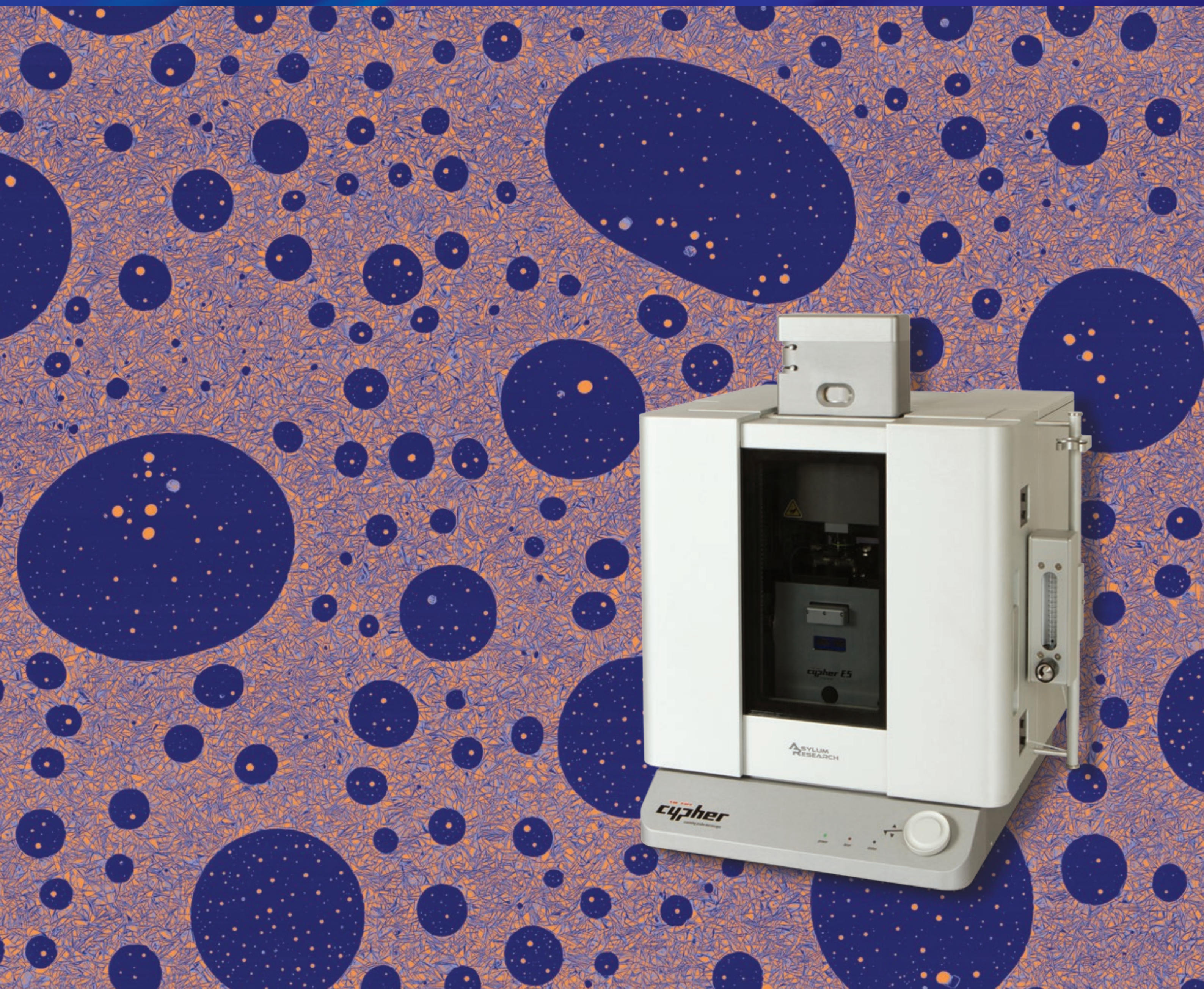
Asylum Research

Cypher AFMs

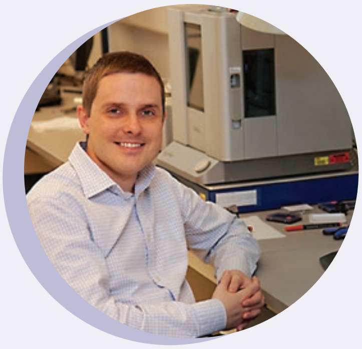
There is no other AFM like Cypher for materials and life science research



OXFORD INSTRUMENTS

The Business of Science®

AFM
Asylum Research



"Cypher is by far the best, most stable and most configurable AFM I have ever used."

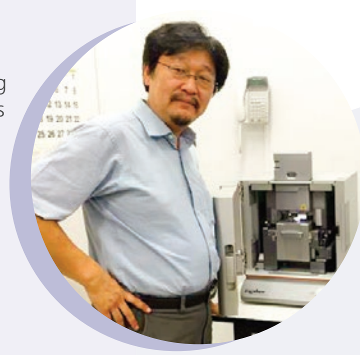
Professor Andras Kis,
EPFL, Switzerland

CONTENTS

** See links to Cypher movies*

"Asylum's Cypher is clearly the best choice for polymer research. When I compared Cypher to the alternatives, it became very obvious that Asylum Research is far ahead of their competitors in pushing the limits of AFM performance and developing tools for nanomechanical measurements."

Professor Ken Nakajima,
Tokyo Institute of Technology, Japan



"Cypher is truly the first of a new generation of AFMs. The Asylum Research folks have looked at everything that limited AFM performance in the past and addressed all of them in this new design.

Cypher has better resolution, less noise, less drift, is more accurate, is able to scan faster and, on top of that, it's the easiest to use AFM that I've ever seen—and that's pretty much all of them."

Professor Bruce Parkinson,
University of Wyoming, United States

"Since we got the Cypher we are glued to it. We love the resolution, the reliability and… the blueDrive! It is allowing us to make quantitative measurements on a whole range of biological systems from single molecules to plant tissues. The Cypher is inspiring us to try many things that we would have not tried otherwise."

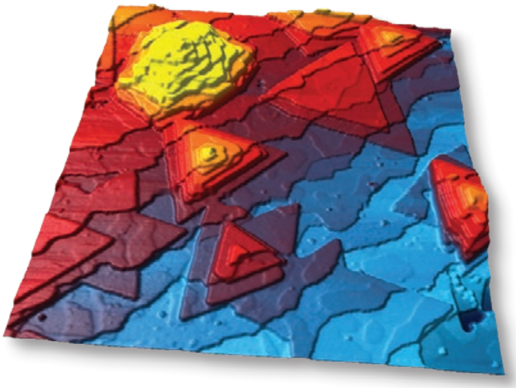
Professor Sonia Contera,
University of Oxford, United Kingdom

#NoOtherAFM

There is No Other AFM Like **Cypher™**

Higher resolution, faster, easier, more versatile

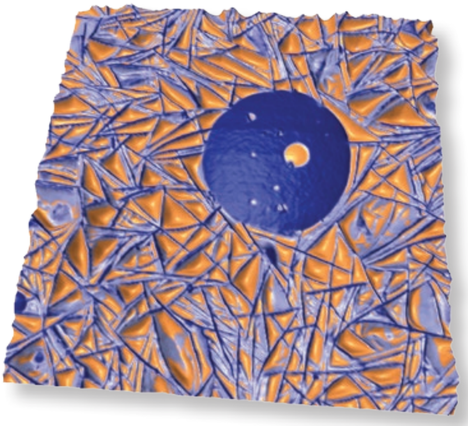
Asylum Research **Cypher**™ AFMs are in a class by themselves. Every design choice was guided to achieve a unique combination of highest resolution, fast scanning, integrated environmental control, and unmatched productivity.



