

nanoScratch

Quantitative Force and Displacement Data for Tribology, Coating Thickness, and Friction Studies

Nanoscratch testing is a versatile tool for analysis of both thin films and bulk materials. Nanoscratch provides the capability to investigate modes of deformation and fracture that are not possible using standard indentation techniques. Nanoscratching is accomplished by applying a normal load in a controlled fashion while measuring the force required moving the tip laterally across the sample. By selecting the appropriate normal loading profile and lateral displacement pattern, many different types of tests can be performed. The damage incurred from the test is then typically observed using optical or Scanning Probe Microscopy (SPM) imaging. Hysitron provides *in-situ* SPM imaging of the sample with nanometer resolution for immediate feedback of the test results.

QUANTITATIVE RESULTS

Nanoscratch can be used for a wide range of different tests and comes with a versatile load function editor for simple test design. Hysitron has created an easy-to-use software product that was designed by experimentalists for experimentalists.

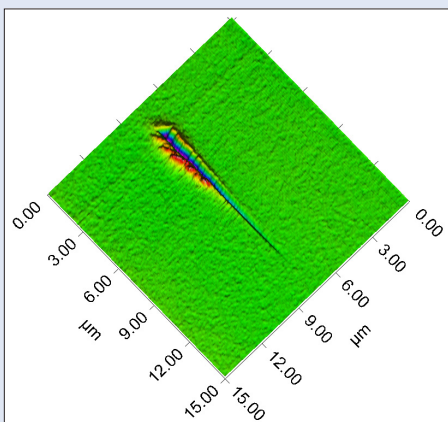


Figure 1. Nanoscratch of a low- κ film, showing evidence of film failure.

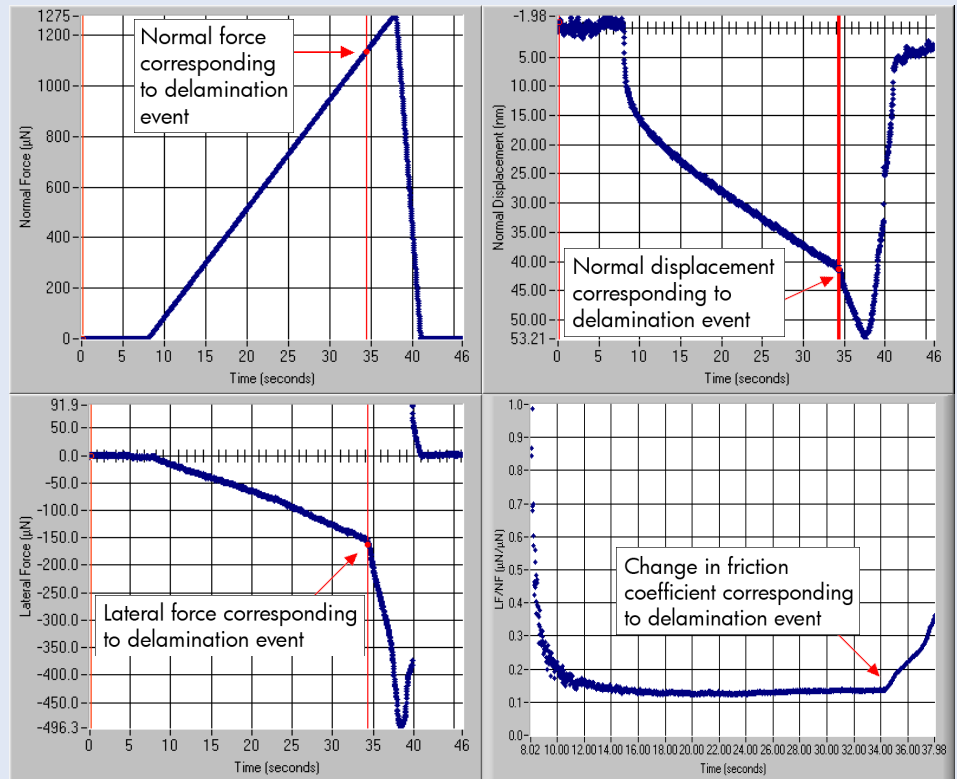
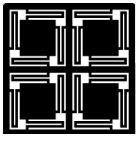


Figure 2. Nanoscratch data from a ramping force scratch test on protective glass coating showing point of delamination (red arrow) and the associated friction measurement. Plots were generated automatically using **TriboScan** software.

This software allows the user to define the applied normal load and the lateral displacement across the surface of the sample. A single scratch with a ramped normal load is shown in Figure 2. From this data, useful information such as critical load, film adhesion, and delamination force can be measured. The software can also be used to generate a load function that repeatedly scratches over the surface of the sample with a defined normal load, thus enabling reciprocating wear testing. Nanoscratch data, in conjunction with *in-situ* SPM images, provides a wealth of information concerning a materials behavior under simultaneous normal and lateral stresses.

