

# AFM

## MFP-3D Origin

The best place to start with Atomic Force Microscopy

Performance – Expert Support – Closed-Loop – Affordable – Upgradable



**ASYLUM  
RESEARCH**  
an Oxford Instruments company

## MFP-3D Origin

### The best place to start with Atomic Force Microscopy

The MFP-3D Origin™ marks the intersection of performance and affordability in the Asylum Research MFP-3D™ AFM family. It features the technical excellence, innovation, and world-class customer support that is the trademark of every Asylum AFM that ships out our door. With full upgrade potential to the MFP-3D and its complete range of accessories, the MFP-3D Origin is simply the best place to start with atomic force microscopy.

#### Why choose the MFP-3D Origin?

- The most affordable member of the MFP-3D family
- Leading closed-loop AFM resolution and performance
- Modes and accessories that empower your research
- Proven research productivity runs in the MFP-3D family
- Unmatched customer support, every step of the way
- Easily upgradable to the MFP-3D for maximum versatility

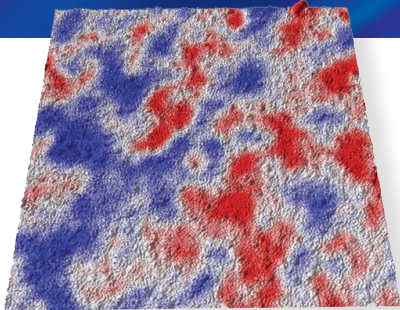
*"As a fairly young research institute, it was important for us to purchase only the best instrumentation available, both to attract the best researchers and to ensure immediate scientific competitiveness. As such, Asylum Research was a natural choice."*

– Lars Niemann,  
CSI, Technische Universität Darmstadt, Germany

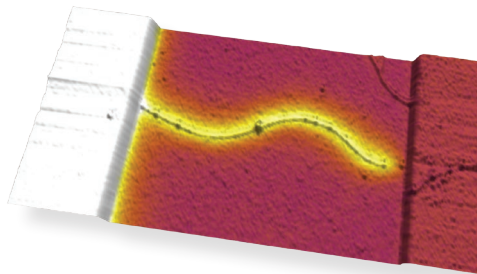
# RESULTS

## What Can the MFP-3D Origin Do for You?

### Diverse applications, powerful results



**Microgel thin film**, surface potential image, 15 µm scan. Courtesy of C.D. Sorrell and L.A. Lyon, Georgia Institute of Technology.



**Carbon nanotube** attached to an electrode, EFM phase is overlaid on topography, 5 x 2.5 µm scan. Courtesy of Minot Lab, Oregon State University.

### Polymers

- Morphology and nanomechanics
- Organization in blends and copolymers
- Interface / interphase properties
- Investigation of thermal transitions

### Thin Films

- Morphology and uniformity
- Hardness and wear properties
- Electrical conductivity
- Storage and loss moduli

### Electronic Devices and other Advanced Materials

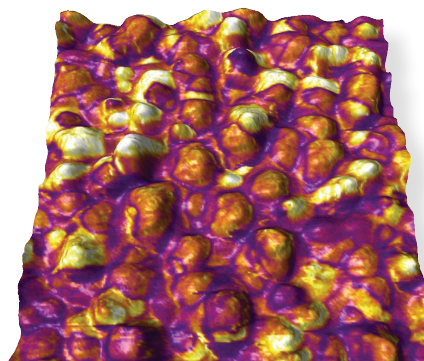
- Nanoscale failure analysis
- Data storage and magnetism
- Piezoelectric properties
- Batteries and photovoltaics

### Bioscience and Biophysics

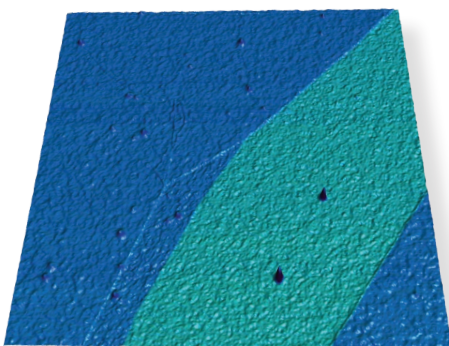
- Cell mechanics and mechanobiology
- Membranes and bilayers
- Biomolecular self-assembly
- Biomaterials and ecology



**DNA origami triangles**, imaged in fluid, ~120 nm per edge, 600 nm scan. Sample courtesy of P.W.K. Rothemund, California Institute of Technology.



