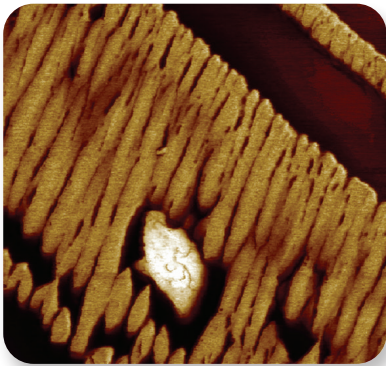


## MultiMode 8-HR

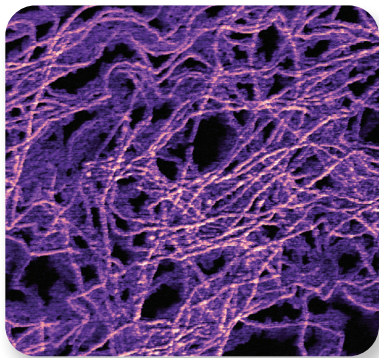
● The Benchmark for High-Performance Atomic Force Microscopy

# The Legendary MultiMode AFM Continues to Evolve

The MultiMode® platform's success is based on its combination of superior resolution, performance, and unparalleled versatility and productivity. The new MultiMode 8-HR™ AFM takes full advantage of these developments to provide significant improvements in imaging speed, resolution, and nanomechanical performance with higher speed PeakForce Tapping®, enhanced PeakForce QNM®, new FastForce Volume™, and exclusive Bruker probes technology.



Modulus map of polydiethylsiloxane (PDES) imaged using PeakForce QNM. Image shows a 3 μm scan area where the modulus varies from 1.5 to 15 MPa.



PeakForce TUNA current map of poly(3-hexylthiophene) (P3HT) organic conductive nanowires using 3V bias. Image shows a 3 μm scan area where the current varies from 0 to 80 pA.

“Thanks to PeakForce QNM, we were able to rapidly obtain pertinent information on the mechanical properties of very soft and sticky polymer materials, such as bioadhesives or adaptive hydrogels, that other classical SPM techniques were not able to provide.”

— Philippe Leclère et al, University of Mons (UMONS) Belgium

## ■ Highest Resolution Imaging — Any Time, Every Time

Enabling researchers to routinely create high-resolution images with PeakForce Tapping

## ■ Most Complete Quantitative Nanoscale Data

Performing routine, quantifiable, nanoscale electrical and mechanical property mapping, whatever you measure

## ■ Surprisingly Simple, Making Every User an AFM Expert

Allowing users of all experience levels to achieve expert results via ScanAsyst® image optimization software

## ■ Unlimited Potential — Fully Flexible with Open Access

Accessing AFM functions easily and directly through NanoScope® Open Access Toolbox

# • PeakForce Tapping

## How AFM Should Be

Bruker's exclusive PeakForce Tapping permits the use of greatly reduced imaging forces, leading to the most consistent, highest resolution AFM imaging, from the softest biological samples to very hard materials. MultiMode 8–HR provides even faster imaging speeds and higher frequency modulation PeakForce QNM for unrivalled nanomechanical property mapping.

### PeakForce Tapping delivers:

- Higher PeakForce imaging speeds with no loss of performance on multiple sample types for imaging in air and fluid
- Instantly correlated PeakForce QNM quantitative nanomechanical modulus and adhesion mapping and PeakForce Tapping electrical modes

### PeakForce QNM provides:

- Highest resolution, fastest, quantitative nanomechanical mapping, extended to 4 kHz modulation frequency increasing PeakForce QNM imaging speeds by 2x
- Widest operating range for samples, from extremely soft materials (~1 kPa) to hard metals (100 GPa)

