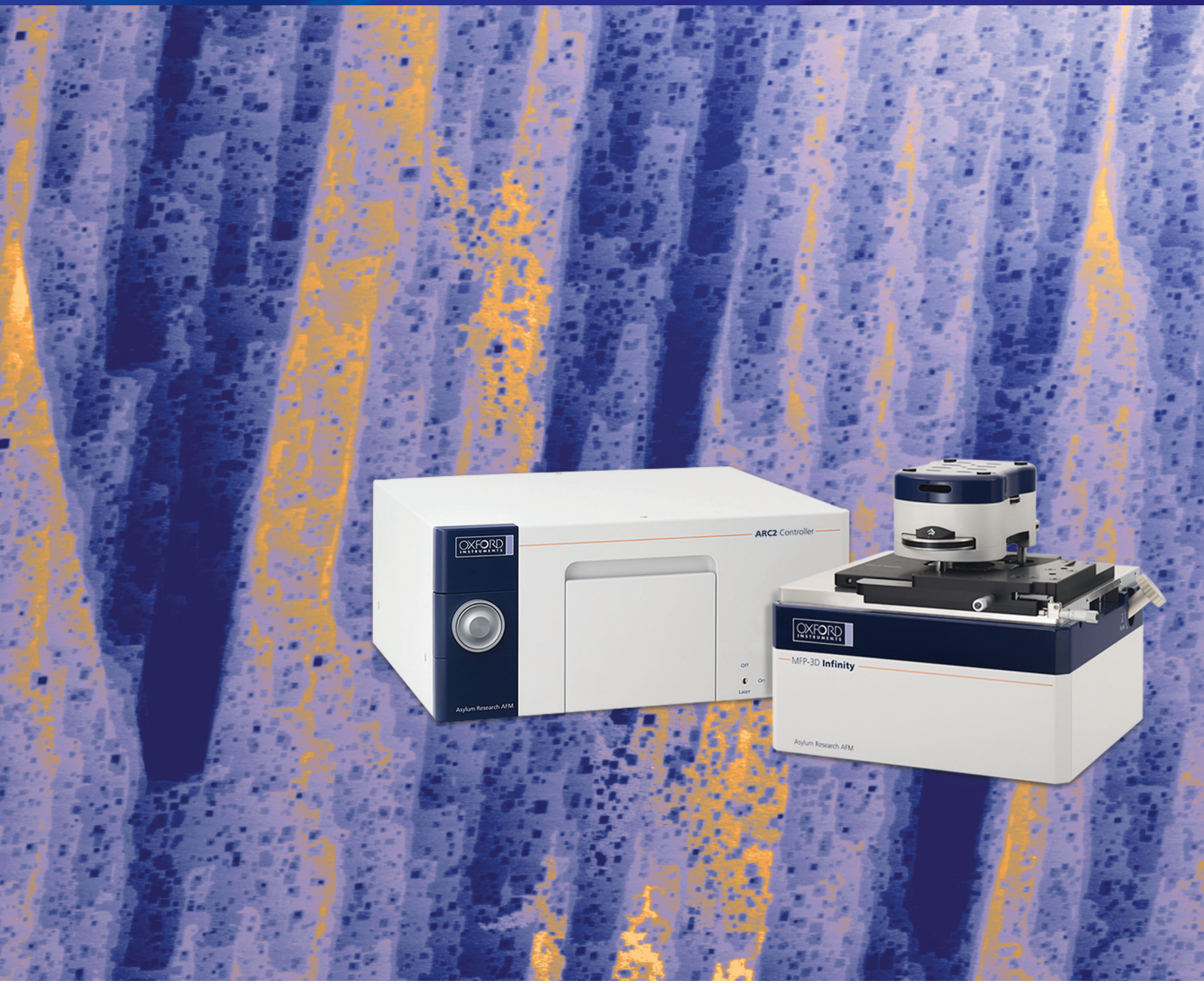
Asylum Research

MFP-3D **Infinity** AFM

Endless Applications. Unlimited Potential.