**GaFeO<sub>3</sub> thin film**, PFM amplitude overlaid on topography, 1.25 µm scan. Sample courtesy of Somdutta Mukherjee, Rajeev Gupta and Ashish Garg, Department of Materials Science and Engineering, Indian Institute of Technology, Kanpur.



**Graphene on SiO<sub>2</sub>**, AM-FM image of second mode frequency overlaid on topography, 2 µm scan. Sample courtesy of Fereshte Ghahari, Philip Kim, Columbia University and Dan Dahlberg, University of Minnesota.

## Performance Runs in the Family

### MFP-3D Origin – where performance and affordability intersect

Performance and modern features that go far beyond all competitors in its class.

#### High-resolution imaging in both air and fluid

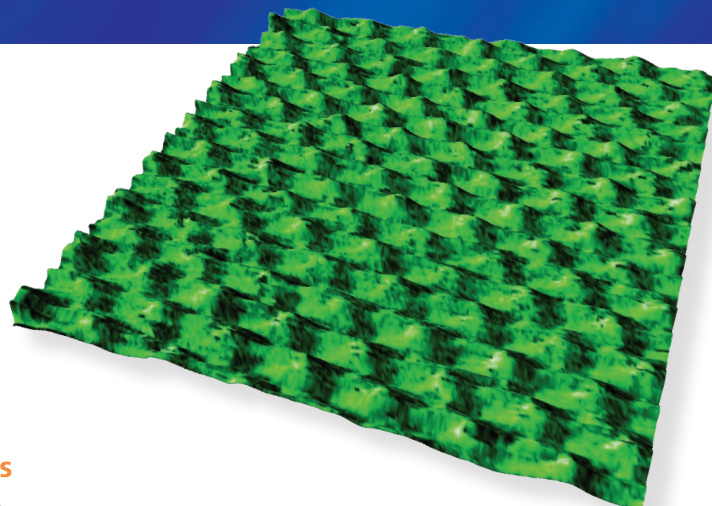
- Robust mechanical design minimizes noise and drift in images
- Digital controller architecture for fast, low noise operation
- Accommodates large samples, up to 80 mm diameter

#### Most accurate, lowest-noise force measurements

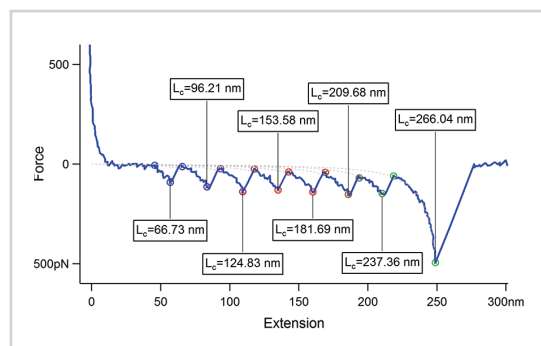
- Unique inverted optical lever design eliminates interference artifacts
- Sensitivity limited only by the intrinsic thermal noise of cantilevers
- Closed-loop Z scanner eliminates hysteresis for accurate ramping

#### High-performance closed-loop scanner comes standard for easy and precise operation

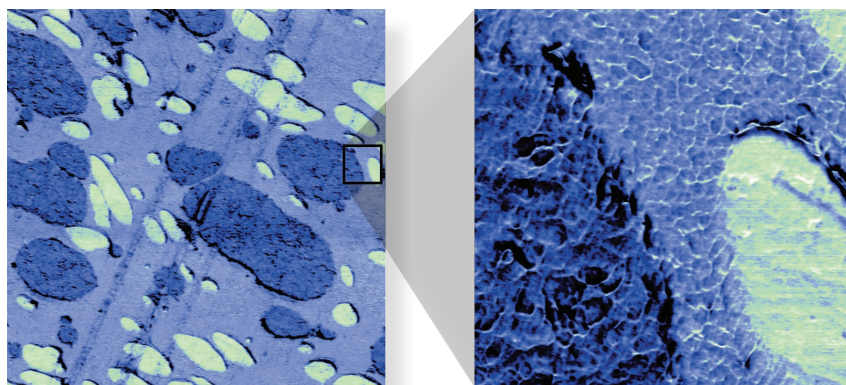
- We proudly publish our low-noise closed-loop scanner specifications
- Closed-loop allows you to easily zoom and offset to regions of interest in larger overview scan images and to target specific structures for force curves – older open-loop scanners are unpredictable in these motions
- Decoupled XY and Z scanners use flexures to keep the scan axes orthogonal and the scan plane flat – older AFMs use piezo tubes which have coupling between scan axes and introduce scanner “bow” artifacts



