

Cypher ES

Ultra-high-resolution, fast-scanning AFM with advanced environmental control options

The Cypher ES from Oxford Instruments Asylum Research is the only AFM designed from the ground up to combine exceptional environmental control capabilities with an ultra-high performance AFM. Like the Cypher S, it delivers unmatched imaging resolution and speed and is compatible with Asylum's exclusive blueDrive tapping mode. But in addition, it's also the only AFM with a fully-sealed, highly chemical-resistant sample chamber, which enables imaging in controlled gas or liquid environments, sample heating and cooling, humidity control, and more. These tightly integrated environmental control options enable researchers to more easily conduct some of the most demanding AFM studies in fields including life science, polymers, and battery and photovoltaic materials.



Simple, integrated environmental control

- Fully-sealed sample chamber for exceptionally simple and effective control of the sample environment.

Routinely achieve higher resolution

- Unmatched low-noise performance, with a noise floor of only 15 pm, 50% lower than most AFMs.

Up to 40× faster scanning than typical AFMs

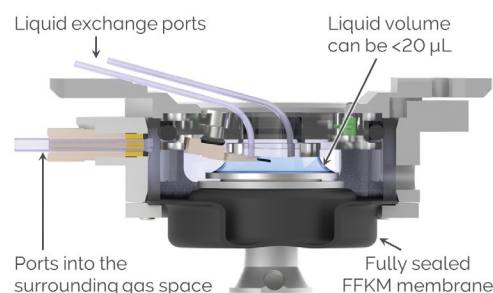
- Capture images in seconds instead of minutes, without giving up performance or capabilities.

Exclusive blueDrive tapping mode

- blueDrive makes tapping mode simpler and delivers more consistent high-resolution images.

Learn more with modes that go beyond topography

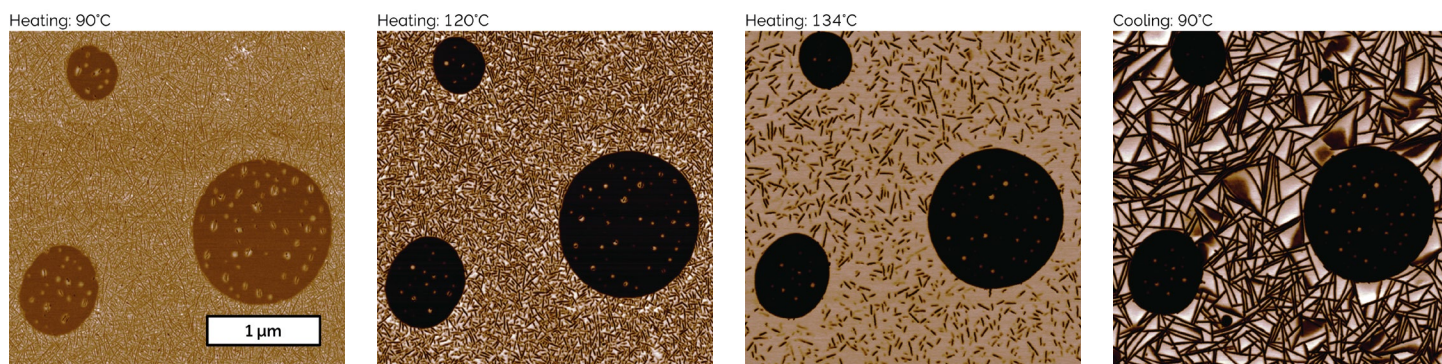
- Widest range of imaging modes for measuring electrical, mechanical, and functional properties.



Exceptional environmental control on the Cypher ES is made possible with an innovative design featuring fully-sealed sample chambers. Here, a cutaway view of the liquid perfusion cell is shown, but similar options are available for controlled gas environments, sample heating and cooling, and electrochemistry. An integrated pressure sensor can be used to verify that the cell is airtight by applying a slight overpressure (5 psi / 35 kPa). Highly chemical resistant materials are used throughout. Depending on the accessory, ports are available for gas and liquid perfusion and for electrical connections to the tip and sample. Accessories are easily and quickly exchanged thanks to the modular Cypher ES design.