MoS_2 deposited on epitaxial graphene
Molybdenum disulfide grown by chemical vapor deposition forms triangular terraces, 2 µm scan. Subsequent growth precipitates a new nucleus on a previously grown triangle, thereby forming multilayered pyramids. Image courtesy I. Balla, S. Kim, and M. Hersam, Northwestern University.

Cypher AFMs come in two configurations:

- **Cypher S** is ideal for materials and life science research under ambient conditions in air or liquid.
- **Cypher ES** provides heating and cooling, gas and liquid perfusion, and unmatched chemical compatibility for all applications that require environmental control.



(Cover and above) Two-component polymer thin film imaged on Cypher ES
The film has a complex structure after a slow melting and recrystallization process. The original cover image was scanned over a 30 µm area at high pixel density, which then allowed a digital zoom into the 2 µm area shown above. *See page 13 for further explanation and a movie of the process.*

All Cypher AFMs offer these core benefits

- Routinely achieve higher resolution than other AFMs
- Fast scanning with results in seconds instead of minutes
- Every step of operation is simpler for remarkable productivity
- Small footprint in the lab, huge potential to grow in capability
- Support that goes above and beyond your expectations

On top of all that, Cypher ES makes it easy to control the AFM environment

- Enables gas and liquid perfusion through a sealed cell
- Controls sample temperature over a wide 0–250°C range
- Broadest compatibility with harsh chemicals

AMAZING

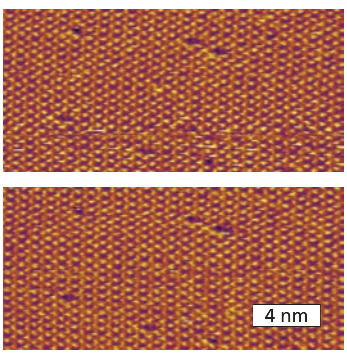
No Other AFM Makes High Resolution This Easy

Scientists routinely get spectacular results using their Cypher AFMs

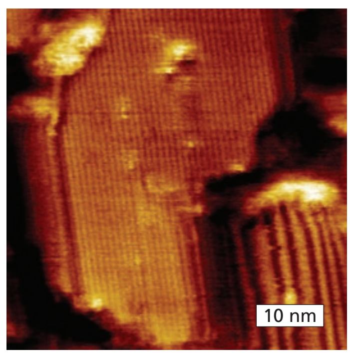
"There's plenty of room at the bottom,"
Nobel laureate physicist Richard Feynman told us.
No other AFM will take you further or get you there faster.

Only Cypher makes it this easy to achieve the highest resolution

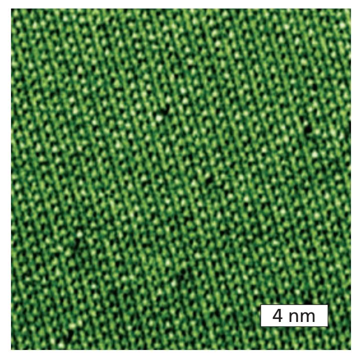
Cypher is not the first AFM to resolve atomic point defects, but it is the first AFM that makes these results routine. There are no tricks, special modes, or luck involved. It's just what Cypher does well.



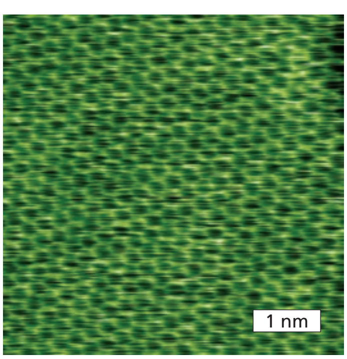
Calcite defects imaged in FM mode
Single atomic point defects are resolved in successive scans. Imaged using frequency-modulated AC mode in water with blueDrive photothermal excitation, rather than conventional tapping mode (AM mode).



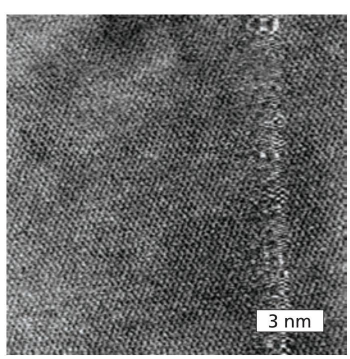
Crystalline lamella in polyethylene
This AM-FM stiffness image shows lamella spacing of 0.89 nm, consistent with expected polymer chain packing. The larger spacing (lower right) corresponds to steps between stacked lamella terraces.



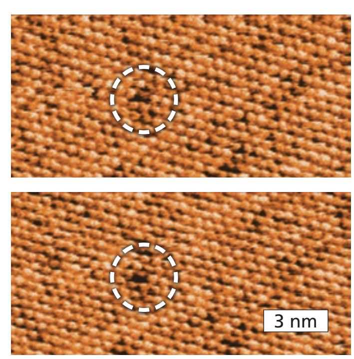
Calcite defects imaged in AM mode
Like FM mode (image far left), conventional amplitude-modulated (AM) or tapping mode can also readily resolve single point defects. Here, the phase data is shown from an image taken using blueDrive in water.



Hexagonal boron nitride lattice
Contact mode images in air show the atomic lattice spacing of 0.25 ± 0.01 nm. Image courtesy P. Beton, Univ. Nottingham. See related work in *ACS Nano* **10**, 10347 (2015).



Graphene lattice
One of more than a thousand images collected over 7 h of unattended imaging using lateral force microscopy in air. Image courtesy N. Wilson, Univ. Warwick. See *Nanotechnology* **24**, 255704 (2013).



Cesium ions adsorbed to mica
Packing defects in the adsorbed ions were observed in successive images. Imaged using tapping mode in solution with blueDrive. Sample courtesy M. Valtiner, Max Planck Institut für Eisenforschung.

#NoOtherAFM

Why does Cypher outperform every other AFM?

Unmatched mechanical stability—Noise floor is half that of any other AFM sold today!