Atomic resolution on a calcite crystal. Imaged in liquid in contact mode, 7.5 nm scan.



Mechanical unfolding of the modular protein titin.



The closed-loop scanner makes it easy to accurately zoom into regions of interest. Here a three component polymer blend was imaged. A large overview scan (20  $\mu\text{m}$ ) was collected first, then the indicated region was chosen with a single click for a higher-resolution scan (2  $\mu\text{m}$ ). The modulus data channel is shown, clearly indicating three components. Sample courtesy of Dalia Yablou, ExxonMobil Research and Engineering, Corporate Strategic Research.

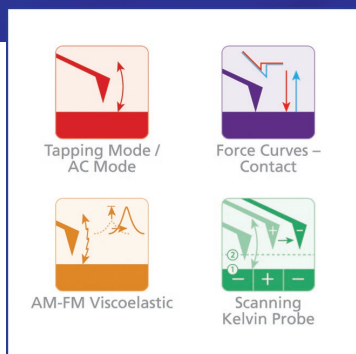
# FLEXIBILITY

## Get Both Versatility and Productivity

Software that will help get you started and will never hold you back

### Get your results faster with SmartStart and ModeMaster

- SmartStart™ auto detects and configures system components to get started fast
- ModeMaster™ configures the software for your choice of measurement type



ModeMaster enables one-click configuration for more than thirty different modes.

### Many advanced features are included at no extra charge

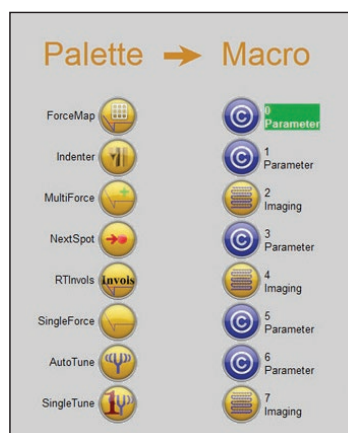
- Includes powerful MicroAngelo™ feature for nanomanipulation and nanolithography
- Large range of advanced techniques for investigating material properties
- Create stunning 3D renderings of your data even as you scan in real-time, and easily prepare publication-ready graphics



Nanolithography example created by scratching polycarbonate, 20 μm scan.

### Automation? Advanced needs? No problem.

- MacroBuilder™ allows you to easily implement custom routines by simply dragging “modules” together to form macros, no coding required
- Even greater customization potential is possible with the lower-level IGOR Pro scripting language



### Included Modes

- Contact Mode
- Dual AC™
- Dual AC Resonance Tracking (DART™)
- Electric Force Microscopy (EFM)
- Force Curve Mode
- Force Mapping Mode (Force Volume)
- Force Modulation
- Frequency Modulation
- Fluid imaging
- 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 with Q-control
- Vector PFM

### Optional Modes

- AM-FM Viscoelastic Mapping
- Band Excitation
- Conductive AFM (CAFM) with ORCA™ and Eclipse™ Mode
- iDrive™ (magnetically actuated AC Mode in fluid)
- Scanning Thermal Microscopy (SThM)
- Scanning Tunneling Microscopy (STM)
- Sample heating from ambient to 275°C

## Empower Your Research

### Asylum Research – the technology leader in AFM

The MFP-3D Origin benefits from years of ongoing innovation at Asylum Research.