Only AFM with a fully-sealed sample chamber for simple, integrated environmental control

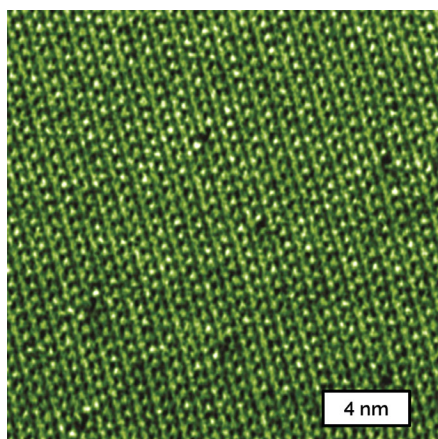
- Fully-sealed cells available for operation in controlled gas or liquid environments with ports for gas/liquid flow.
- Sample heating available in gas environments (ambient to 250°C) or heating/cooling in gas or liquid (0-120°C).
- Sample chambers are also available for humidity sensing or electrochemistry applications.
- All accessories are fully integrated and quickly and easily swapped, with no external controllers, pumps, etc.



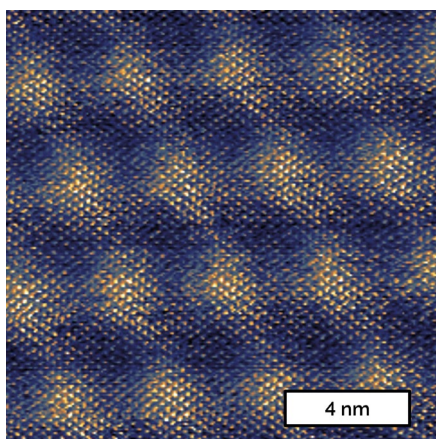
Melt and recrystallization dynamics in a syndiotactic polypropylene (sPP) and polystyrene (PS) polymer thin film imaged with fast scanning blueDrive tapping mode over more than 4 hours while the sample was heated with the high-temperature heater accessory. These four images were selected from the resulting video. They show round, isolated domains of PS ($T_m=240^\circ\text{C}$) surrounded by a continuous matrix of sPP ($T_m=130\text{--}170^\circ\text{C}$). 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. These 3 µm scans were imaged at 10 Hz line rate and 1024×512 pixels, enabling each frame to be captured in ~52 seconds. Full video is available at: AFM.oxinst.com/WatchCypher

Cypher makes ultra-high-resolution imaging much simpler to achieve

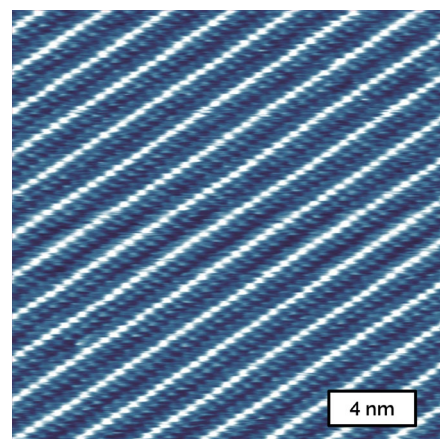
- Compact Cypher design is mechanically stable and less susceptible to vibration and acoustic noise, enabling it to reach a noise floor of only 15 pm, which is at least 50% lower than most AFMs.
- High noise immunity enables uncompromised performance even in a glovebox for air/water sensitive materials.
- Exclusive linear variable differential transformer (LVDT) position sensor technology enables ultra-low noise closed-loop scanning while eliminating the requirement for periodic recalibration.
- Fully-integrated enclosure and optional temperature regulation ensures exceptionally low thermal drift.



Atomic point defects in calcite crystal imaged in solution using blueDrive tapping mode in the fully-sealed liquid cell. The tapping mode phase data is shown for better contrast.



