

# Cypher S

## Ultra-high-resolution, fast-scanning AFM

The Cypher S from Oxford Instruments Asylum Research is an ultra-high-performance AFM for materials science and life science research under ambient gas and liquid conditions. It builds on the Cypher L model with an expanded range of measurement modes, lower noise, faster scanning, and compatibility with Asylum's exclusive blueDrive tapping mode. The award-winning Cypher AFM family has earned a reputation for easily achieving higher resolution than other AFMs. Cypher AFMs are the only full-featured fast-scanning AFMs, offering the productivity of >10× faster imaging without sacrificing performance or capabilities. These strengths have made the Cypher S the gold standard for challenging research in fields including 2D materials, polymer science, and piezo- and ferro-electrics.



### Routinely achieve higher resolution

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

### Over 10× faster scanning than most AFMs

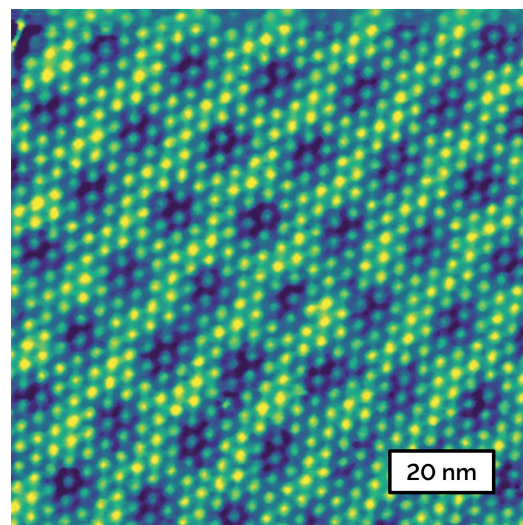
- Capture images in seconds instead of minutes, without giving up performance or capabilities.

### Exclusive blueDrive tapping mode

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

### Learn more with modes that go beyond topography

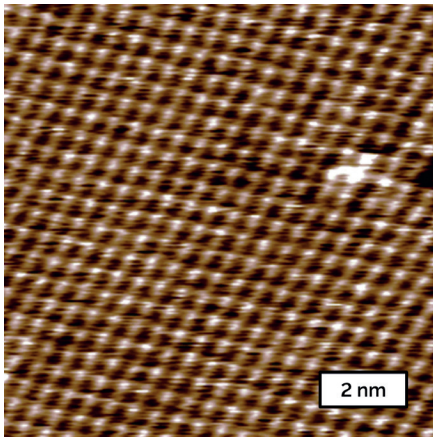
- Widest range of imaging modes for measuring electrical, mechanical, and functional properties.



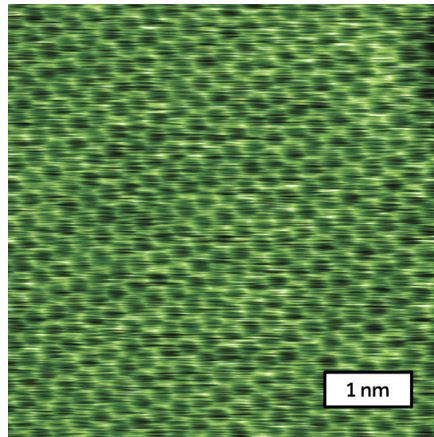
Moiré patterns formed by twisted bilayer graphene on hexagonal boron nitride imaged using conductive AFM. Two patterns are observed, one originating from the graphene/hBN interface and the other from the graphene/graphene interface. Image courtesy of S. Zhang, Tsinghua Univ.

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

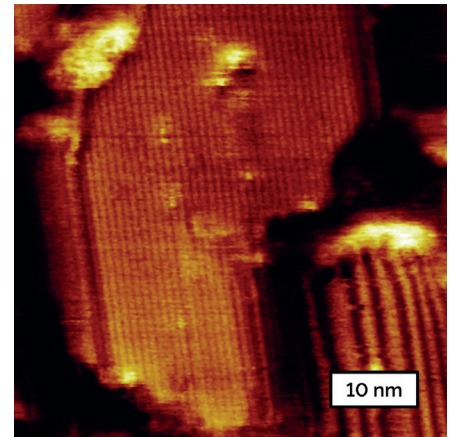
- Compact Cypher design is mechanically stable and less susceptible to vibration and acoustic noise, enabling it to reach a noise floor of only 15 pm, which is at least 50% lower than most AFMs.
- High noise immunity enables uncompromised performance even in a glovebox for air/water sensitive materials.
- 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.



**C8-BTBT epitaxial layer** on boron nitride imaged using tapping mode in air. Defects in the lattice of the molecular crystal are observed. Sample courtesy X. Wang, Nanjing Univ.