#### NanomechPro™ Toolkit

- Powerful suite of tools for nanomechanical characterization
- Fast, high-resolution and quantitative material property mapping
- Flexibility to choose the best method and mechanical model for the most accurate results over the widest range of samples
- Obtain quantitative values for elastic modulus, loss modulus, stiffness, dissipation, adhesion and more

#### Leadership in Piezoresponse Force Microscopy

- Asylum Research is the recognized world leader in commercial PFM
- Exclusive PFM imaging, lithography, and spectroscopy capabilities

#### Enabling biological and electrochemical research

- Exclusive iDrive option for simpler imaging in liquid
- Versatile electrochemistry cell enables energy and corrosion research

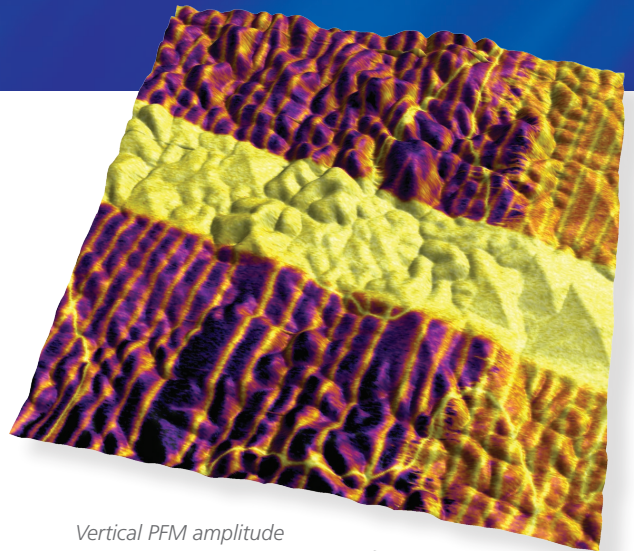
The MFP-3D Origin can grow with your research.

#### Many optional accessories and capabilities

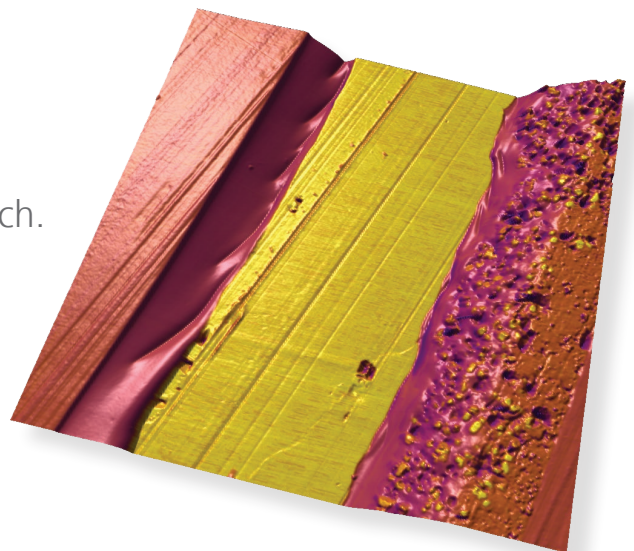
- Conductive AFM for conductivity/current mapping
- High temperature sample heater (up to 275°C)
- Scanning Tunneling Microscopy (STM)
- Compatibility with harsh solvents and other chemicals
- Fluid and environmental cells that allow sealing and perfusion

#### Need more capabilities later? Upgrades are easy.

- Can be easily and affordably upgraded to the full MFP-3D
- Full upgradability eliminates the risk associated with choosing other, more limited, low-cost AFMs that are based on older technology



Vertical PFM amplitude overlaid on topography image of lead titanate film, 5  $\mu\text{m}$  scan. Courtesy of A. Gruverman and D. Wu, University of Nebraska-Lincoln. Sample courtesy H. Funakubo.



AM-FM viscoelastic mapping image of a coffee bag cross-section, 30  $\mu\text{m}$  scan. Modulus data has been overlaid on topography. The center yellow band is a metal layer, attached to two outer vapor barrier layers (orange) by "tie" layers (red). The moduli of the three materials span approximately three orders of magnitude.

