)	33.28 (0.54)	454.6 (9.6)	500**

Table 1. Typical results for a 10x10 array of indents done with Agilent Express Test with DCM II head and NanoVision.

* Time elapsed between user-initiation and the completion of the 100th indent.
 ** C-axis direction. Modulus in orthogonal direction is 400GPa.

Express Test Specifications

Sample Requirements

Surface roughness	<200nm
Minimum Young's modulus	1 GPa
Maximum Young's modulus	500 GPa

System Configuration

DCM II head, NanoVision stage

Maximum array size	200 x 200 indents
Maximum test area	100 μm x 100 μm
Time per indentation, standard	<1.0 sec

XP head, NanoVision stage

Maximum array size	200 x 200 indents
Maximum test area	100 μm x 100 μm
Time per indentation	<3.0 sec
Indentation depth	>200 nm

DCM II head, standard stage*

Maximum array size	200 x 200 indents
Maximum test area	250 μm x 250 μm
Time per indentation	<5.0 sec

XP head, standard stage*

Maximum array size	200 x 200 indents
Maximum test area	500 μm x 500 μm
Time per indentation	<5.0 sec
Indentation depth	>200 nm

* Limited by accuracy of standard stage: 1 μm

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