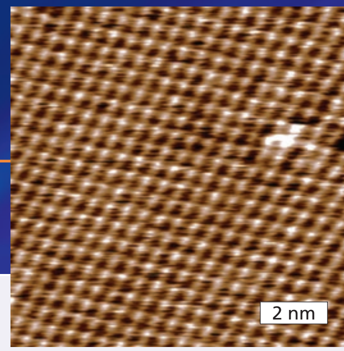
Cypher's mechanical loop is short and stiff, resulting in a noise floor of <15 pm, at least 50% lower than any other AFM. It's the only AFM that routinely achieves atomic resolution with no vibration isolation.

Exceptionally low drift—Features are undistorted and lattice lines are straight

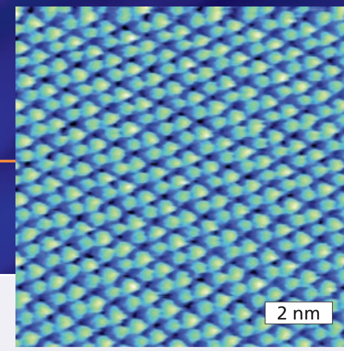
Cypher is designed to minimize thermal drift and is fully enclosed to quickly achieve equilibrium. Optional active temperature control can banish drift almost entirely. Ultra-low-noise sensors enable closed-loop scanning even at the highest resolution, eliminating distortion from open-loop piezo creep.

Lowest noise electronics—No more guessing if periodic features are real or just noise

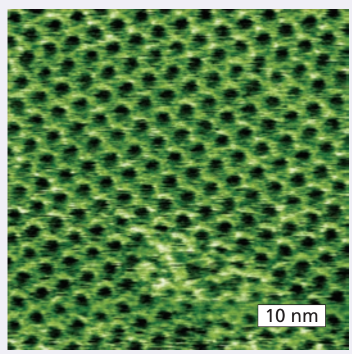
Electronic noise sources have been rigorously identified and eliminated to avoid periodic artifacts that might obscure fine details or be confused with real features.



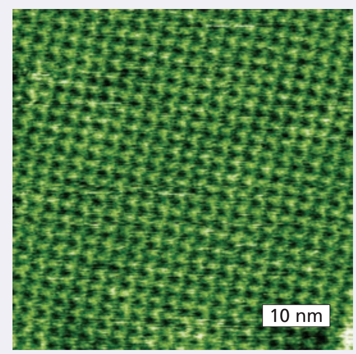
C8-BTBT epitaxial layer
C8-BTBT is an organic molecular crystal being investigated for use in organic field effect transistors because of its high charge mobility. Here the molecular structure of an epitaxial film deposited on boron nitride was imaged using tapping mode in air. Sample courtesy X. Wang, Nanjing Univ. See *Nat. Commun.* **5**, 5162 (2014).



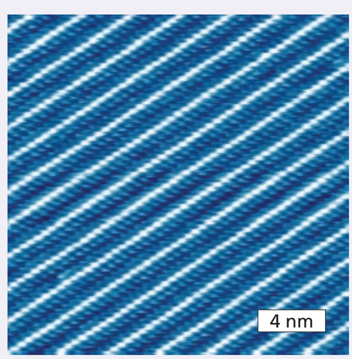
β-DBDCS monocrystal
β-DBDCS is an organic optoelectronic material that exhibits piezochromism. Here, it was imaged in water using tapping mode with blueDrive photothermal excitation. Sample courtesy S. Y. Park, Seoul National Univ., J. Gierschner, IMDEA Nanociencia, and E. Gnecco, Univ. Jena.



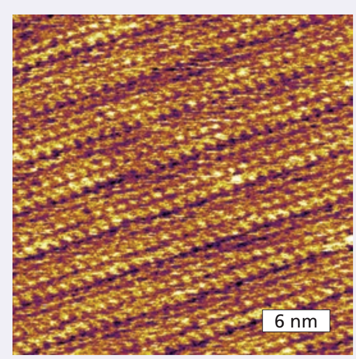
PTCDI-melamine network
PTCDI and melamine form a porous 2D network when deposited from solution on a hexagonal boron nitride substrate. Molecular resolution images were obtained in air using contact mode, from which a lattice constant of 3.54 ± 0.04 nm was measured. Image courtesy P. Beton, Univ. Nottingham.



Porphyrin (TCPP) 2D arrays
TCPP forms a 2D supramolecular network when adsorbed from solution on hexagonal boron nitride. Tapping mode images in air clearly show the square lattice with 2.24 ± 0.05 nm spacing. Image courtesy P. Beton, Univ. Nottingham.



Ordered phase at water-HOPG interface
The ordered phase forms spontaneously, with regularly spaced (1.59 nm) rows that exhibit a periodic (0.48 nm) structure. Similar structures have been attributed to adsorbed nitrogen [cf. *Appl. Surf. Sci.* **304**, 56 (2014)], though others suggest they are formed by trace contaminants. Whatever the origin, tapping mode using blueDrive provides exquisite sub-nm molecular resolution.



EMIm TSFI ionic liquid (IL) Stern layer
The IL-HOPG interface was imaged using tapping mode in the bulk IL to better understand the electric double layer of this electrolyte as a function of surface potential and ion concentration. Surface exchange of ions and dynamics within the mobile molecules results in some waviness of the lattice rows. Image courtesy R. Atkin, Univ. Newcastle. See *ACS Nano* **9**, 7608 (2015).

FAST

The Only Full-Featured Fast-Scanning AFM

Cypher finishes the whole job faster—with just one AFM and scanner!

Cypher AFMs can do it all—including fast scanning. Cypher scans fast and still supports a vast range of modes and accessories. Unlike other AFMs, you never need to switch between different scanners to finish your work.

Real productivity is finishing the whole job faster.

SPEED

Uses the fastest AFM probes

The Cypher small-spot laser module produces a spot of just 3×9 µm—far smaller than most AFMs and compatible with the fastest probes.

Scans 10–100× faster

Cypher's high-bandwidth scanner and high speed electronics combine with small, fast probes to deliver imaging rates 10–100× faster than typical AFMs. You can scan an image at 256×256 pixel resolution in just a few seconds, or reduce scan lines and reach frame rates up to two frames per second.

Fast scanning that goes beyond just topography

Cypher not only scans fast when acquiring topographic images—it can scan fast in other modes too, including AM-FM Viscoelastic Mapping Mode, conductive AFM, and piezoresponse force microscopy.

Faster to set up and get started

The experiment doesn't begin when the tip starts scanning. Setup time counts too. Cypher shortens the entire time from start to finish. Learn about these features on page 8.

