

Keysight NanoSuite Software

Unprecedented Functionality for Nanoindentation and Tensile Testing

Data Sheet



Overview

The Keysight Technologies, Inc. NanoSuite software package offers users of Keysight Nano Indenter G200/G300 and T150 UTM systems a variety of new testing capabilities. We've added new functionality to Express Test (our option for ultra-fast testing): batch mode, histogram plotting, and an integrated thin-film model which automatically accounts for substrate influence. New methods are available for measuring time-dependent material properties, including complex modulus of gels and strain-rate sensitivity of thin metallic films. NanoSuite also provides a variety of 2D and 3D graphs which can be sent to Microsoft Excel as-is.

As in the package's previous iteration, an intuitive interface allows users to set up and run experiments quickly – changing calculation parameters as often as desired – with just a few clicks. NanoSuite offers support of small force/displacement measurements, from MEMS testing to tensile experiments, surface topology, polymers, and more. Versatile imaging capabilities, survey scanning, and streamlined test method development help researchers get from testing to results in record time.

New Features and Benefits

- Newly integrated tool simplifies determination of indenter area function and load-frame stiffness
- Exclusive new test methods for complex modulus, substrate-independent properties, and strain-rate sensitivity
- Standard batch of tests comprising 25 or more samples can be set up in 5 minutes or less
- Revolutionary Express Test with new batch-mode methods
- Create 2D and 3D graphs; export to Excel with plotting options intact
- New file structure organizes samples into projects and sub-projects
- Microsoft Windows 7 (32-bit) compliance for current systems
- Convenient PDF printer to replace need for hardware printers

Applications

- Polymers
- Composites
- Thin film materials
- MEMS
- Stiffness mapping
- Scratch testing

Powerful New NanoSuite Methods

Testing procedure and analysis are defined by means of test methods which are relatively independent of the NanoSuite application. This application/method software architecture provides unparalleled access to standard, advanced, and even novel testing. For standard nanoindentation testing with the G200/G300, NanoSuite has a method for testing in compliance with ISO 14577, and the determination of indenter area function has been greatly simplified, involving just a few mouse clicks. For standard tensile testing, NanoSuite has a method for testing in compliance with ASTM C1557.

Our applications engineers keep abreast of developments in material science and testing so that each release of NanoSuite features new and improved test methods. With NanoSuite, new indentation methods measure the complex modulus of polymers, gels, and biological tissue. Also new are indentation methods which measure the creep response (strain-rate sensitivity) of metals, even as thin films.

Recognizing that our customers use our instruments to push the envelope of materials testing, we make these same method-development tools available to our customers through NanoSuite Explorer and on-line training. With Explorer, the G200 and the T150 become all-purpose tools, able to apply force, measure displacement, and interpret data according to the user's unique specifications.

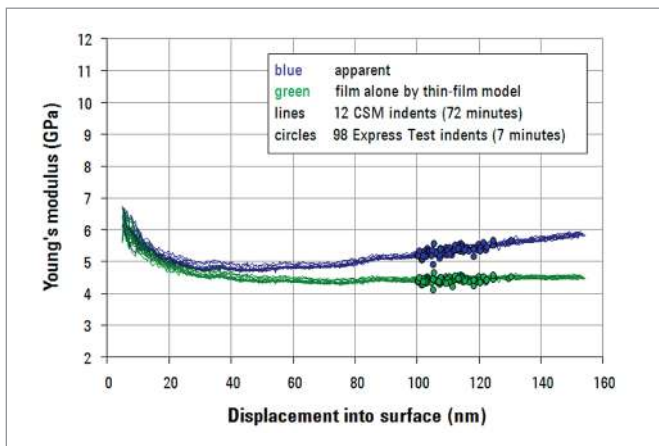


Figure 1. New test method for Express Test gives the substrate-independent Young's modulus of a 1000 nm low- κ film on silicon by means of 98 indents performed in just 7 minutes (green circles).