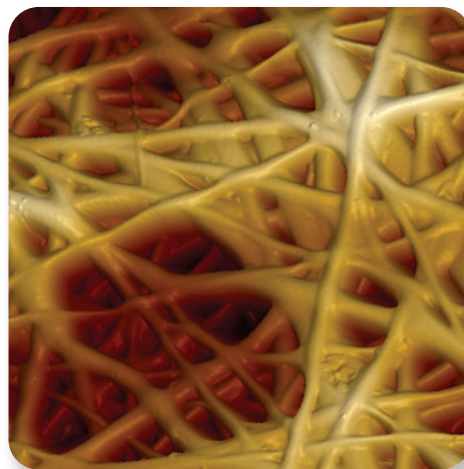
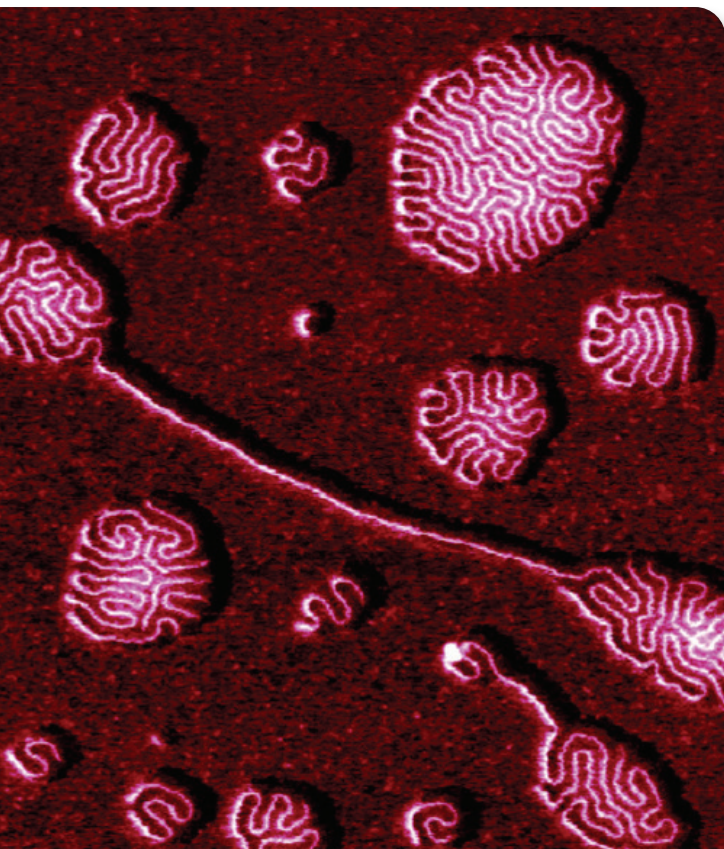
### PeakForce KPFM™ and PeakForce TUNA™ enable:

- Quantitative work function maps with millivolt sensitivity at the 10-nanometer resolution level
- Conductivity maps even on soft and fragile samples not amenable to contact mode

### PeakForce-HR Module ensures:

- The PeakForce-HR module provides up to 6x faster imaging in air compared to most conventional AFMs
- Image optimization for consistent, expert-quality results for all AFM users

Polymer brush structures imaged using PeakForce-HR.  
Scan size 1  $\mu\text{m}$  at 5 Hz. Sample courtesy of S. Sheiko, University of North Carolina, Chapel Hill.



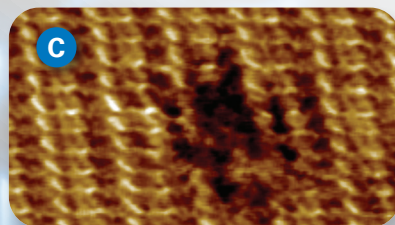
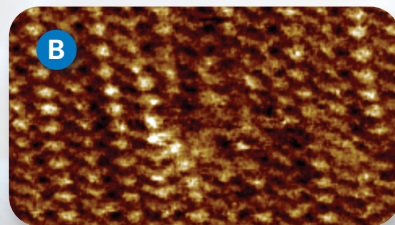
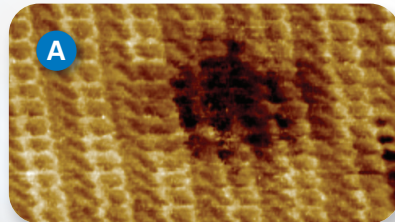
Cell culture substrate imaged with PeakForce-HR. Scan size 8  $\mu\text{m}$ , scan rate 1 Hz. Sample is extremely challenging to image with conventional AC modes even at much slower scan rates.