VERSATILITY

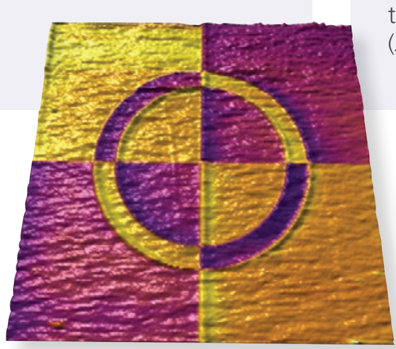
Supports more measurement modes than any other fast scanning AFM

- Includes all standard imaging modes *(see back page for a full list)*
- Delivers superior performance for low-noise, accurate force curve, force mapping, and Fast Force Mapping
- Comes standard with several modes that are either optional or not available on other fast- scanning AFMs, including surface potential (KPFM), nanomanipulation and nanolithography, and piezoresponse force microscopy (PFM)
- Comes standard with several modes not available on most AFMs, including Dual AC™, DART, loss tangent imaging, switching spectroscopy PFM, and vector PFM
- Supports many optional modes not available on most fast-scanning AFMs, including conductive AFM, AM-FM Viscoelastic Mapping Mode, and Contact Resonance Viscoelastic Mapping Mode

Cypher ES combines high speed with easy-to-use environmental control

Cypher ES makes it easy to monitor dynamic events that are driven by environmental changes. *(See pages 13-14 for examples.)*

www.oxinst.com/CypherImages
Scan for more images



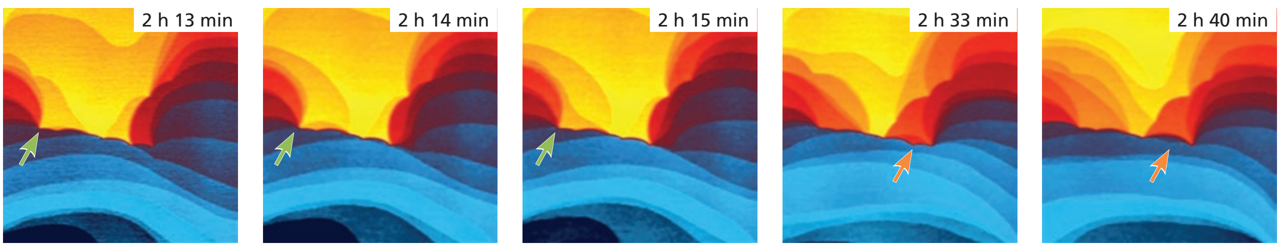
PFM of BTO thin film Piezoresponse Force Microscopy (PFM) phase image of an 8 nm thick BTO layer grown on a GaAs / $A_{l0.3}Ga_{0.7}$ As heterojunction to make confined quantum wells. The sample was poled with a DC bias to create the pattern shown, 10 µm scan. Image courtesy of F. Bi and G. Jnawali, Levy Research Group, University of Pittsburgh.

#NoOtherAFM

Cypher Has the Speed You Need

Capture movies to watch dynamic processes as they happen

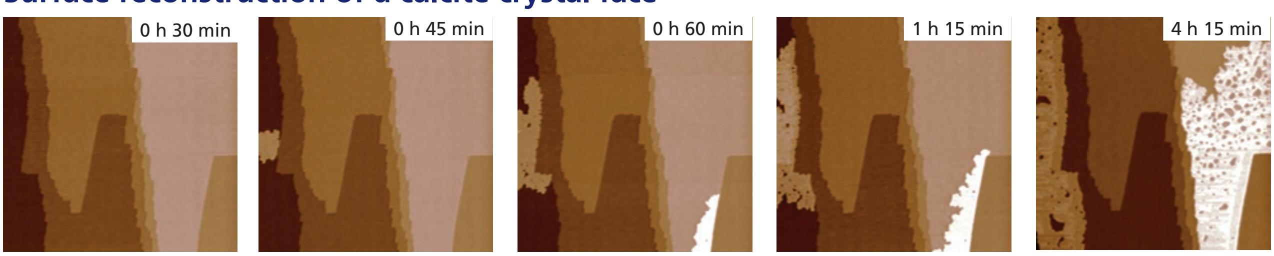
Sublimation of an anthracene crystal in air



(5 µm scan size, 192×192 pixels, height images in tapping mode at 20.8 Hz line rate, ~9 s per frame). Crystal terraces 0.9 nm high are observed moving at velocities of about 20 nm/s as the material sublimates, with step edges often becoming pinned at defects in the crystal (e.g., the edge that comes to a point at the defect marked with the green arrow). The edge begins to taper away from this defect in the second image but remains pinned, then pulls away from it in the third image. Many of the defects persist for the duration of the movie. However, in the fourth image we see a defect marked with an orange arrow that finally disappears. The full movie shows the surface evolution over three hours but is played back in one minute.

www.oxinst.com/WatchCypher
Scan for the movie

Surface reconstruction of a calcite crystal face



(2 µm scan size, 512×512 pixels, height images in tapping mode at 40 Hz line rate, ~13 s per frame). The surface of a freshly cleaved calcite crystal in humid air reconstructs on a time scale of minutes to hours. The reconstruction is known to be water driven, but there is still speculation about the structure and composition of the film. In addition to demonstrating the ability to capture dynamics, this movie nicely illustrates the exceptionally low Z noise floor of Cypher; the initial calcite steps are only about 300 pm tall. The full movie shows the reconstruction over a period of nearly five hours, played back in about thirty seconds.

www.oxinst.com/WatchCypher
Scan for the movie

High speed PFM on a periodically poled lithium niobate sample

(3 µm scan size, 256×256 pixels, phase images in PFM mode at 39 Hz line rate, ~6.5 s per frame). The test sample shown in this movie consists of an alternating pattern of oppositely poled stripe domains with a pitch of 10 µm. Just before the second image, a short (~0.5 s), high-voltage (-100 V) pulse was applied to the sample, distorting the domain boundary. An applied bias was then gradually increased, starting at 0 V and ending at 30 V, during which the domain boundary begins to recover to its original state. The full movie shows three sequences of this cycle.

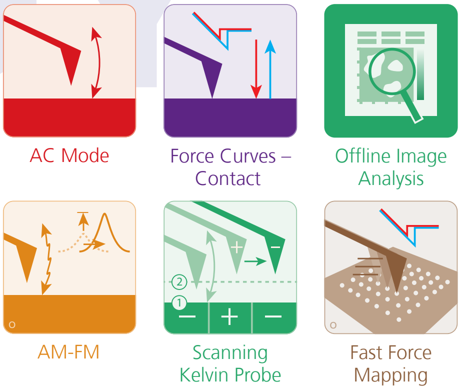
www.oxinst.com/WatchCypher
Scan for the movie

Cypher Makes It Easy to Get Great Results

Software features that make AFM easier, faster, and more consistent

ModeMaster™

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



ModeMaster helps you get started quickly with both basic and advanced AFM tasks. Only a few of the many available modes are shown here.