Performance / Versatility / Support

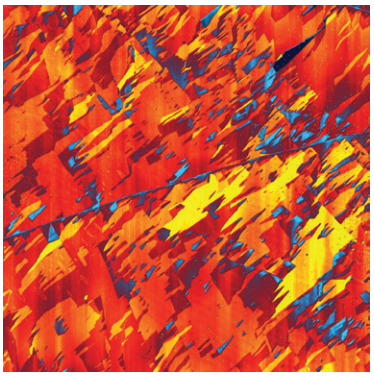
OXFORD INSTRUMENTS

The Business of Science®

5 Great Reasons to Get an Infinity AFM

Gain a research advantage by choosing an Asylum Research AFM

The Asylum Research **MFP-3D Infinity**™ is the most advanced AFM in the MFP-3D family. It offers high performance, the widest range of capabilities, and an advanced system architecture designed for future expansion. The MFP-3D Infinity makes routine imaging tasks fast and easy to complete, while still providing the power and flexibility to support your most ambitious research projects.



Atomic steps imaged on gypsum. Surface reconstruction was imaged in tapping mode in air after brief exposure to water. Z Sensor topography data is shown, 45 µm scan.

1. Stunning high performance for a large sample AFM
2. Easy to use without sacrificing capability and flexibility
3. Robust and productive—thrives in busy labs
4. Broadest spectrum of modes and accessories turns your ideas into results
5. Best customer support in the AFM industry

EXCEPTIONAL

Big Performance on Large Samples

Reach farther into the nanoscale with higher resolution performance

Infinity outperforms every other large sample AFM

Superior mechanical stability—Noise floor is 33% lower than any other large sample AFM

The stability of the mechanical path between the tip and sample sets the limit on AFM resolution. The unique tripod support of the Infinity head makes this path shorter and stiffer than other large sample AFMs. Infinity achieves a noise floor of <20 pm—at least 33% lower than other large sample AFMs.

Lowest noise control electronics

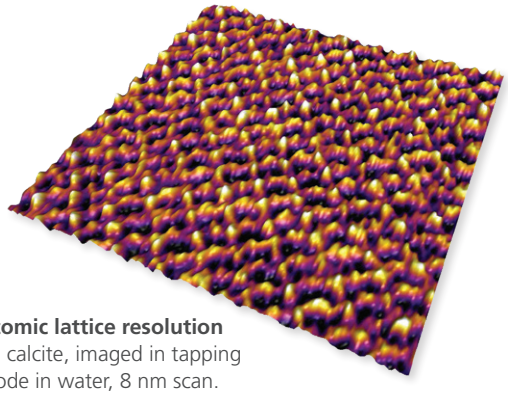
Electronic noise sources have been rigorously identified and eliminated. Performance is optimized by keeping the most critical electronics close to the AFM. Careful electronic design avoids periodic artifacts that might obscure fine details or be confused with real features.

Low noise, high stability position sensors

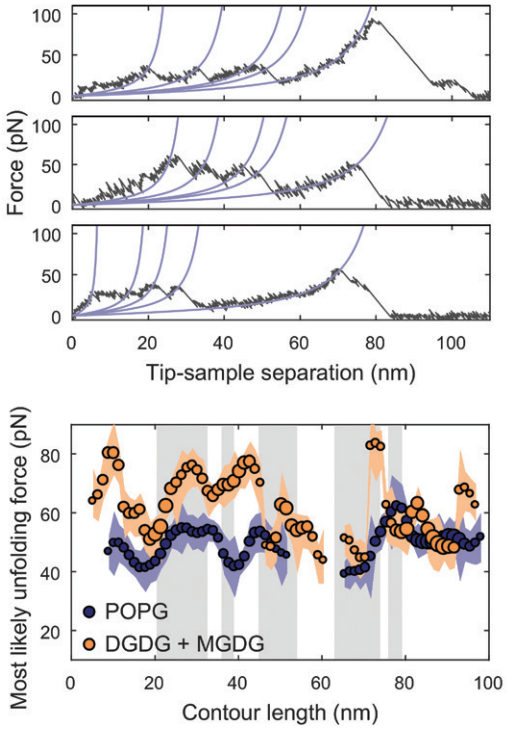
Infinity uses Asylum's latest generation of proprietary linear variable differential transformer (LVDT) position sensors. These sensors have superior stability compared to capacitive and strain gauge sensors and require no routine calibration, as well as providing excellent low-noise performance.