“PeakForce Tapping provided my lab with the force control and resolution necessary to produce ground-breaking ligand-receptor interaction maps using functionalized probes on live cells in a very time efficient and controlled way.”

— Dr. Daniel Müller, ETH Zurich, Switzerland

# • Highest Resolution Imaging and Most Complete Quantitative Nanoscale Data

PeakForce QNM images revealing a molecular defect on a polydiacetylene crystal, in air. Individual molecules are resolved in height (A) as well as adhesion (B) and stiffness (C) maps, with a notable decrease in stiffness at the defect site. Image size 10 nm.



## Highest Resolution Imaging — Any Time, Every Time

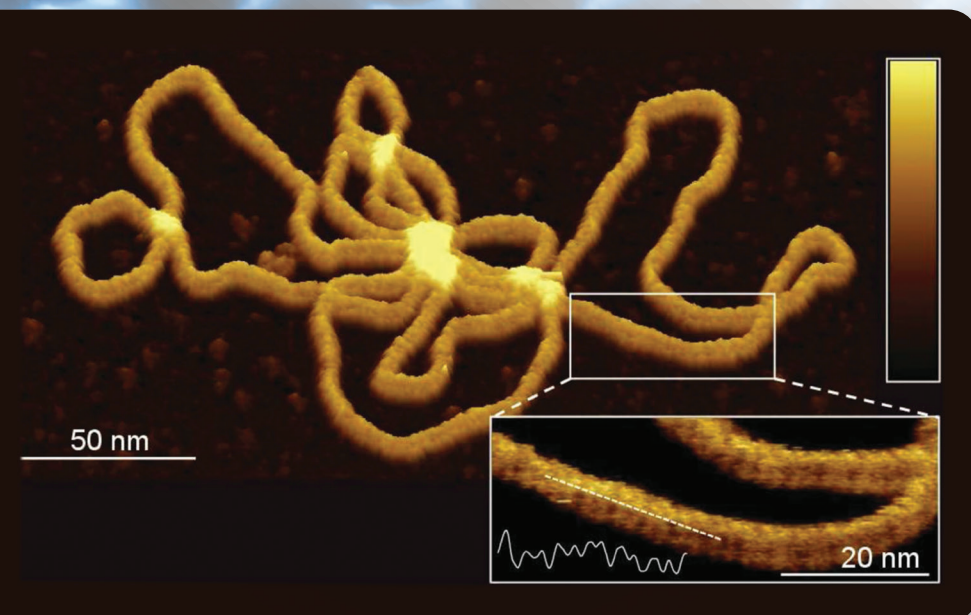
- Enabling researchers to routinely create high-resolution images with PeakForce Tapping on graphene, polymers, 2D materials, and many other real world samples
- Demonstrated highest resolution performance on molecular and biological structures, such as protein structures or DNA showing double helix structure
- Correlated imaging with unique PeakForce Tapping modes showing topography, nanomechanical and nanoelectrical modes

## Most Complete Quantitative Nanoscale Property Mapping Data

- High-resolution, most quantitative, nanomechanical studies on molecules, proteins and cells with a full suite of nanomechanical capabilities
- The widest range of nanoelectrical techniques of any AFM for the highest resolution, most complete electrical characterization
- Undertake visco-elastic studies with the widest frequency range available on any AFM from 0.1 Hz to 4 KHz frequency

## World's Highest Resolution Biological Imaging and Most Sensitive Molecular Force Spectroscopy

MultiMode 8-HR continues to demonstrate the highest resolution molecular and fluid imaging by providing routine high-resolution molecular imaging with PeakForce Tapping and force spectroscopy techniques.



Topography image of plasmid DNA showing corrugation along the strand that corresponds to the double helix structure. Inset: High-resolution image of a segment of the DNA strand where the alternating major and minor grooves are clearly resolved in the corresponding height profile. Color scales: 3.5 nm; 1.4 nm (inset).