SpotOn™

- Fully motorized laser and detector alignment
- Click on the cantilever and the laser is aligned
- Automated detector adjustment

oxinst.com/WatchCypher

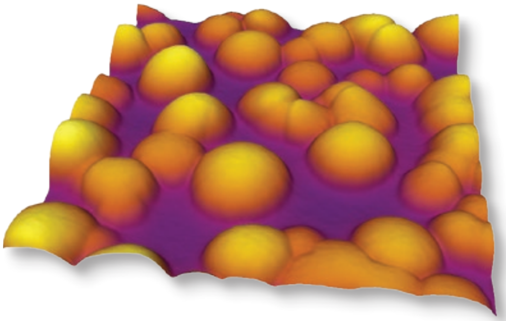
Scan to watch how quick SpotOn makes setup

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

GetStarted™

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



MDMO-PPV:PCBM polymer/fullerene solar cell
Topography imaged using GetStarted in tapping mode, 2 μm scan. Image courtesy of P. Cox, M. Glaz, S. Vorpahl, and D. Ginger, University of Washington.

www.oxinst.com/WatchCypher

Scan to see "GetStarted" movie

#NoOtherAFM

blueDrive™ Reinvents Tapping Mode

Cypher Exclusive

Remarkably simple. Strikingly accurate. Incredibly stable.

blueDrive is a better way to tap

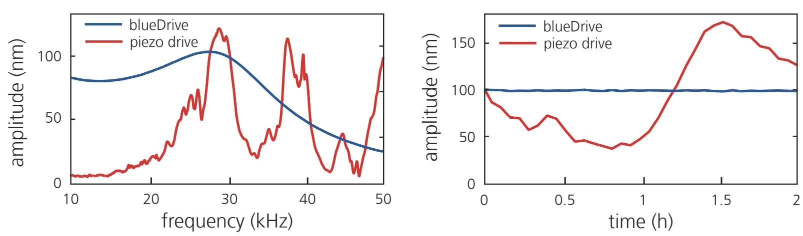
Tapping is the most commonly used AFM mode because it can measure not just topography, but also mechanical, electrical, and magnetic properties. blueDrive uses light (photothermal excitation) instead of a piezo to drive the cantilever oscillation. Unlike a tapping piezo, blueDrive acts directly on the cantilever and does not excite any other system resonances.

blueDrive tunes are clean, stable, and closely match the theoretical response.

Simple cantilever tunes

Automatically tune the cantilever using blueDrive, even in liquid. There's no guesswork in selecting the correct peak.

There's never a "forest of peaks" like you see when using piezo drive for tapping in liquid.



(Left) Tunes for an AC40 cantilever in water.
(Right) Amplitude stability under the same conditions.

Remarkably stable imaging

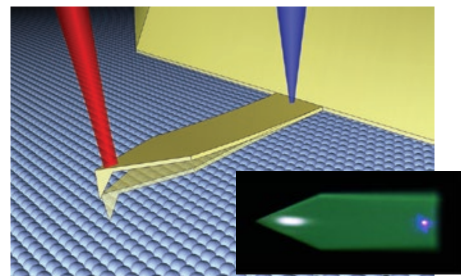
The driving force using blueDrive remains constant over time, so the cantilever amplitude remains stable.

Image for hours with no setpoint adjustments.

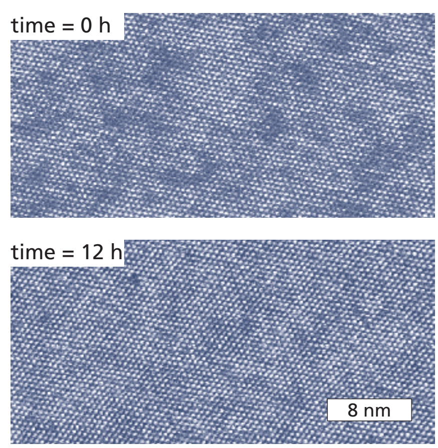
More quantitative results

The cantilever response is a rich source of information. With blueDrive, the response matches theory and can be measured, tracked, and modeled with greater accuracy and precision.

blueDrive produces better results!



Rendering showing the detection laser focused near the tip and the blueDrive laser focused near the base. (Inset) Actual optical image showing the laser spot positions on an Olympus AC160 probe. Note the blueDrive spot is very small, so it is compatible with both standard and small, fast-scanning cantilevers.



Point defects in adsorbed cesium ions on mica Even after 12 h of continuous unsupervised imaging, the tip was undamaged and resolved atomic point defects. Imaged with tapping mode in 1 M CsCl solution using blueDrive.

www.oxinst.com/WatchCypher
Scan to see blueDrive Webinar

QUANTITATIVE

Most Powerful Tools for Quantitative Nanomechanics

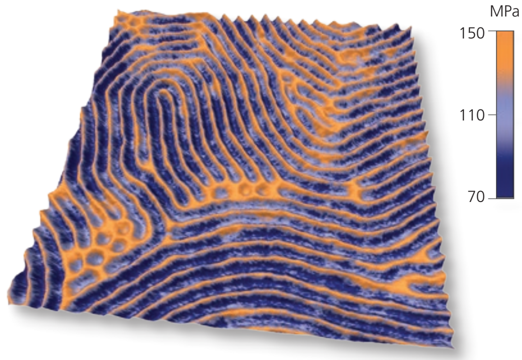
Measure viscoelastic properties including both storage and loss moduli

There's no single best nanomechanical technique for every application.

Here are a few techniques from the Asylum NanomechPro™ Toolkit:

AM-FM Viscoelastic Mapping Mode

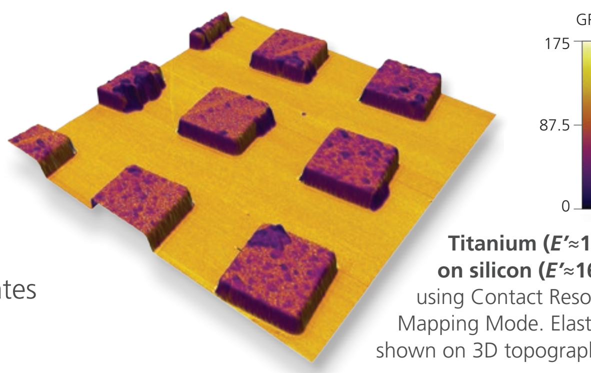
- Tapping mode technique that measures both the elastic storage modulus, *E′*, and the viscoelastic loss tangent, $\tan\delta = E''/E'$
- Good for samples from 50 kPa to 300 GPa
- Fast—line scan rates up to 20 Hz are possible



Poly(styrene-(ethylene-ran-butadiene)-styrene) triblock copolymer (SEBS) spin-coated onto a silicon wafer and imaged using AM-FM Viscoelastic Mapping Mode. Elastic modulus is shown on 3D topography, 750 nm scan.

Contact Resonance Viscoelastic Mapping Mode

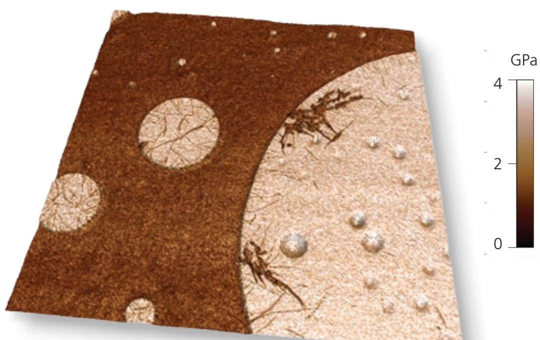
- Contact mode technique that measures both storage modulus, *E′*, and loss modulus, *E″*
- Good for samples from 1 GPa to 300 GPa



Titanium ($E'\approx110$ GPa) thin film on silicon ($E'\approx160$ GPa) imaged using Contact Resonance Viscoelastic Mapping Mode. Elastic modulus is shown on 3D topography, 25 µm scan.