Excellent acoustic and vibration isolation

Infinity includes a custom-engineered acoustic isolation hood and high performance active vibration isolation. Besides enhancing performance, the side-swinging door provides a safe, ergonomic user experience and the integrated accessory expansion module bay reduces clutter and allows accessories to be used without compromising isolation.



Atomic lattice resolution on calcite, imaged in tapping mode in water, 8 nm scan.



Force spectroscopy evaluation of membrane protein stability as a function of membrane lipid composition. Hundreds of curves were measured unfolding trimeric LHCII from membranes consisting of either a phospholipid (POPG) or a glycolipid mixture (DGDG+MGDG). Three representative unfolding curves are shown above from the POPG dataset. Analysis yielded the most likely unfolding force vs. contour length. These results demonstrate that the glycolipids increase stability of at least three of the five helical domains (gray bars) relative to the phospholipid membrane. Data courtesy of A. Janshoff (U. Göettingen) and H. Paulsen (U. Mainz). Adapted from: *Scientific Reports* **7**, 5158 (2017).

Simple to Use. Robust and Dependable.

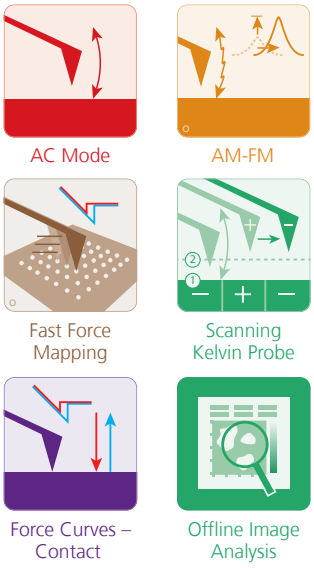
An AFM that thrives in busy research groups and multi-user facilities

ModeMaster™

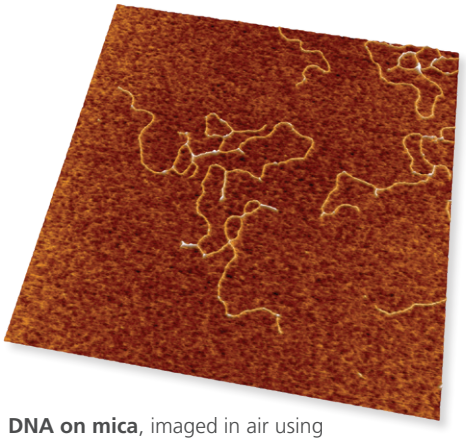
- Automatically configures the software for the selected mode
- Supports both basic and advanced imaging techniques
- Makes switching between modes fast and simple

GetReal™

- Calibrates the cantilever sensitivity and spring constant without touching the tip to the sample, keeping it clean and undamaged
- Automatic process is fast, simple, and accurate
- Helps make AFM results more consistent and more quantitative



ModeMaster helps you get started quickly. Only a few of the many modes are shown here.



DNA on mica, imaged in air using tapping mode with GetStarted, 2 µm scan.

GetStarted™

- Automatically sets optimal tapping mode parameters including drive amplitude, setpoint, gains, and scan rate
- Predictive algorithm is more robust than iterative optimization approaches that diverge to slow scan rates and high forces
- Pre-scan optimization produces high-quality data from the very first scan line—no tip or sample damage while the system searches for appropriate setpoint and gain values

Robust construction. Dependable performance.

- Built to withstand the rigors of daily use and multiple users in central microscopy facilities and other multi-user labs.
- Just because it is precision instrumentation doesn't mean that it has to be delicate. There are no piezo tubes or other components that are easily broken by occasional mishandling.
- Asylum AFMs do not require routine scanner calibration.
- Asylum AFMs have an exceptionally low rate of failures, even throughout a long lifetime of heavy usage.