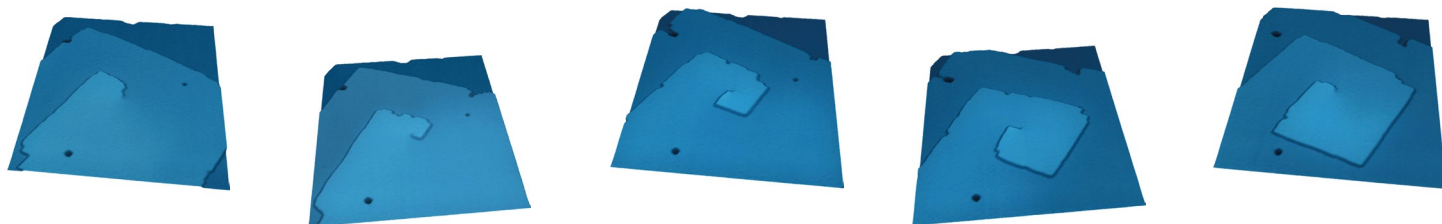
Moiré pattern in twisted HOPG layers imaged using conductive AFM under ambient conditions. The atomic lattice is also clearly visible. Image courtesy of S. Sumaiya and M. Baykara, Univ. California, Merced.



Self-assembled structures at HOPG-water interface imaged using blueDrive tapping mode in the fully-sealed liquid cell, showing regularly spaced (1.59 nm) rows that exhibit a periodic (0.48 nm) structure.

Increase your productivity or even capture sample dynamics with >10× faster scanning

- Cypher scans up to 40× faster than most AFMs, which means that images are captured in seconds, not minutes.
- Fast scanning is a standard capability of the full-featured Cypher ES. Unlike other fast scanning AFMs, there's no need to swap to a special "fast" scanner that limits imaging mode availability and performance.
- Only Cypher supports user-exchangeable light sources with different spot sizes down to 3×9 μm, which makes it compatible with the smallest and fastest AFM cantilevers available.



Crystal growth at a screw dislocation in calcite imaged with fast scanning blueDrive tapping mode. Calcium carbonate growth solution was perfused continuously through the Cypher ES liquid perfusion cell while imaging. The sequence here shows only about 30 seconds of the 45 minute experiment. These 500 nm scans were imaged at 20 Hz line rate and 256×128 pixels, enabling each frame to be captured in ~6.5 seconds. Full video is available at: AFM.oxinst.com/WatchCypher

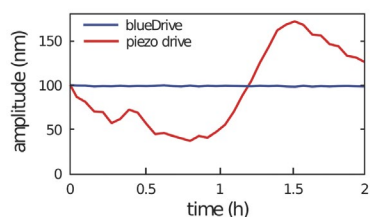
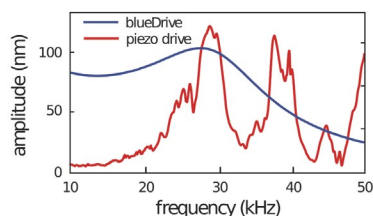
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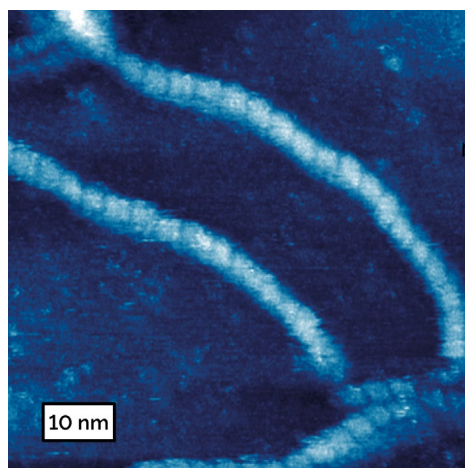
[AFM.oxinst.com/
WatchCypher](https://AFM.oxinst.com/WatchCypher)

Exclusive blueDrive tapping mode is simpler and more stable

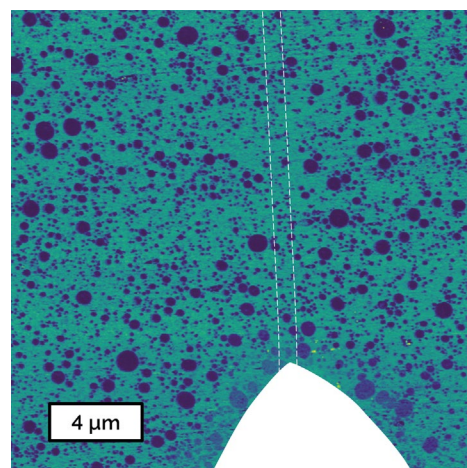
- blueDrive uses photothermal excitation (i.e. light) instead of a piezo to drive the cantilever oscillation.
- blueDrive makes setup simpler because tapping tunes are clean, not a "forest of peaks" like piezo drive.
- blueDrive makes imaging more stable because the cantilever amplitude does not drift over time.
- blueDrive enables AM-FM and contact resonance viscoelastic mapping modes.