FEATURES

- *In-situ* SPM imaging capabilities for unparalleled nanoscratch testing precision and analysis
- **TriboScan™** and **TriboView™** software packages enable multiple modes of nanoscratch testing, including closed loop force/displacement control, and data analysis
- Utilizes the same transducer design as quasistatic testing, recognized for its proven stability and sensitivity
- Easy-to-use, user-interchangeable tip assembly for utilization of wide range of application-specific tip geometries



SOFTWARE

In addition to **TriboScan** software for test setup and analysis, Hysitron nanoscratch systems come standard with **TriboView**, an offline analysis package that enables users to gain additional information from images generated using *in-situ* SPM imaging. Users can also use the **TriboView** software to quickly generate images and plots for reporting purposes, including 3-D images as shown in Figure 1.

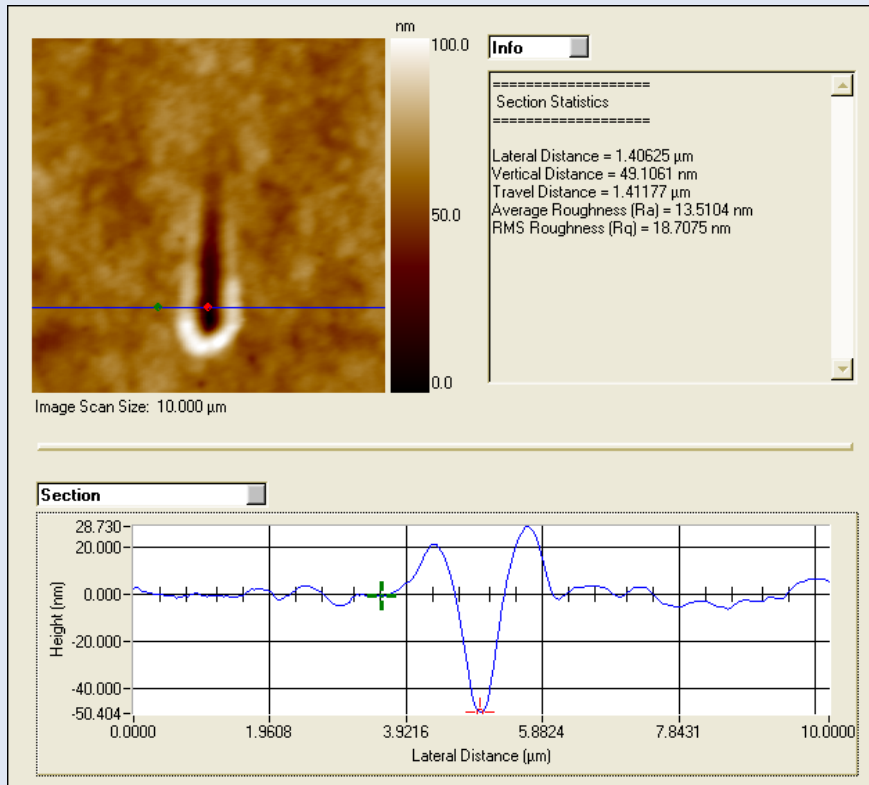


Figure 3. Screenshot of **TriboView** software interface showing a 10 µm *in-situ* SPM image of a ramped force scratch on a polymer coating on glass and an accompanying line plot with section statistics.

UPGRADES / COMBINATORIAL OPTIONS

- **3D OmniProbe™** for extended force/displacement scratch and indentation
 - Max. Normal Force: 10 N
 - Max. Lateral Force: 5 N
 - Max. Normal Displacement: 80 µm
 - Max. Scratch Length: 150 mm
- Heating/Cooling Stage
 - Temp. range: -10 °C up to 200 °C
- **TriboAnalysis™** software package for advanced data analysis and reporting
- **performech™** Advanced Control Module for increased accuracy
- **TriboImage** software package for quick reciprocating scratch load function creation and complete time-resolved nanoscale reciprocating wear analysis
- **VersaChuck™** for complex and multiple sample loading
- 300 mm wafer chuck
- AFM Imaging

SCRWBTEC r1.f

APPLICATIONS

- Protective coatings (DLC, TiC, TiN)
 - Disk Drives, Glass
- Tribological coatings
- Paints
- Biological/Biomedical
 - Implantable devices, cartilage/tissue, contact lenses
- Friction analysis
 - Lubrication layers, reciprocating wear/scratch

SPECIFICATIONS

STANDARD CONTROLLER

- Normal Force Noise Floor: <100 nN
- Normal Force Resolution: 3 nN
- Normal Disp. Noise Floor: <0.2 nm
- Normal Disp. Resolution: 0.0004 nm
- Max. Normal Disp.: 5 µm
- Normal Direction Drift <0.05 nm/s
- Lateral Force Noise Floor: <5 µN
- Lateral Force Resolution: 0.5 µN
- Lateral Disp. Noise Floor <5 nm
- Lateral Disp. Resolution 3 nm
- Max. Scratch Length: 15 µm
- Lateral Direction Drift <0.05 nm/s

PERFORMECH UPGRADE

- Normal Force Noise Floor: <30 nN
- Normal Force Resolution: <1 nN
- Imaging Contact Force: ≤ 70 nN
- Lateral Force Noise Floor: <3.5 µN
- Lateral Force Resolution: <50 nN
- Lateral Disp. Noise Floor <2 nm
- Lateral Disp. Resolution <0.02 nm