"My Asylum AFMs logged some pretty heavy usage for the year. My two MFP-3D systems logged 3046 hours and 3023.5 hours of use, so they each averaged over eight hours every single day spread over 365 days. All this with truly negligible downtime. Amazingly robust systems. Great job!"

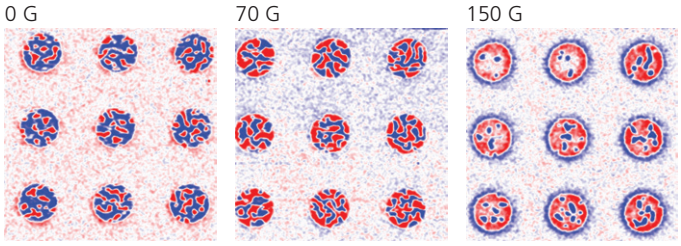
Scott MacLaren
Univ. of Illinois at Urbana-Champaign

Accessories that Expand Research Horizons

Go beyond ambient conditions—so many variables under your control

Accessories that meet the practical needs of real research applications

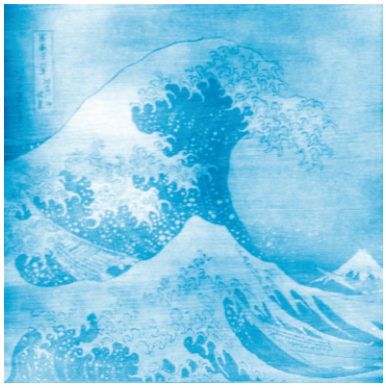
The MFP-3D Infinity accessories are carefully designed to provide unique capabilities while maintaining AFM performance and ease of use. Many have been designed in partnership with our customers to ensure that they meet the practical demands of real research applications.



Magnetic skyrmions in Co-based thin film pads imaged with MFM under out-of-plane magnetic fields applied with the VFM3. Each pad is ~900 nm in diameter. Images courtesy of K. Bouzehouane, Unité Mixte de physique CNRS, Thales, Univ. Paris-Sud, Université Paris-Saclay, France.

Temperature Control

- **PolyHeater™** – sealed cell heats samples up to 400°C
- **CoolerHeater** – sealed cell heats or cools, -30° to 120°C
- **BioHeater™** – coverslip-based heater for liquids, up to 80°C
- **Petri Dish Heater** – heats petri dishes up to 45°C



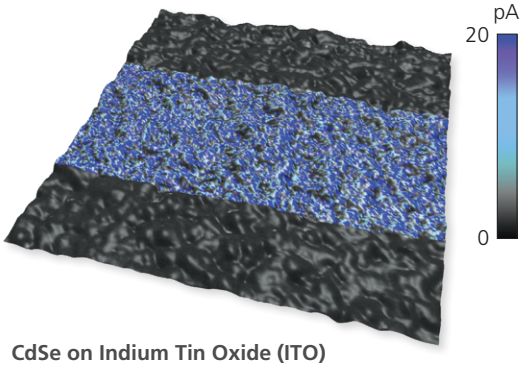
Anodic oxidation on silicon was used to print this "nano-lithograph" of Hokusai's 19th century masterpiece *The Great Wave off Kanagawa*. The humidity cell was used to maintain optimal conditions. 30 µm scan.

External Driving Forces

- **Variable Field Module** – apply in-plane or out-of-plane magnetic fields
- **Photovoltaic (PV) option** – apply controlled bottom-side illumination
- **NanoRack™** – tensile or compressive stress up to 80 N
- **High Voltage Field** – apply up to ±150 V to the sample or tip
- **Probe Station** – apply external electric signals to samples

Controlled Gas or Liquid Environments

- **Closed Fluid Cell** – sealed cell allows gas and liquid perfusion
- **Fluid Cell Lite** – operate in liquid without perfusion
- **Humidity Cell** – sealed cell with humidity sensor
- **Electrical Closed Cell** – control gas environment in sealed cell
- **Petri Dish Holder** – minimizes evaporation from dish
- **MicroFlow Cell** – small volume fluid exchange
- **Electrochemistry Cell** – also available with heating



CdSe on Indium Tin Oxide (ITO) imaged with conductive AFM, showing current on 3D topography. The PV option was used to irradiate the sample with 0.9 W/cm^2 intensity light only during the middle of the scan, inducing the measured photocurrent (blue strip). 2 µm scan.