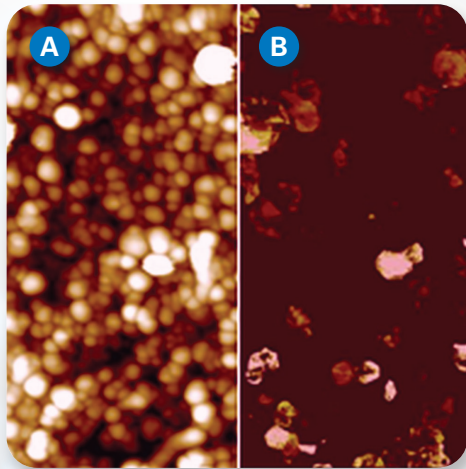
Figure courtesy of A. Pyne et al. *Small* (2014) doi: 10.1002/sml.2012400265.

## Most Advanced Suite of Nanoscale Mechanical Property Mapping Tools

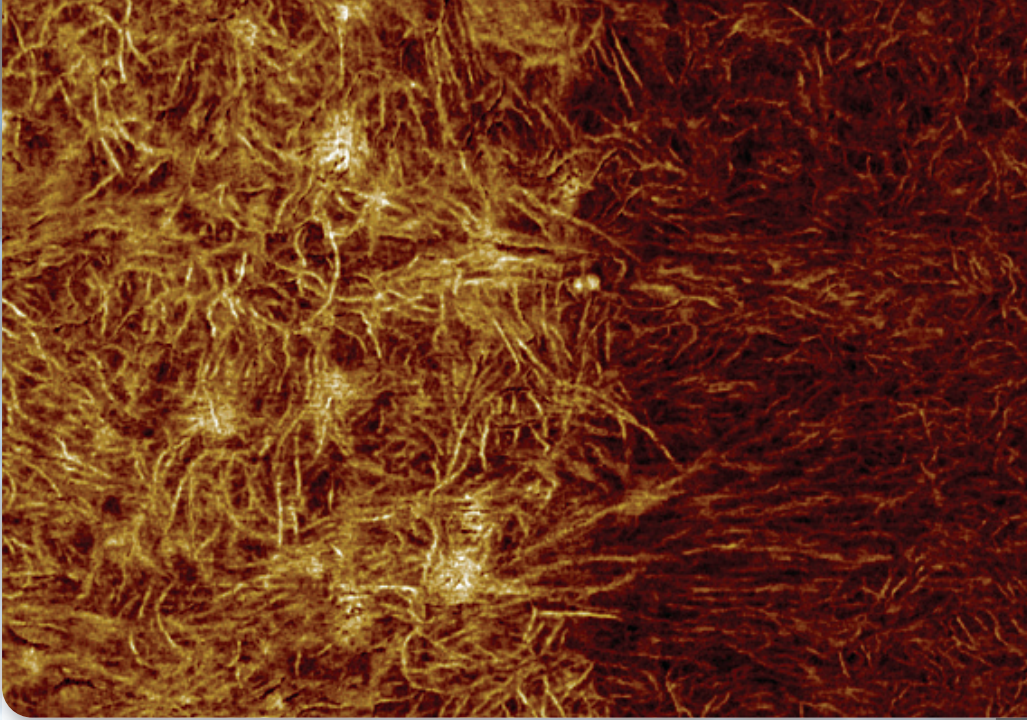
Higher frequency PeakForce QNM and new FastForce Volume mapping techniques complement existing force spectroscopy capabilities to provide researchers with the most advanced nanomechanical mapping techniques to investigate mechanical properties of the widest range of materials.

## Highest Resolution Electrical Characterization Techniques

MultiMode 8-HR utilizes proprietary PeakForce TUNA and PeakForce KPFM techniques to extend capabilities beyond standard contact mode-based nanoelectrical techniques, uniquely providing the means for researchers to advance electrical materials characterization across the full range of materials.