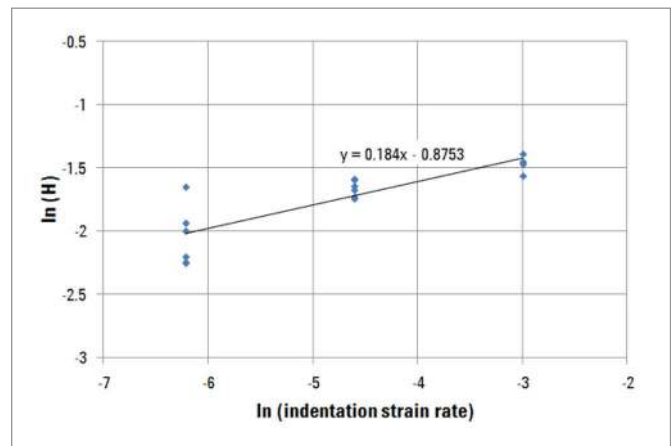


Figure 2. New test method measures the strain-rate sensitivity of SAC 105 solder to be $m = 0.184 \pm 0.013$, obtained as the slope of the logarithm of hardness vs. the logarithm of strain rate.

New Keysight Express Test

NanoSuite also enables a totally novel, ultrafast way to conduct high-precision nanomechanical tests. Designed for exclusive use with the Nano Indenter G200, the new Express Test option performs one complete indentation every second, meaning that 100 indentations can be performed at 100 different sites in 100 seconds! Highly versatile, easy-to-use Express Test methods are ideal for applications involving metals, glasses, ceramics, structural polymers, thin films, and low-k materials. There is now a new Express Test method for thin films that incorporates the thin-film model for rapid measurement of substrate-independent Young's modulus.

In order to achieve all of these revolutionary measurements, the G200 must be configured with a DCM II indentation head, Keysight's NanoVision stage option, and the new Express Test option.

With NanoSuite users can automatically generate histograms and 3D mechanical-properties maps. Graphs and supporting data are easily exported to Microsoft Excel.

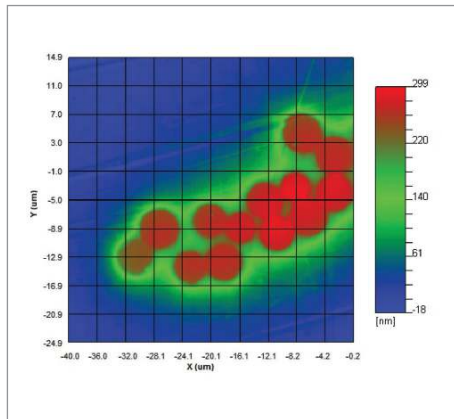


Figure 3. Surface topology of fiberglass via NanoVision scan. For this image, the tip remained in continuous contact with the surface while tracing its topology. Scan force = 10 μ N; scan time = 17 min; image size = 200x400 pixels.

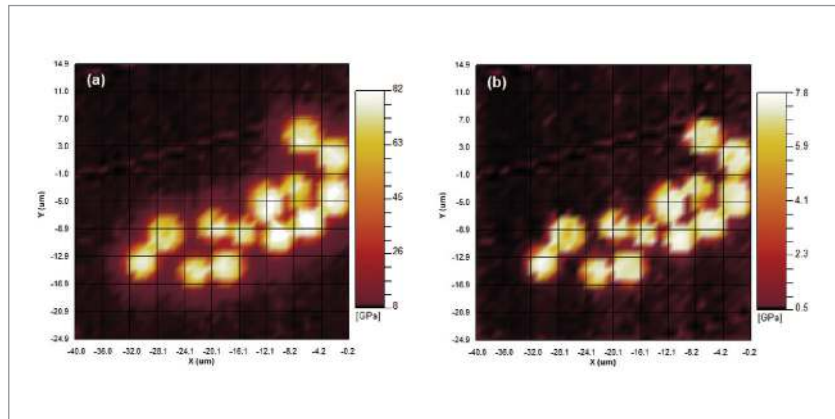


Figure 4. (a) Young's modulus and (b) hardness maps of fiberglass via Express Test. These images display the results of a single Express Test comprising 1600 individual indents. Maximum indentation force = 1mN; test time = 26 min; image size = 40x40 pixels.

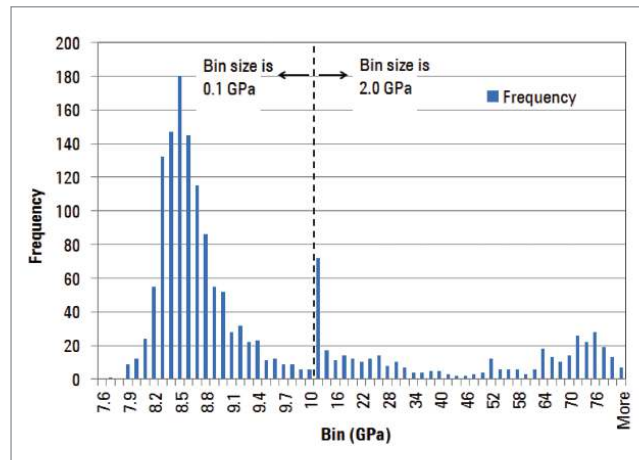


Figure 5. Histogram of 1600 modulus measurements showing peaks for each fiberglass constituent. Intermediate values are affected by both constituents.