## Best in Class System Specifications

**Guaranteed. Tested. Delivered.**

### High-precision, low-noise scan motion, and closed-loop operation in all three axes

**X & Y Range** 90  $\mu\text{m}$

**X & Y Sensors** <0.5 nm noise, <0.5% non-linearity (max deviation/full travel)

**Z Range** >15  $\mu\text{m}$  (Extended range Z option >40  $\mu\text{m}$ )

**Z Sensor** <0.25 nm noise, <0.05% non-linearity (max deviation/full travel)

### Lowest-noise force measurements limited only by inherent thermal noise limit

**Cantilever Deflection Sensing** Optical lever in 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 (SLD), FDA/IEC Class 1M (non-hazardous).

**DC Detector Noise** <15  $\mu\text{m}$

### Low system noise enables high-resolution imaging

**DC Height Noise** <50  $\mu\text{m}$

**AC Height Noise** <50  $\mu\text{m}$

### Versatile system configuration

**Sample Stage** Accommodates samples up to 80 mm diameter and up to 10 mm thick (up to 27 mm with optional leg extenders). Micrometer driven stage allows precise tip-sample alignment.

**Top-View Optics** Probe, IR SLD spot, and sample can be viewed through top-down brightfield optics with two selectable fields of view, 720  $\mu\text{m}$  and 240  $\mu\text{m}$ , through a 10X objective.

**Available Upgrades** Can be upgraded to full MFP-3D and MFP-3D-BIO™ configurations with all MFP-3D accessories.

### MFP-3D Origin Controller – 100% digital controller for fastest, lowest-noise performance

**Scanner Drive** Three high-resolution 24-bit DACs are used for XY scanning and Z motion, ensuring that bit noise (<6  $\mu\text{m}$  XY and <1  $\mu\text{m}$  Z) never limits scan resolution. Ultra-low-noise amplifiers result in <70  $\mu\text{V}$  Adev noise on the high voltage (-10 to 150 V) piezo drive signals in a 1 Hz to 10 kHz bandwidth.

**Closed-loop Scanner Feedback** Integrated low-noise position sensors in all three axes are immediately digitized and input to three independent, all-digital feedback loops to provide seamless closed-loop operation. This eliminates and corrects position errors in the scanning system due to piezo hysteresis, creep, and non-linearity, and substantially reduces thermal drift.

**Deflection Signal** Immediately sampled with 16-bit ADC operating at 5 MHz with seven gains and a 16-bit offset.

**AC Mode Support** Two Direct Digital Synthesizers (DDS) are summed to generate the AC drive signal on a 16-bit, 10 MHz DAC at frequencies from DC to 2.0 MHz. Fully digital dual lock-in provides quadrature outputs at bandwidths up to 9 kHz. Digital Q-control can typically enhance or suppress cantilever Q by up to 5X.

**Data Acquisition** Limited only by the memory on the PC (i.e., 10 million point force curves, >8k x 8k pixel images).

**Computer Interface** Universal Serial Bus (USB) interface to a high-performance, dual-monitor, Windows 7 64-bit PC.

(All noise measurements are quoted as the average deviation measured with a 1 kHz bandwidth over a full 10 second period unless otherwise noted. Specifications assume recommended vibration and acoustic isolation in an appropriate laboratory environment.)

# SUPPORT

## Unmatched Customer Support

We help you get the results you need

### Personalized, exceptional support

- Free support from our worldwide technical staff
- OnSight Remote Support allows us to control and diagnose your AFM over the internet
- Online User Forum has almost 3,000 members engaged in lively technical discussions

### Much more than just technical support

- Our AFM experts can help every step of the way – sample preparation, selecting the best technique, choosing a probe, data analysis and more
- Give your research a boost by developing your skills and learning new ones from our experts during our specialized AFM training courses

### Best warranty in its class

- The Origin includes a full one-year warranty
- Asylum makes the most robust, reliable AFMs in the world

*"Asylum Research ... proves every day how much they care about their customers by providing the best service and support in the industry. Truly exceptional."*

– Scott MacLaren,  
University of Illinois at Urbana-Champaign

*Asylum Research founders  
Roger Proksch, Dick Clark,  
and Jason Cleveland*



Front cover image: SEBS triblock copolymer, 15  $\mu\text{m}$  scan.

Visit [www.AsylumResearch.com/Origin](http://www.AsylumResearch.com/Origin) to learn more and get a quote

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