QUANTITATIVE

Most Powerful Tools for Quantitative Nanomechanics

Measure viscoelastic properties including both storage and loss moduli

There's no single best nanomechanical technique for every application. Here are a few techniques from Asylum's NanomechPro™ Toolkit:

AM-FM Viscoelastic Mapping Mode

- Tapping mode technique that measures both the elastic storage modulus (*E'*) and the viscoelastic loss tangent, $tan\delta = E''/E'$
- Good for samples from 50 kPa to 300 GPa
- Fast—same speed as regular tapping mode

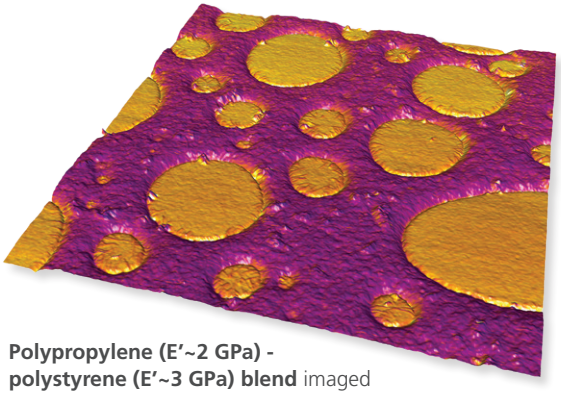
Contact Resonance Viscoelastic Mapping Mode

- Contact mode technique that measures both storage modulus (*E'*) and loss modulus (*E"*)
- Good for samples from 1 GPa to 300 GPa

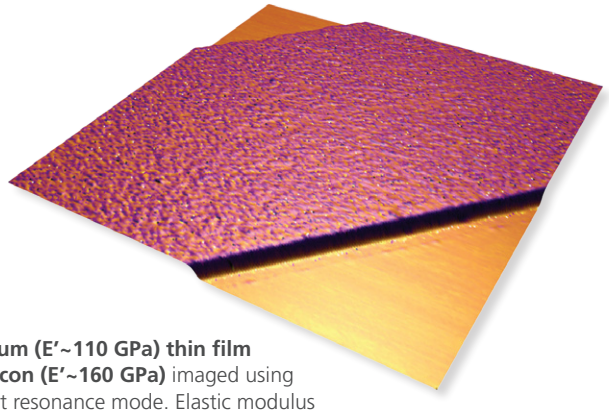
Fast Force Mapping Mode

- Force-distance curve mapping technique that operates at up to 300 Hz pixel rate
- Captures every force curve in the image, with no missing curves or hidden data manipulation
- Captures both deflection and height sensor data for accurate measurement of the whole F-D curve
- Real-time and offline analysis models can be applied to calculate modulus, adhesion and other properties. Models are fully accessible by users for verification and modification.
- Good for samples from 10 kPa to 100 GPa

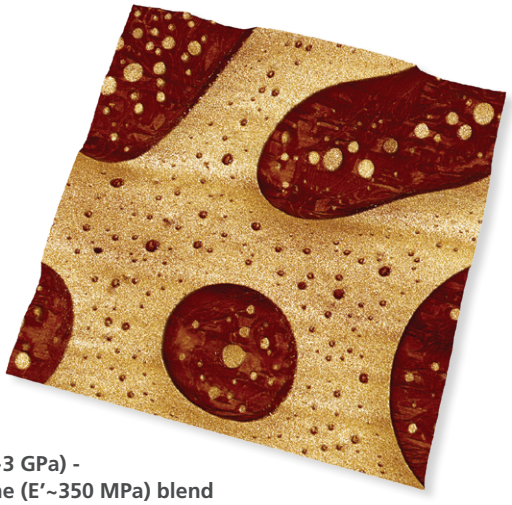
Learn more:
AFM.oxinst.com/**MFP-Nanomechanics**



Polypropylene (E'~2 GPa) - polystyrene (E'~3 GPa) blend imaged using AM-FM mode. Elastic modulus is shown on 3D topography, 8 µm scan.