Fast Force Mapping Mode

- Force-distance curve mapping mode that operates at up to 1000 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 both axes
- 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



Polystyrene-polypropylene polymer blend thin film imaged using Fast Force Mapping mode. Elastic modulus is shown on 3D topography, 6 µm scan.

Learn more:
www.oxford-instruments.com/**NanomechPro**

#NoOtherAFM

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

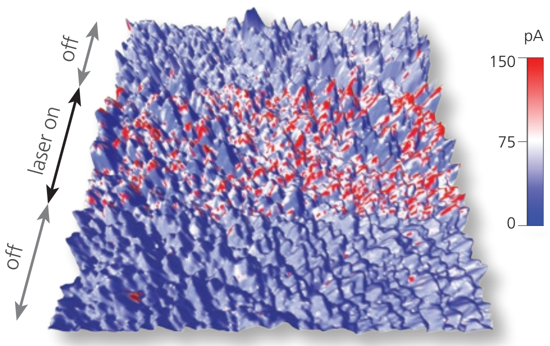
Conductive AFM (CAFM)
- Measures DC current from 1 pA to >10 μA

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

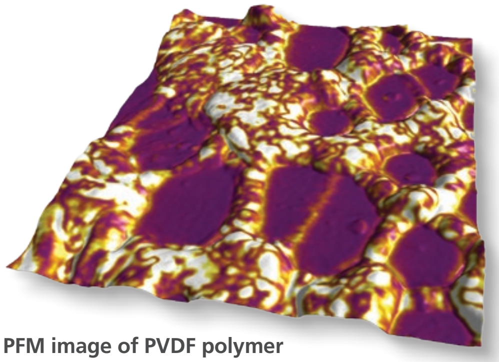
Scanning Microwave Impedance Microscopy (sMIM)
- Measures both permittivity and conductivity in contact or Fast Force Mapping Mode
- Operates on insulating, semiconductor and conductive materials

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)

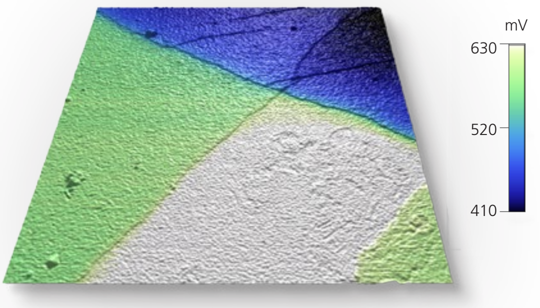
Electrochemical Strain Microscopy (ESM)
- Probe electrochemical reactivity and ionic flows in energy storage and energy generation materials
- Directly measures effect of ionic currents on mechanical strain



Photocurrent in a Eu-doped ZnO thin film
Doped zinc oxide films are potential photocatalytic materials, because the dopant narrows the band gap enough to allow photoexcitation by visible light. Here, CAFM was used to measure the photocurrent induced by the blueDrive laser, which was aligned just off the end of the cantilever. Current is shown on 3D topography, 5 μm scan.



PFM image of PVDF polymer
The piezoelectric response of PVDF is widely exploited in tactile sensors. PFM lateral amplitude is shown on 3D topography, 2 μm scan. Sample courtesy D. Guo, Institute of Acoustics, Chinese Academy of Science.



KPFM image of silver nanoparticle layers
The work function of the deposited layers can be tuned by varying the chemistry of an organic SAM that caps the particles. Surface potential is shown on 3D topography, 10 μm scan. See P. Wang *et. al*, *Appl. Phys. Lett.* **107**, 151601 (2015).

POWERFUL

Hassle-Free Environmental Control

Cypher ES enables hassle-free AFM under controlled environments

The Cypher ES features a unique modular scanner design that seamlessly integrates environmental control with normal operation.

All Cypher ES environmental control features are:

- Simple to set up and easy to use
- Uniquely designed to be robust for routine, worry-free operation
- Compatible with fast scanning to help observe dynamics, not just static images
- Compatible with blueDrive photothermal excitation for even simpler, more stable imaging

Choose a Sample Stage + Probe Holder to create your ideal environment

SAMPLE STAGES

- **Ambient**- Operate in gases or liquids at ambient temperature (*standard*)
- **Heating and cooling**- Operate in gases or liquids at temperatures between 0–120°C (*optional*)
- **Heating**- Operate in gases at temperatures from ambient to 250°C (*optional*)
- **Humidity sensing**- Operate in gases and measure the humidity in the cell (*optional*)

PROBE HOLDERS

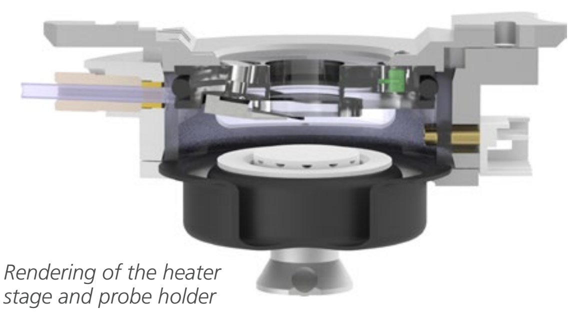
- **Standard**- For most AFM modes in gas environments (*standard*)
- **Liquid Droplet**- For most AFM modes in a fixed liquid droplet (*optional*)
- **Liquid Perfusion**- Ports allow exchange and perfusion of liquid (*optional*)
- **Conductive AFM**- CAFM measurements in gases (*optional*)
- **Scanning tunneling microscopy**- For STM operation in gas environments (*optional*)
- **Electrochemistry Cell**- For EC-AFM (*optional*)

#NoOtherAFM

Need to Heat or Cool? Just Pick a Temperature

Cypher ES makes temperature control easy over a wide 0–250°C range

Two temperature control stages are available for the **Cypher ES**. The heater stage controls the sample temperature up to 250°C in gas environments. The cooler-heater stage enables sample temperatures from 0°C to 100°C in both gas and liquid environments.