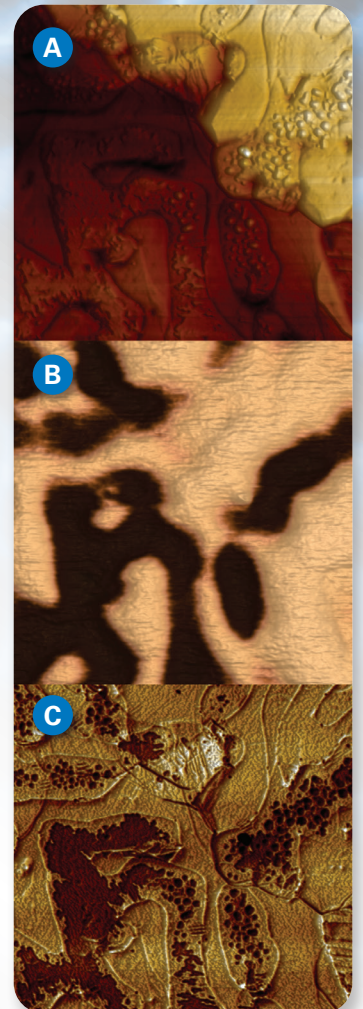


Height (A) and current (B) maps of a carpet of vertical carbon nanotubes, obtained with PeakForce TUNA, which are impossible to image with contact mode. Image size 1  $\mu\text{m}$ .



This modulus image shows the subtle transition between the ULDPE tie layer to the PS/LDPE sealant layer of cross sectioned packaging material. Mapping the modulus at high spatial resolution reveals lamella from the tie layer act as nucleation sites penetrating into the sealant and increasing lamellar ordering within 1  $\mu\text{m}$  from the interface. Image size 3  $\mu\text{m}$ .

Height (A), surface potential (B), and adhesion (C) images of Sn-Pb obtained with PeakForce KPFM. The workfunction difference is accurately mapped while nanoscale phase structure in the adhesion map is simultaneously revealed. Image size 4  $\mu\text{m}$ .



“The PeakForce QNM data are absolutely outstanding and incredibly close to those that we can back-estimate via elastic models for multi stranded fibrils. We now really have rock-solid evidence on the stiffness of these fibrils, and for Bruker very remarkable evidence of how reliable PeakForce QNM can be.”

— Raffaele Mezzenga, ETH Zurich, see Adamcik et al. *Applied Physics Letters* 98, 193701 (2011)

# • Unlimited Potential and Flexibility with Open Access Complete Accessory Range

## Configurations for a Wide Range of Budgets

The MultiMode 8 platform is available in two main configurations, both of which support a wide range of accessories to help you tailor your AFM to your specific application requirements:

- MultiMode 8-HR with high-rate PeakForce Tapping capabilities
- MultiMode 8 base configuration designed to suit lower budget levels

Systems can be configured with accessories for focused, specific-application performance, such as biological imaging, molecular force spectroscopy and functionalized imaging, and STM and advanced materials research applications.

## NanoScope Open Access Toolbox

MultiMode 8-HR offers a variety of options to monitor signals, modify real-time operation, and implement custom offline analysis.

### Complete Data Access with Both ASCII Export and MATLAB Toolbox

- Standard NanoScope tools exist for direct MATLAB import of data, such as PeakForce Capture™ and HSDC

### Monitor Internal Signals and Customize Signal Inputs

- Access internal NanoScope signals and data channels along with user input of external signals with VirtualSAM, or expand your capabilities with optional SAM III

### Control Your AFM to Design Your Own Experiment

- Control of AFM functions are available through optional nanolithography and NanoScope COM interface with different levels of AFM control capabilities

### Invent Your Own Mode!

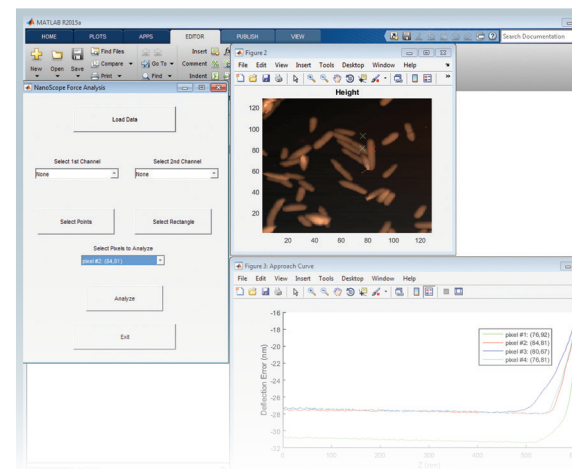
- Leverage NanoScope Open Access capabilities to extend your experiment beyond standard AFM modes
- Be first to develop your own mode for obtaining new unique data sets