Titanium (E'~110 GPa) thin film on silicon (E'~160 GPa) imaged using contact resonance mode. Elastic modulus is shown on 3D topography, 10 µm scan.



Polystyrene (E'~3 GPa) - polycaprolactone (E'~350 MPa) blend imaged with fast force mapping. Elastic modulus is shown on 3D topography, 4 µm scan.

Highest Sensitivity Electrical Measurements

Unmatched range of nanoelectrical and electromechanical techniques

Electrostatic Force Microscopy (EFM)

- Measures electrostatic force gradient

Kelvin Probe Force Microscopy (KPFM)

- Measures sample surface potential and work function

Conductive AFM (CAFM)

- Measures DC current from 1 pA to >10 µA

Fast Current Mapping Mode

- Measures current in Fast Force Mapping Mode to reduce lateral forces
- Collects complete current vs. Z curves at each pixel

Scanning Microwave Impedance Microscopy (sMIM)

- Measures both permittivity and conductivity in contact or Fast Force Mapping Mode
- Operates on insulating, semiconductor and conductive materials

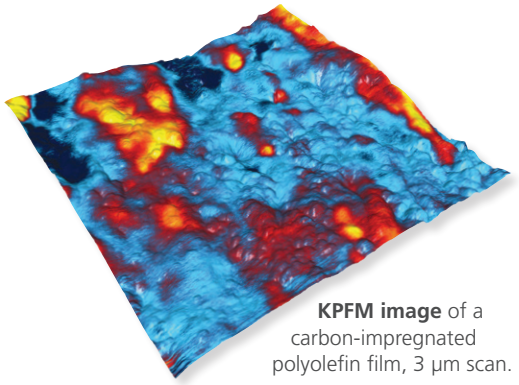
Piezoresponse Force Microscopy (PFM)

- High sensitivity and crosstalk-free measurements
- Higher sensitivity is enabled by operating at high voltages (up to ±150 V) and at the tip-sample contact resonance frequency (DART Mode)

Electrochemical Strain Microscopy (ESM)

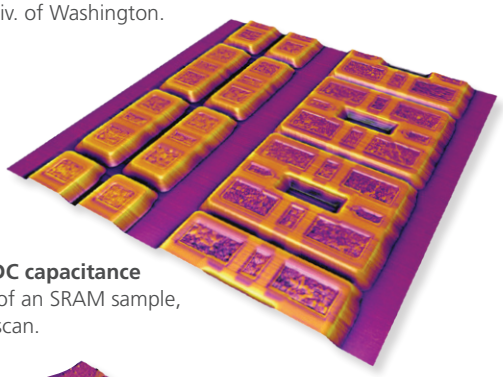
- Probe electrochemical reactivity and ionic flows in energy storage and energy generation materials
- Directly measures effect of ionic currents on mechanical strain

Learn more:
AFM.oxinst.com/**MFP-Nanoelectrical**

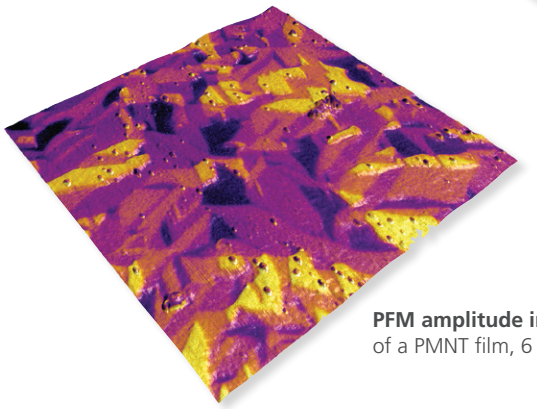


KPFM image of a carbon-impregnated polyolefin film, 3 µm scan.