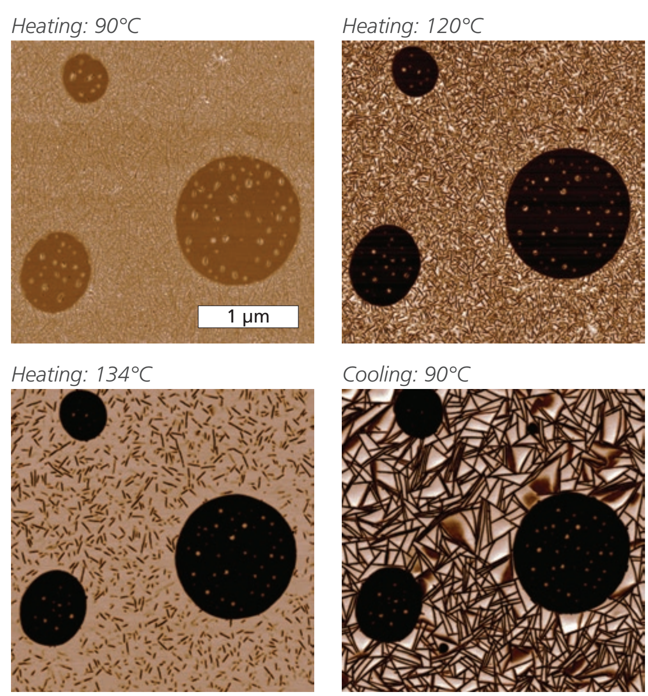


Rendering of the heater stage and probe holder

No other AFM controls sample temperature this easily

- Fully sealed sample chamber can be purged with gas during imaging. For instance, flow an inert gas to prevent oxidation at high temperatures, or a dry gas to prevent condensation at low temperatures, or operate in a liquid droplet surrounded by saturated vapor to avoid net evaporation
- Low-drift design allows large temperature changes while maintaining the same imaging area
- All operating modes supported by the Cypher ES are compatible with the temperature control stages
- Temperature is controlled through software, manually or programmatically (e.g. ramp and soak cycles)
- Passive heat transfer and insulation eliminate the need for heat exchange liquids and pumps
- No external control boxes or other modules are required. No extra clutter or complexity

www.oxinst.com/WatchCypher
Scan for the movie



Melt and recrystallization dynamics in a syndiotactic polypropylene (sPP) and polystyrene (PS) polymer thin film
These four images were selected from the movie linked on the left. They show round, isolated domains of PS (T_m≈240°C) surrounded by a continuous matrix of sPP (T_m≈130-170°C). As the film is heated,the sPP crystallites begin to melt. Before they completely melt, the sample is allowed to cool. The remaining crystallites act as nucleation sites, rapidly recrystallizing and growing. The phase data channel is shown because it shows the best contrast between the two components. Recent work has shown that the loss tangent, which can be calculated from the phase data, begins to change as the polymer approaches a phase transition, even before obvious structural changes. See *J. Appl. Phys.* **119**, 134901 (2016).

VERSATILE

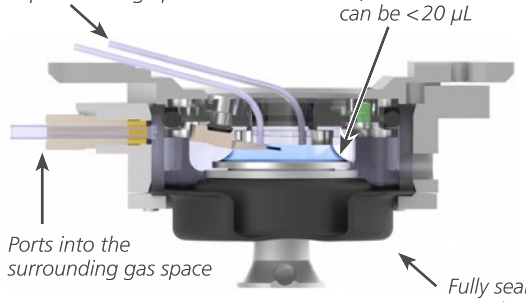
Simple and Safe AFM Measurements in Liquids

Cypher ES makes liquid setup easy and eliminates the risk of leaks

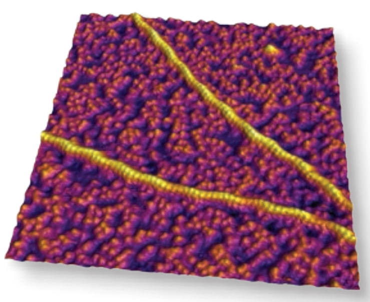
Cypher ES handles liquids with ease

Loading samples and adding liquid is easy, whether you prefer to operate in a fixed droplet or exchange/perfuse solutions. It's not a problem if a little liquid spills over; it will just get caught in the sealed membrane. If you want to be extra cautious, use a syringe to slightly pressurize the chamber and then monitor the integrated pressure sensor to verify it's fully sealed.

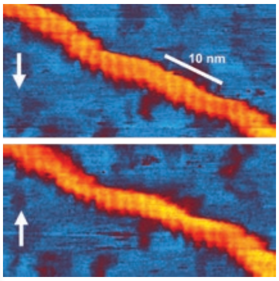
The Cypher ES is the only AFM with a fully sealed liquid cell that can be pressure tested.



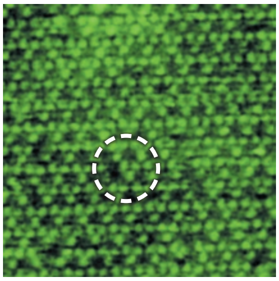
Cross-sectional drawing of the ambient stage and fluid perfusion probe holder



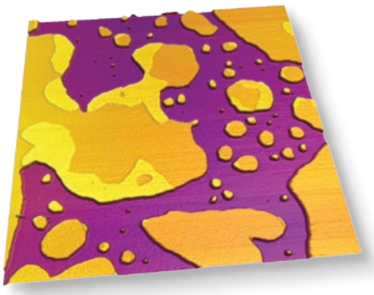
F-actin filaments, imaged in tapping mode, 340 nm scan. The measured helical pitch is 37.8 nm, consistent with literature values. Sample courtesy E. Reisler, UCLA.



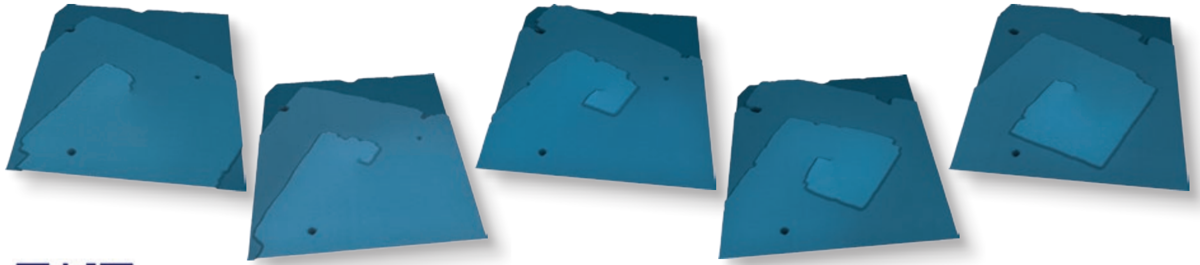
Successive scans of DNA in buffer scanning down (top) and back up (bottom). Both the major and minor grooves of the double helix are clearly resolved.



Bacteriorhodopsin protein membrane imaged in tapping mode in buffer, 75 nm scan. Missing subunits (white circle) are observed in some trimers.



Mixed lipid bilayers (50:50 DOPC:DPPC), imaged in tapping mode using blueDrive, 3 µm scan. The DPPC phase is ~1.3 nm thicker than the DOPC phase.



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Scan for the movie

Crystal growth at a screw dislocation in calcite imaged in tapping mode with blueDrive, 500 nm scans. Calcium carbonate growth solution was perfused through the Cypher ES liquid perfusion cell while images were captured at high speed. The sequence here shows only about 30 seconds of the 45 minute experiment.