The MultiMode 8-HR configuration for fluid imaging and a variety of biological applications, includes:

- PeakForce Tapping modes and probes for highest resolution fluid imaging
- Liquid resistant scanners with both open and closed fluid cell operation
- A heater option that heats up to 60°C in fluid, or a low-range heating and cooling option that enables temperature control between -35°C and 100°C



NanoScope controller for signal input and output.



Personalize your experimental data with data export tools, such as MATLAB toolbox and PeakForce Capture.

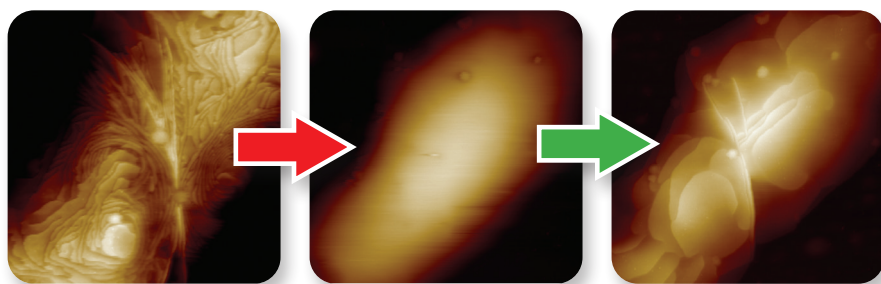
## Turnkey Glovebox Solution for Demanding Environmental Control

Some advanced materials are sensitive to oxygen and/or water, notably organic photovoltaics and lithium ion cathode materials. These materials demand an environment where both water and oxygen can be maintained at <1 ppm. Bruker's turnkey glovebox is the perfect solution when a simple purged chamber is not sufficient.



## Temperature and Environmental Control

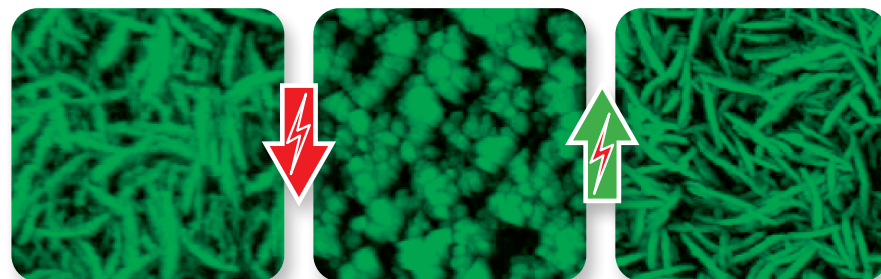
The MultiMode 8-HR is available with both sample heating and cooling capabilities. The low-range option enables heating and cooling between -35°C and 100°C in either air or fluids. The high-range option heats up to 250°C and is often used to study polymer phase transitions. It is unique in that it allows both gas purging to prevent sample oxidation and tip heating to prevent tip contamination. Environmental control accessories are available both integrated with the heater/cooler options or as separate environmental chambers.



Poloxamer tri-block copolymer (BASF Pluronic) sample imaged with PeakForce-HR. Starting at room temperature (left), the sample melts upon heating to 60°C (middle), and then recrystallizes upon cooling to 55°C (right). Scan sizes 3  $\mu\text{m}$ , imaged at 10 Hz.

## Unmatched Electrochemistry and STM Capabilities

The MultiMode 8-HR supports a full suite of accessories for electrochemistry research with configurations for both ECAFM and ECSTM, as well as for Bruker's exclusive Scanning Electrochemical Potential Microscopy mode. When a simple purged chamber is not sufficient, Bruker's turnkey glovebox for the MultiMode 8-HR provides the perfect solution for <1 ppm environment control.