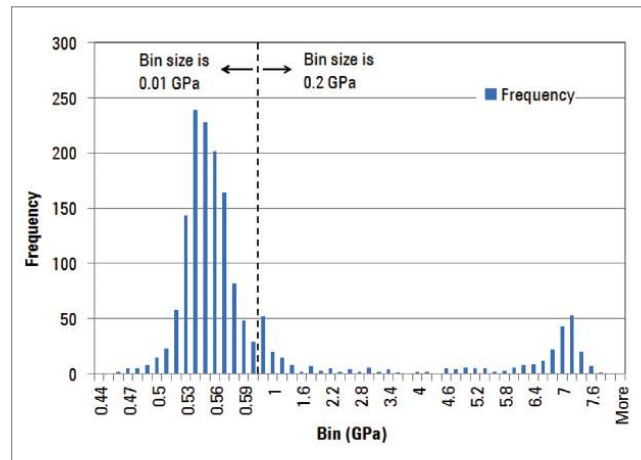


Figure 6. Histogram of 1600 hardness measurements showing bimodal distribution, with peaks for each fiberglass constituent.

New Batch Testing Capabilities

NanoSuite lets researchers quickly create new batches of tests for multiple samples. In addition to easily adding, editing, reviewing, or deleting samples, researchers can select a previously run batch of tests as a template for the current run. Utilizing this NanoSuite technique, a standard batch of tests comprising 25 or more samples can be set up in 5 minutes or less.

NanoSuite also supports new batch capabilities for Express Test! This new mode lets G200 users, in one batch definition, prescribe multiple Express Test arrays on multiple samples to run unattended. With the previous version of NanoSuite, users had to utilize Express Test in individual mode and could only prescribe one array at a time.

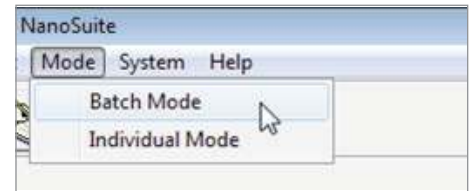


Figure 7. NanoSuite is usually operated in 'Batch Mode'.

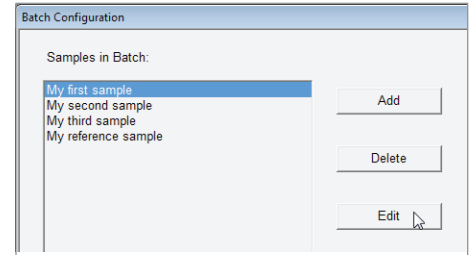


Figure 8. Use 'Batch Mode' to prescribe multiple indentations on multiple samples. The batch is easily saved and edited for future testing.

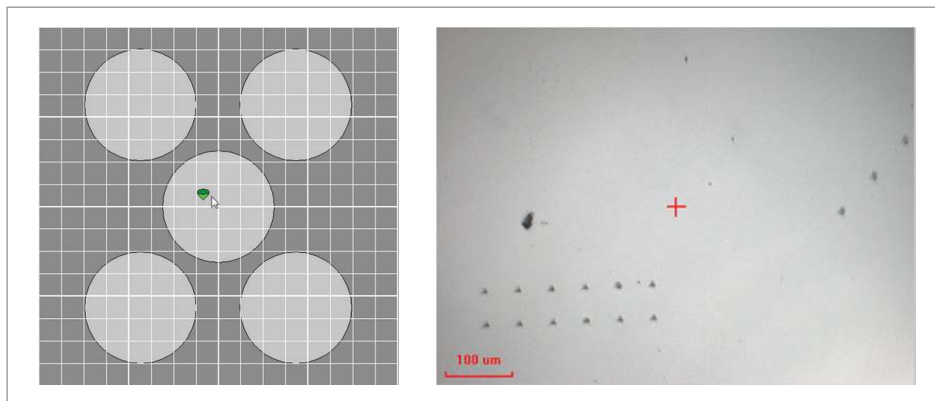


Figure 9. Test locations in a batch are selected using both a macroscopic map (left) and microscopic view (right).