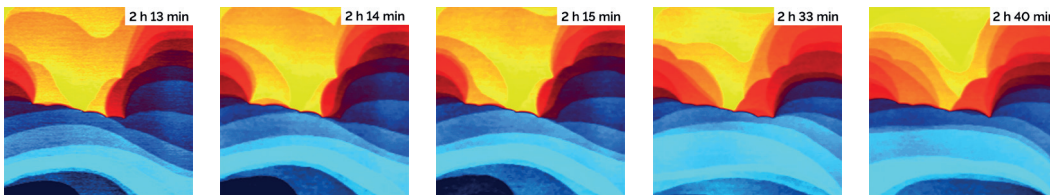
**Hexagonal boron nitride** imaged in contact mode in air shows the atomic lattice spacing of  $0.25 \pm 0.01$  nm. Data courtesy P. Beton, Univ. Nottingham.



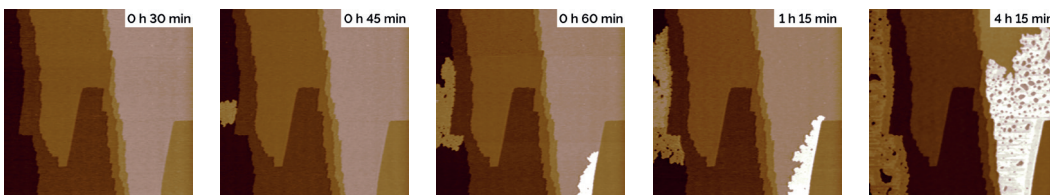
**Crystalline lamella in polyethylene** are visible in this AM-FM stiffness image. The measured 0.89 nm spacing is consistent with known polymer chain packing.

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

- Cypher scans 10-20× 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 S. 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  $3 \times 9 \mu\text{m}$ , which makes it compatible with the smallest and fastest AFM cantilevers available.



**Sublimation of anthracene crystals in air** is observed in this sequence of images. Crystal terraces 0.9 nm high are observed moving as the material sublimates, with step edges often becoming pinned at defects in the crystal. These  $5 \mu\text{m}$  scans were imaged in tapping mode at 20.8 Hz line rate and  $192 \times 192$  pixels, enabling each frame to be captured in ~9 seconds.



**Surface reconstruction of a freshly cleaned calcite crystal** occurs in humid air. The full video shows the reconstruction over a period of nearly five hours, played back in about thirty seconds. Note that the calcite steps are only about 300 pm tall. These  $2 \mu\text{m}$  scans were imaged in tapping mode at 40 Hz line rate and  $512 \times 512$  pixels, enabling each frame to be captured in about ~13 seconds.

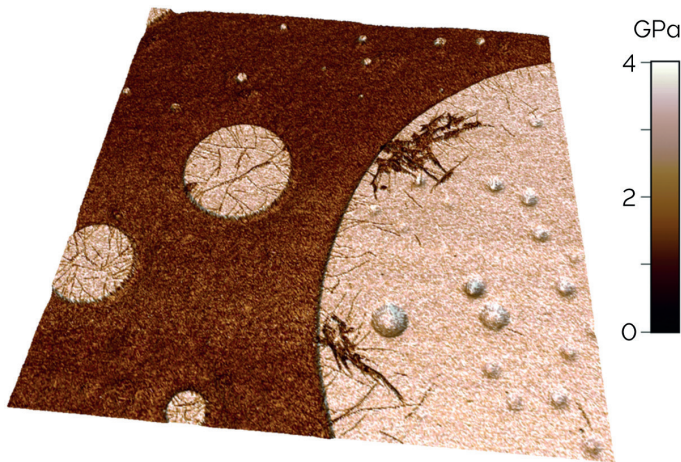
Watch these videos and more



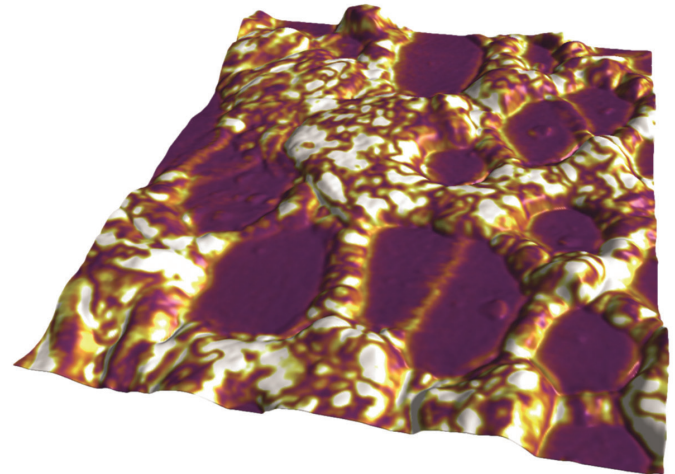
[AFM.oxinst.com/WatchCypher](https://AFM.oxinst.com/WatchCypher)

## Go beyond topography—Measure electrical, mechanical, and functional properties

- Measure electrical properties like current, surface potential, and capacitance with unmatched sensitivity.
- Widest range of nanomechanical techniques for modulus measurements from kPa to GPa.
- AM-FM Mode is the only fast tapping nanomechanical mode for measuring both storage and loss moduli.
- Asylum Research is the world leader in sensitive and accurate piezoresponse force microscopy (PFM).