Vanadium pentoxide thin film imaged using TappingMode at a scan size of 5  $\mu\text{m}$ . The film was used as the positive electrode in a lithium micro-battery and examined in its original, pristine condition (left), after the first discharge (middle), and after the subsequent charge (right). Even this single charge/discharge cycle irreversibly changes the film structure. Images courtesy of B. Fleutot, H. Martinez, B. Pecquenard, J.B. Ledeuil, A. Levasseur, and D. Gonbeau, University of PAU, France.

# MultiMode8-HR

## No Platform Is More Extendable

### PeakForce Imaging Modes:

- ScanAsyst®
- PeakForce Tapping™
- PeakForce Tapping-HR

### General Imaging Modes:

- TappingMode™
- Contact Mode
- PhaseImaging™
- Torsional Resonance Mode (TRmode™)
- Lateral Force Microscopy (LFM)
- Scanning Tunneling Microscopy (STM)

### Mechanical Property Characterization:

- PeakForce QNM®
- FastForce Volume™
- RAMP&HOLD
- Nanoindentation
- Piezoresponse Force Microscopy
- Nanoscale Thermal Analysis
- Scanning Thermal Microscopy
- Force Modulation
- Friction Force Microscopy
- HarmoniX®

### Life Science and Fluid Imaging:

- Liquid Resistant Scanners

“The MultiMode can't be beat when it comes to resolution, reliability and ease of use. It's a favorite of over 600 users here in our imaging facility who come from many diverse research backgrounds”

– Gajendra Shekhawat, Northwestern University

- Small Volume Fluid Exchange
- ScanAsyst Mode with “Tuning Free” Imaging
- PeakForce QNM for Live-Cell Imaging

### Electrical and Magnetic Property Characterization:

- PeakForce TUNA™
- PeakForce KPFM™
- PiezoForce Microscopy
- Surface Potential Mapping (FM and AM KPFM)
- Electric Force Microscopy (EFM)
- Magnetic Force Microscopy (MFM)
- LiftMode™

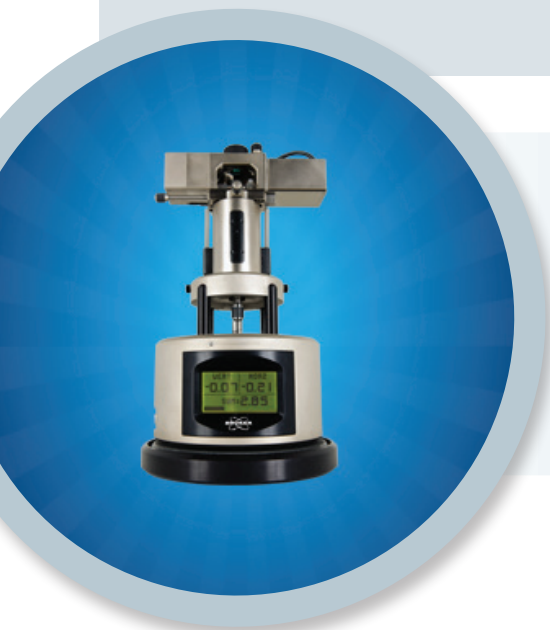
- Conductive AFM (CAFM)
- Tunneling AFM (TUNA)
- Scanning Spreading Resistance Microscopy (SSRM)
- Scanning Capacitance Microscopy (SCM)

### Electrochemistry:

- Universal Bipotentiostat
- ECAFM™
- SECPM™
- ECSTM™

### Temperature and Environmental Control:

- Ambient to 60°C Heater
- -35°C to 250°C Heater-Cooler
- Glovebox with 0.1 ppm
- Atmospheric Chamber




## Upgrade Your MultiMode

Take advantage of the very latest advances in AFM technology

Contact your Bruker representative today at [productinfo@bruker.com](mailto:productinfo@bruker.com)

### System Specifications

Imaging Noise Level	<30 pm RMS (Z noise using TappingMode in air at zero scan size)
Maximum Sample Size	15 mm diameter x 5 mm thick
Regulatory Certification	CE and UKCA compliant
Laser Classification	Class 2M, 1 mW maximum at 690 nm (IEC and US CDRH) 

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