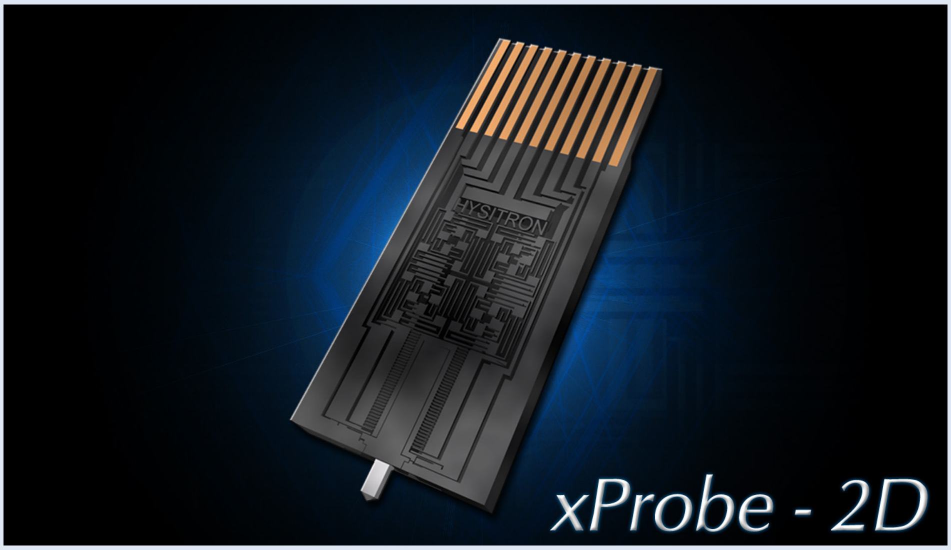
UPGRADE OPTIONS

HYSITRON®

# xProbe - 2D

Reaching Beyond Nano- Tribomechanical Testing




## Introduction

The **xProbe - 2D** is the next step for extending beyond Hysitron's standard transducer's force and displacement sensitivity range, facilitating mechanical testing beyond the nanoscale regime.

The xProbe - 2D integrates nanoindentation, nanoscratch, and nanowear with extreme sensitivity allowing to effectively measure lateral forces for friction imaging, scratch of very thin films, or achieveing ultra-low contact forces for testing soft samples. Through intricate interlaced MEMS design technology, the xProbe - 2D is a perfect solution for ultra-sensitive measurements.

## Next Dimension for Imaging

Equipped with a sharp cube-corner tip, the xProbe - 2D is capable of producing high resolution in-situ SPM images, while recording lateral forces, which allows a user to correlate frictional changes with topography and target specific nanoscale features.

The xProbe - 2D in-situ SPM imaging can easily locate features previously unattainable such as super thin cross-sectioned samples for interfacial studies, very small multiphase/non-homogeneous regions, or image with an ultra-light setpoint for extremely wear prone surfaces.

## Superior Design

The core of the xProbe - 2D is the capacitive force/displacement MEMS comb drive actuator, which provides high sensitivity with linear force and displacement. A differential capacitive sensing scheme is used to measure the movable electrode displacement. This configuration allows the user to apply a load while simultaneously sensing displacement or, via a feedback loop, to adjust the load to enforce a prescribed displacement rate.

## Highlights

- Direct and quantitative measurements with AFM level noise floors
- MEMS based transducer for enhanced force and displacement sensitivity
- Lateral force imaging for friction mapping
- High resolution in-situ SPM imaging
- Ultra-low force and displacement testing for extremely thin materials and sensitive materials

## Applications

- Lateral force/friction imaging of non-homogeneous regions
- High resolution imaging of nanoscale morphology
- Scratch testing of very thin films
- Ultra-low contact forces for soft samples

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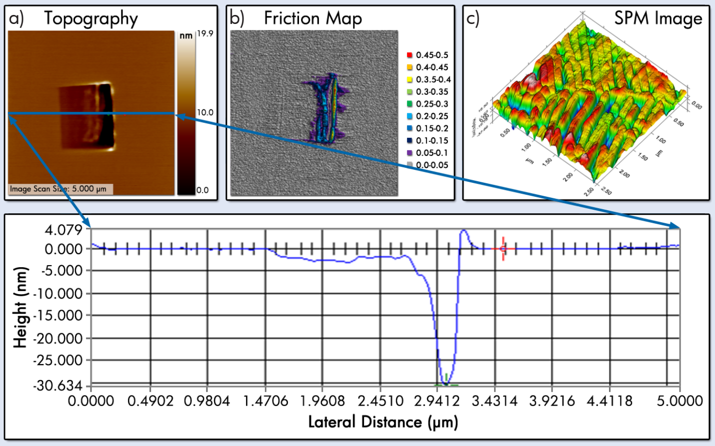


Figure 2: a) Topography image with a line profile of a lubricated DLC coating hard drive after a ramped wear test with b) corresponding friction map attained from the lateral force signal and normal force setpoint. c) A high resolution 2.5µm x 2.5µm SPM image of a grain boundary of Damascus steel.

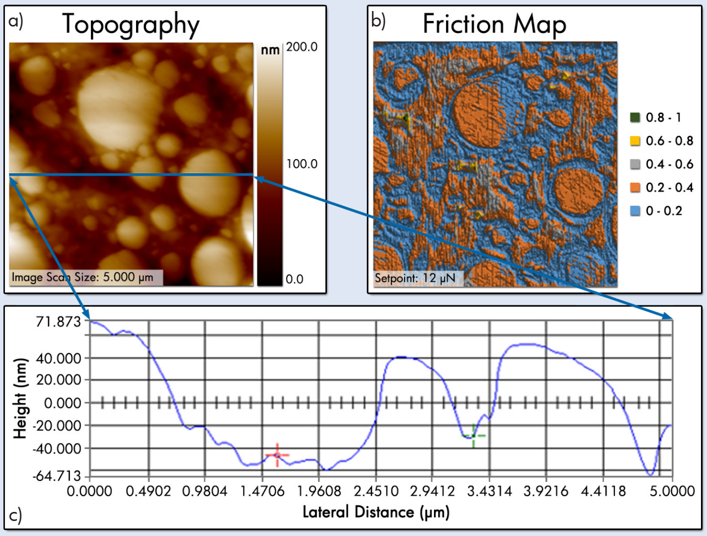


Figure 3: A 5µm x 5µm topography image a) with cross-section b) and corresponding friction map c) of a glass-reinforced polymer underfill sample.

## 2nm DLC Coating Characterization

A lubricated DLC coated hard drive was ramp wear tested starting with a normal force of 5µN and increased to 100µN over a 2µm x 2µm area. A subsequent 5µm x 5µm lateral force image was used to generate a frictional map of the wear pit showing an increase in friction through the depth of the DLC coating.

## Direct Imaging of Steel Surface

Damascus steel clearly shows phases based on the in-situ SPM imaging, but only interfaces at the friction image.

## Composites

Lateral force SPM imaging of a glass-reinforced polymer underfill composite clearly shows a differentiation of coefficient of friction between the polymer region (≤ 0.2) and the glass reinforment (0.2-0.4) when contacted with a diamond cube-corner tip.

## Specifications

- Maximum Normal Force: 500µN
- Normal Force Noise Floor: < 30nN
- Maximum Normal Displacement: 2µm
- Normal Displacement Noise Floor: < 0.3nm
- Maximum Lateral Force Measurement: 150µN
- Lateral Force Noise Floor: < 50nN
- Maximum Piezo Lateral Displacement: 60µm
- Lateral Displacement Noise Floor: < 0.5nm