CAFM image of Europium-doped ZnO sample, 2 µm scan. Sample courtesy of the Krishnan Lab, Univ. of Washington.



sMIM DC capacitance image of an SRAM sample, 30 µm scan.



PFM amplitude image of a PMNT film, 6 µm scan.

SPECIFICATIONS

Precise, Ultra-low Noise Closed-loop Scanner

X&Y range 120 µm

X&Y sensors <130 pm noise

Z range >15 µm (>40 µm option)

Z sensor <35 pm noise

Low-noise, High Bandwidth Optical Lever

Cantilever deflection sensing uses an inverted configuration (incident beam off-vertical) to dramatically reduce interference from light reflected by the sample.

Light source Low-coherence infrared (860 nm) superluminescent diode, FDA/IEC Class 1M (Non-hazardous)

DC detector noise <10 pm

Detector bandwidth 7 MHz

High Resolution System Performance

DC height noise <20 pm

AC height noise <20 pm

Top-view Optics

Resolution Better than 3 µm

Field of view Exceeds 1.5 x 2 mm

Camera Color, 5 megapixel with digital pan & zoom

Illumination

- **Type** Köhler with aperture and field diaphragms
- **Intensity** Software controlled
- **Source** White LED
- **Coupling** Multimode fiber, 600 µm core, SMA905 connector

Sample Stage

Sample size Up to 80 mm diameter

Sample thickness Up to 10 mm (up to 27 mm option)

Service and Support

Warranty Full two-year comprehensive warranty

Support No-charge technical support and expert applications support for the lifetime of the AFM

Acoustic and Vibration Isolation Enclosure

A custom enclosure fully integrates both acoustic and vibration isolation, part of the Infinity controller electronics, and the accessory expansion module bay.

Vibration isolation
Active vibration isolation provides superior damping without the instability and compressed air requirements of passive isolation tables.

Acoustic isolation Design provides effective isolation of acoustic noise in typical labs.

Ergonomics The door of the enclosure effortlessly swings to the side to open and is reversible to accommodate different laboratory floor plans. A smaller access window allows users to reach into the enclosure to make adjustments.

Included Operating Modes

Contact mode; DART™ PFM; Dual AC™; Dual AC Resonance Tracking (DART); Electric force microscopy (EFM); Fluid imaging; Force curve mode; Force mapping mode (force volume); Force modulation; Frequency modulation; Kelvin probe force microscopy (KPFM); Lateral force mode (LFM); Loss tangent imaging; Magnetic force microscopy (MFM); MicroAngelo (nanolithography / nanomanipulation); Phase imaging; Piezoresponse force microscopy (PFM); Switching spectroscopy PFM; Tapping mode (AC mode); Tapping mode (AC mode) with Q control; Vector PFM

Optional Operating Modes

AM-FM Viscoelastic Mapping Mode; Band Excitation; Contact Resonance Viscoelastic Mapping Mode; Fast Force Mapping Mode; Conductive AFM (CAFM) with ORCA™ and Eclipse™ mode; Current mapping with Fast Force Mapping; Electrochemical Strain Microscopy (ESM); High voltage PFM; iDrive™ (magnetically actuated AC mode in liquid); Nanoscale Time Dependent Dielectric Breakdown (nanoTDDB); Scanning Thermal Microscopy (SThM); Scanning Tunneling Microscopy (STM)

(All noise measurements are quoted as the average deviation measured with a 1 kHz bandwidth over a full 10 seconds at the center of the scanner range. Specifications assume required vibration and acoustic isolation in an appropriate laboratory environment.)

Visit **AFM.oxinst.com/Infinity** to learn more about Infinity and get a quote

6310 Hollister Avenue
Santa Barbara, CA 93117
Voice +1 (805) 696-6466
Toll free +1 (888) 472-2795
Fax +1 (805) 696-6444
AFM.oxinst.com
AFM.info@oxinst.com

OXFORD INSTRUMENTS

The Business of Science®

CE