(Top) blueDrive produces a clean resonance peak, unlike the "forest of peaks" seen with piezo drive. (Bottom) blueDrive keeps the tapping amplitude constant, which keeps imaging stable, while the amplitude drifts with piezo drive.



DNA double helix imaged in buffer using blueDrive tapping mode in the fully-sealed Cypher ES liquid cell. Both the major and minor grooves of the helix are observed. Scan size 65 nm.



AM-FM modulus map of ABS polymer formed by fused filament additive manufacturing shows fewer and smaller rubbery butadiene particles along the weld (dashed lines), which may reduce its fracture toughness. Image courtesy of C. Brinson, Duke Univ. Adapted from: D. Collinson, et al. Additive Manufacturing 41 (2021): 101964.

Cypher ES specifications

Scanner

Cypher ES uses a flexure-based sample scanning design driven by piezo stacks. Compared to commonly used piezo tube scanners, it eliminates bow/crosstalk artifacts and is much less easily damaged. Linear variable differential transformer (LVDT) sensors are used, which are inherently linear and do not require periodic recalibration.

X&Y range 30 μm (closed-loop)

X&Y sensor noise <60 pm

Z range >5 μm

Z sensor noise <50 pm

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

Engage process is fully motorized.

Optical Beam Deflection Cantilever Sensing

Four modules are available (purchased separately):

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

DC detector noise <10 pm

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

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

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 four modules share these specifications:

Wavelength 850 nm

Detector bandwidth DC to 7 MHz

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

Imaging Performance

Scan speed Up to 40× faster than typical AFMs.

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.

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

Top-view Bright-Field Optics

Resolution <1 μm (diffraction limited NA=0.45)

Field of view 600×800 μm

Illumination Intensity is software controlled.

Instrument Isolation

Vibration <10 pm coupling into deflection for 1 mm/s² floor acceleration when using just the built-in passive isolation. No additional isolation is necessary for typical laboratories.

Acoustic Included enclosure provides ~20 dB of isolation.

Included Operating Modes

Contact mode; DART PFM; Dual AC (Bimodal); 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; Torsional Force Microscopy (TFM); Vector PFM

Optional Modes and Accessories

AM-FM Viscoelastic Mapping Mode*; Contact Resonance Viscoelastic Mapping Mode*; Fast Force Mapping Mode (FFM); Conductive AFM (CAFM) with ORCA; Current mapping with FFM; Electrochemical Strain Microscopy (ESM); Nanoscale Time Dependent Dielectric Breakdown (nanoTDDb); Scanning Thermal Microscopy (SThM); Scanning tunneling microscopy (STM)

(*these modes are included if AFM is equipped with blueDrive)

Other Options and Accessories

blueDrive photothermal excitation for tapping mode

Liquid cantilever holder (standard or perfusion versions)

Heating & cooling stage operates 0 to 120°C in gas or liquid

High temperature heating stage operates ambient to 250°C in gas

Humidity sensing measures humidity in the ES sample chamber

Electrochemistry cell (see datasheet for details)

High-voltage option up to ±150 V can be applied to tip or sample

Glovebox integration available for applications requiring sub-ppm water and oxygen levels, without degrading AFM performance.

System Upgrades

Cypher: Upgradable to Cypher VRS1250

Vero: Upgradable to Vero interferometric AFMs with QPDI

Service and Support

Warranty One-year comprehensive warranty.

Support Ask about service and support agreements that extend the original warranty and offer additional training and support services.

Regulatory Information

Cypher ES is CE compliant.

Cypher ES is a Class 1 laser product.



Contact us to find the best AFM for your research!

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CYPHER-ES-BR-0726-R1