New 2D and 3D Graph Plotting and Exporting

Two-dimensional graphs can be plotted on the screen in NanoSuite and then exported directly to Microsoft Excel: axis titles, scales, and all. This thoughtful functionality gives users the ability to export the graph they are viewing straight to Excel exactly as it appears on the monitor.

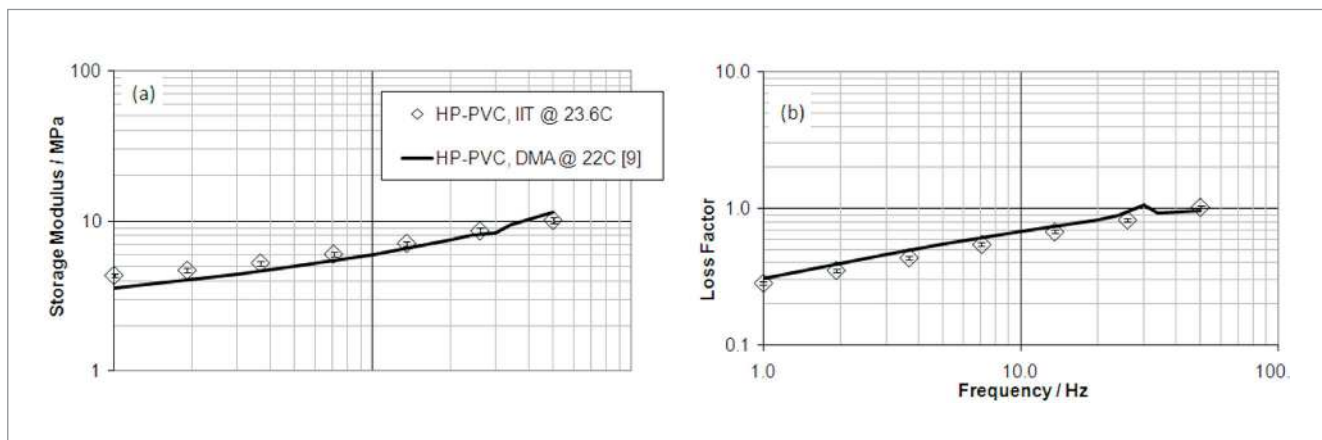


Figure 10. New test method gives complex modulus of highly plasticized PVC as a function of frequency (diamonds). Values compare well with dynamic mechanical analysis under similar conditions (solid line).

Versatile Imaging and Survey Scanning

NanoSuite provides a wide array of imaging capabilities, including profile cross-sectional imaging, real-time adjustment of scanning parameters, polynomial distortion or leveling correction, plane-fit leveling, and a broad color palette.

For scanning of areas up to 500 μm x 500 μm , NanoSuite offers a survey scanning option. Flatness of travel is 0.1% per 100 μm . This option is ideal for scratch and wear testing on large samples. It is also very useful for working with large samples that have irregular shapes, large samples composed of heterogeneous materials, and various metals, ceramics, and hard-coated materials.

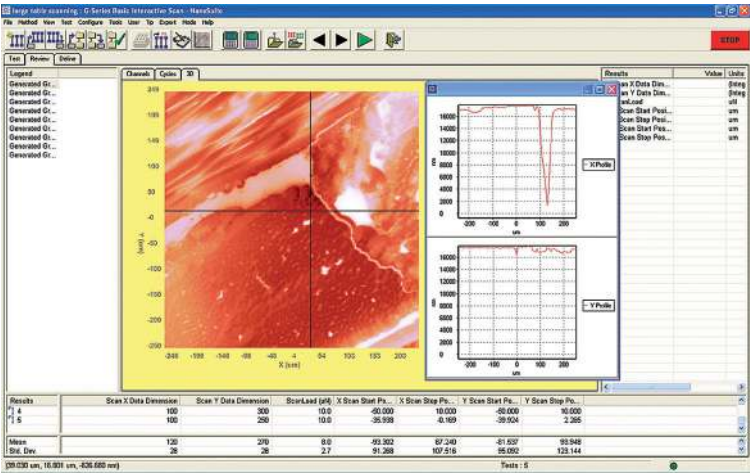


Figure 11. Original 500 x 500 μm survey scan. Carbon fibers are standing on end in the lower part of the image and in the upper left they are laying flat.