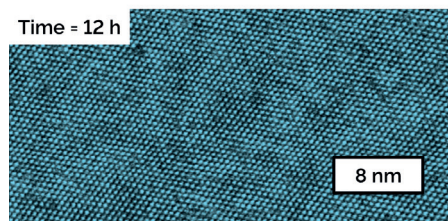
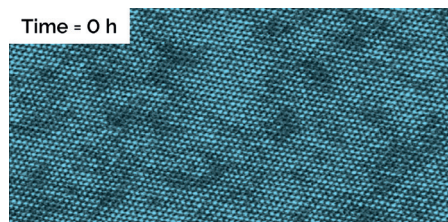
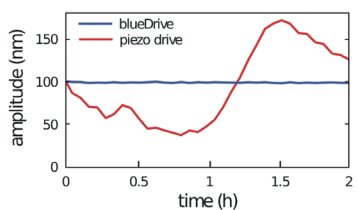
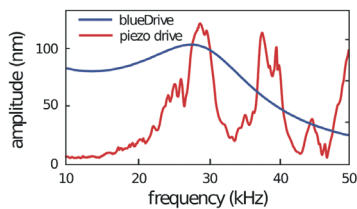
Polystyrene-polypropylene polymer blend thin film imaged using Fast Force Mapping mode. Elastic modulus is shown on 3D topography, 6  $\mu\text{m}$  scan.



Piezoelectric response of PVDF is widely exploited in tactile sensors. PFM lateral amplitude is shown on 3D topography, 2  $\mu\text{m}$  scan. Sample courtesy D. Guo, Institute of Acoustics, Chinese Academy of Science.

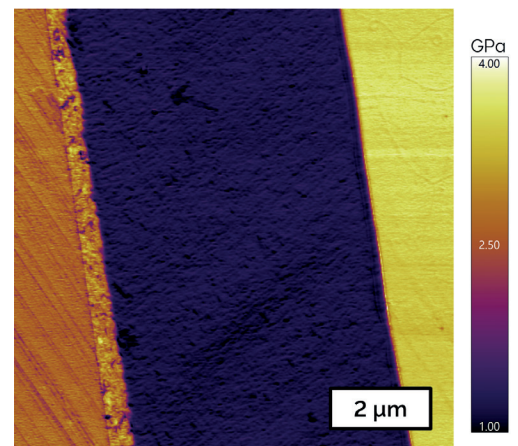
## Exclusive blueDrive tapping mode is simpler and more stable

- 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 also 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.

Point defects in an adsorbed layer of cesium ions on mica are observed. Even after 12 h of unsupervised imaging with blueDrive in a 1 M CsCl solution, the tip remained undamaged and resolved atomic point defects.



Modulus map of a multilayer polymer film cross section generated by AM-FM Viscoelastic Mapping Mode with blueDrive. From left to right, the film consists of polyethylene terephthalate (PET), an adhesive layer, polyethylene (PE), and ethylene vinyl alcohol (EVOH).

## Cypher S specifications

### Scanner

Cypher S 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  $\mu\text{m}$  (closed-loop)

**X&Y sensor noise** <60 pm

**Z range** >5  $\mu\text{m}$

**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 $\times$ 30  $\mu\text{m}$  spot size. Recommended for most imaging applications:

DC detector noise <10 pm

AC detector noise <25 fm/Hz<sup>1/2</sup> above 100 kHz

**Standard SLD Module:** Superluminescent diode (SLD) source with nominal 10 $\times$ 30  $\mu\text{m}$  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 $\times$ 9  $\mu\text{m}$  spot size. Required for most imaging applications with small cantilevers.

**SLD Small Spot Module:** Superluminescent Diode source with nominal 3 $\times$ 9  $\mu\text{m}$  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 Hz line rate (varies with sample, probe, scan size, and imaging mode).

**DC height noise** <15 pm

**AC height noise** <15 pm

**XY Drift** <200 nm/ $^{\circ}\text{C}$  change in lab temperature. Optional temperature control module reduces this to <20 nm/ $^{\circ}\text{C}$ .

*(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.)*

### Top-view Bright-Field Optics

**Resolution** <1  $\mu\text{m}$  (diffraction limited NA=0.45)

**Field of view** 690 $\times$ 920  $\mu\text{m}$

**Illumination** Intensity is software controlled.

### Instrument Isolation

**Vibration** <10 pm coupling into deflection for 1 mm/s<sup>2</sup> 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; 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 Capacitance Microscopy (SCM); Scanning microwave impedance microscopy (sMIM); Scanning tunneling microscopy (STM)

(\*these modes are included if AFM is equipped with blueDrive or can be supported with optional piezo-driven probe or sample actuators)

### Optional Modes and Accessories

**blueDrive photothermal excitation** for tapping mode

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

**High-voltage option** up to  $\pm 150$  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 ES or 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 S is CE compliant.

Cypher S is a Class 1 laser product.



Contact us to find the best AFM for your research!

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