#NoOtherAFM

Explore the Most Extreme Nanoscale Worlds

Cypher Exclusive

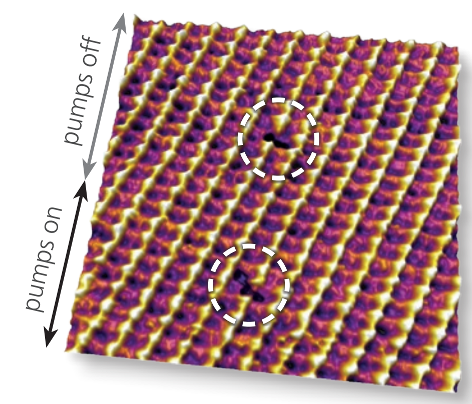
Exclusively Cypher. There's no other AFM like it

Cypher can go where other AFMs can't. Here are just three examples of what Cypher offers that others don't.

1. The first and only uncompromised AFM experience in a glovebox

Cypher easily images single atomic point defects, even with glovebox pumps running. The motorized laser alignment, detector adjustment, and engage process are controlled from software.

Using Cypher in a glovebox is like using it normally. No other AFM can say that.

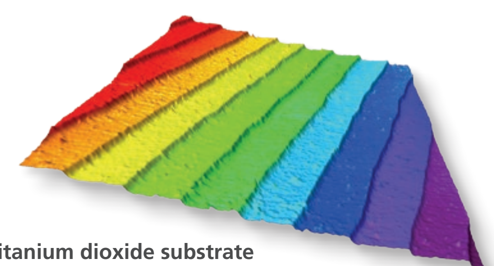


Calcite defects imaged with Cypher in a glovebox
The pumps were disabled for the top half of the scan, then turned on for the bottom half. There's no observable effect on the image quality despite the vibration. No extra vibration isolation was used.

2. Exclusive blueDrive enables operation in highly viscous ionic liquids

blueDrive photothermal excitation effectively drives the cantilever oscillation in tapping mode, even in highly viscous environments like ionic liquids.

Only a Cypher with blueDrive makes imaging in liquid this simple and stable.

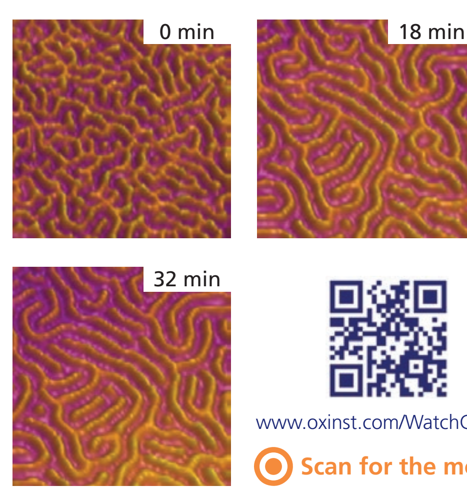


Titanium dioxide substrate imaged in a viscous liquid, 5 µm scan
blueDrive allowed the cantilever to be driven cleanly in the liquid, while conventional piezoacoustic excitation did not.

3. Unmatched compatibility with aggressive chemical environments

The Cypher ES provides unmatched chemical compatibility for operating in aggressive liquid and vapor environments. Liquids only touch the sample, the fused silica probe holder window, and a stainless steel or PEEK cantilever clip.

The Cypher ES can perform experiments that would destroy other AFMs.



SEBS polymer film annealing in toluene vapor
Toluene rapidly degrades the materials most often used in O-rings and other seals. However, the Cypher ES membrane is made from an advanced fluoropolymer that withstands a wide range of chemicals.

www.oxinst.com/WatchCypher

Scan for the movie

SPECIFICATIONS

Scanner

X&Y range 30 µm (closed-loop)

X&Y sensor noise <60 pm

Out of plane motion <3 nm in Z over XY range

Z range >5 µm

Z sensor noise <50 pm

Sample size up to 15 mm diameter, 7 mm thick. Samples can be moved to select an imaging area using software controlled stick-slip motion.

Engage process Using software controls, the user focuses on the tip and then the sample to find the approximate separation distance. An automatic motorized process then takes over to engage quickly and without damage to the tip.

Cantilever Deflection Sensing

Four modules are available (purchased separately):

Standard Laser Module: Modulated laser diode source with nominal 10×30 µm spot size. Recommended for most imaging applications.

Standard SLD Module: Superluminescent diode (SLD) source with nominal 10×30 µm spot size. Suggested for contact mode and force curves.

Laser Diode Small Spot Module: Modulated laser diode source with nominal 3×9 µm spot size. Required for most imaging applications with small cantilevers.

SLD Small Spot Module: Superluminescent Diode source with nominal 3×9 µm spot size. Recommended for contact mode and force curves when using small cantilevers.

All modules share these specifications:

Wavelength 850 nm

DC detector noise <5 pm

AC detector noise <25 fm·Hz$^{-1/2}$ above 100 kHz

Detector bandwidth DC to 7 MHz

Spot positioning and detector adjustment are fully motorized and software controlled.

Imaging Performance

DC height noise <15 pm

AC height noise <15 pm

XY Drift <200 nm/°C change in lab temperature. Optional temperature control module reduces this to <20 nm/°C.

(Noise measurements are quoted as the average deviation measured with a 1 kHz bandwidth over a full 10 seconds.)

Top-view Bright-Field Optics

Resolution Diffraction limited (<1 µm), NA=0.45

Field of view 690×920 µm

Illumination Intensity is software controlled. Manual controls for the aperture and field diaphragms.

Instrument Isolation

Vibration <10 pm coupling into deflection for 1 mm/s^2 floor acceleration when using just the built-in passive isolation. No further isolation is necessary for typical laboratories.

Acoustic Included enclosure provides 20 dB of isolation.

Included Operating Modes

Contact mode; DART PFM; Dual AC; Dual AC Resonance Tracking (DART); Electric force microscopy (EFM); Force curves; 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); Nanolithography and nanomanipulation; Phase imaging; Piezoresponse force microscopy (PFM); Switching spectroscopy PFM; Tapping mode (AC mode); Tapping mode with digital Q control; Vector PFM

Optional Operating Modes

AM-FM Viscoelastic Mapping Mode; 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; Nanoscale Time Dependent Dielectric Breakdown (nanoTDDB); Scanning microwave impedance microscopy (sMIM); Scanning tunneling microscopy (STM)

Other Options and Accessories

blueDrive photothermal excitation is available on both Cypher S and Cypher ES systems. See page 9 for details.

Liquid cantilever holder for Cypher S provides a low-evaporation chamber for measurements in liquid.

Environmental control accessories for Cypher ES are listed on page 12. Please inquire about specific configurations.

Electrochemistry Cell for Cypher ES.

Note: We continuously add new capabilities to our AFMs, so please contact us if you need something not shown here.

Service and Support

Warranty Full two-year comprehensive warranty

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

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