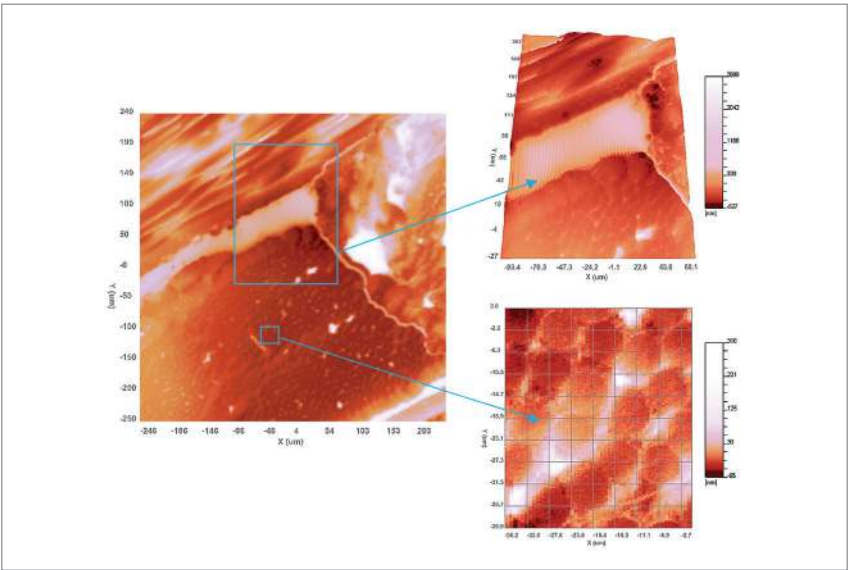


Figure 12. Left: 500 x 500 μm scan of carbon fibers over 18 μm of height deviation. Right top: 40 μm scan of feature shown in 3D. Bottom right: 40 μm scan of carbon fiber ends after polynomial leveling.

Data Acquisition, Recording, and Control

The fundamental data acquisition rate for all Keysight Nano Indenters is 12.5 kHz. Acquired data is accumulated and averaged in an electronic buffer and recorded at a rate of up to 500 Hz. Even at the system's highest recording rate, NanoSuite provides the power of real-time experimental control based on any recorded or calculated data channel. This allows functionality such as plotting real-time properties, or more complex capabilities, such as responding intelligently when a test sample fails.

Professional and Explorer Versions

The Professional version of NanoSuite gives users access to test methods written by Keysight applications engineers, including the methods for testing in compliance with ISO 14577 and making substrate-independent measurements on thin film materials. Keysight is constantly developing and releasing new methods for users.

The Keysight NanoSuite Explorer software package is offered as a T150 UTM option. The Explorer version of NanoSuite enables researchers to write their own NanoSuite methods via an easy-to-use method creation protocol that reduces the lines of code needed for customized test development. It is exactly the same software tools employed by Keysight applications engineers. In simulation mode, users can write test methods and process data analysis off-line. The variety of tests that can be designed within the NanoSuite environment is limited only by the researcher's imagination. No other commercially available package offers this degree of flexibility and control.

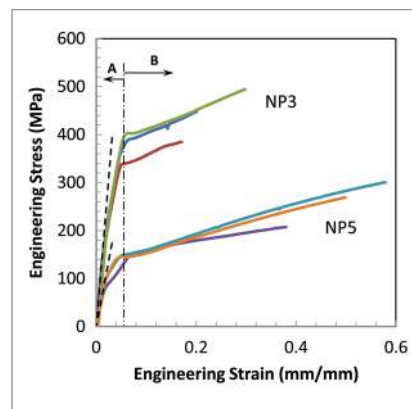


Figure 13. T150 UTM engineering stress-strain curves for nylon-PET bicomponent IS fibers, with 85% nylon and 15% PET. The molecular weight of PET in NP5 fibers is higher than that in NP3 fibers. The dashed lines at the initial part of the curve indicate linear elastic deformation. Regime A is prior to formation of any neck in the fiber, whereas regime B indicate strain hardening in the necked region.

Nanoindentation instruments from Keysight Technologies conform to the ISO 14577 standard, delivering confidence in test accuracy and repeatability. These state-of-the-art solutions ensure reliable, high-precision measurement of nanomechanical properties for research and industry.

Nano Mechanical Systems from Keysight Technologies

Keysight Technologies, the premier measurement company, offers high-precision, modular nano-measurement solutions for research, industry, and education. Exceptional worldwide support is provided by experienced application scientists and technical service personnel. Keysight's leading-edge R&D laboratories ensure the continued, timely introduction and optimization of innovative, easy-to-use nanomechanical system technologies.

www.keysight.com/find/nanoindenter

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