Decoding the Nanoworld
Break the Nanocode with the Next Generation of AFM

The World’s Fastest and Highest Resolution AFM

You’ve been expecting something genuinely new from the AFM/SPM industry, but for many years you’ve only seen tweaks to old technology. Now Asylum Research introduces the Cypher™ AFM, the first totally new small sample AFM/SPM in over a decade. More capability, more control, more functionality, more modularity, and more resolution – all with >20X faster scanning and striking ease of use.

Closed loop image of domains of surfactant hemi-micelles surrounding a defect on graphite, 200nm scan.
Closed loop atomic resolution using sensors in all three axes ensures the highest resolution and most accurate images possible today. With the Cypher AFM, you no longer have to choose between the accuracy and control of closed loop and the low noise of open loop. Asylum’s third generation NanoPositioning System (NPS™) sensors are the quietest in the world today. With positioning accuracies better than 60 picometers in X, Y and Z, you not only achieve atomic resolution in closed loop, you also get the most accurate measurements, positioning and nanomanipulation possible.

SpotOn™ automated laser alignment provides extraordinary ease of use. With Cypher’s fully motorized laser and photodiode positioning, a mouse click aligns the laser spot on your cantilever and centers your photodetector.

Laser spot sizes as small as 3µm enable high-speed AC imaging with small cantilevers. Cypher provides the industry’s smallest spot size, allowing you to use cantilevers smaller than 10µm for fast imaging and sub-picoNewton force measurements.

>20X Faster Scanning
Small cantilevers provide much higher resonant frequencies than conventional cantilevers without an increase in stiffness.
Designed from the Ground Up for Superior System-Wide Performance

Cypher’s proprietary system-level mechanical design is inherently immune to normal environmental vibration, eliminating the need for additional isolation add-ons for most labs. The integrated system enclosure allows for thermal control and provides additional acoustic isolation for noisy environments. This system-level design creates images of atomically flat samples that are free of periodic noise. Cypher also features unimpeded 180 degree optical/mechanical access to your samples and a small 40x42cm footprint that conserves lab space.

Interchangeable modules broaden your options for applications and scanning modes. MultiLux™ source modules are available with laser diodes and low-coherence SLDs in a variety of spot sizes to provide optimal signal-to-noise over a wide range of cantilever lengths. Module exchange takes only a minute.

High resolution top-view optics with Köhler illumination provide crystal clear viewing of your sample and tip. Cypher’s custom optics with 20X objective are limited only by physical diffraction. You’ll see sub-micron resolution over a 690x920µm field of view with digital zoom and pan.

Diffraction-limited Optics 3.1 megapixel top view image shows AFM calibration grating (20µm pitch) with inset of 8X digital zoom.
Cypher’s integrated enclosure allows for thermal control and acoustic isolation to optimize imaging and measurement stability. Achieve >10X improvement in thermal drift compared to older, less advanced SPMs.
The World’s Highest Resolution AFM

With the Cypher AFM, you can do things that are simply not possible with other AFMs. Here are some examples of how the Cypher AFM can help you decode the nanoworld.

Closed loop STM showing graphite atoms, 6nm scan.

Closed loop AC mode image showing the molecular level ordering of cetyl palmitate adsorbed onto HOPG, 150nm scan.

Closed loop image of cleavage defects on graphite surface, 1.7µm scan.

Closed loop image of Lambda digest DNA imaged in buffer, 530nm scan.

Closed loop Dual AC Mode image of collagen. Second mode amplitude is overlaid as color on topography, 300nm scan.
Open loop AC mode image of calcite in water, 15nm scan, 1Å height scale. The point defects remained visible through several images demonstrating true atomic resolution.

Closed loop AC mode image of extracellular face of bacteriorhodopsin in buffer, 50nm scan, 5Å height scale. G.M. King Lab, University of Missouri-Columbia.

**Unbreakable Nanocode? Crack It with the Cypher AFM and the Asylum Research Team**

You need the new Cypher AFM to make tomorrow’s discoveries and to keep your facility first in science. With capabilities far beyond those of older SPMs – and modularity and expandability for the future – the Cypher AFM can help you be a leader in decoding the nanoworld.

**The Asylum Research team will support you every step of the way.**

Asylum’s legendary product and applications support ensures you get up and running quickly and achieve optimum results. Asylum is the clear leader in customer satisfaction. If you’re not already an Asylum user, just ask one (or ask us for a reference).

And Asylum’s Exclusive Five-Year Warranty and Six-Month Money-Back Guarantee ensure your satisfaction. Our quality and support are unrivaled – but just in case, you’re covered.

**Seek Asylum for the most advanced AFM/SPM technology and tools**

Choose the Cypher AFM for:
- Closed loop imaging from tens of microns down to atomic scales
- Small cantilevers for high-speed scanning
- High-speed, low-noise force measurements
- High-bandwidth data acquisition
- Diffraction-limited optical sample viewing/imaging
- Automated laser alignment

Choose MFP-3D™ AFM for:
- Large closed loop scan area
- Compatibility with inverted optical microscopes
- Sample viewing from top and bottom
- Long-range, low-noise force measurements
- Widest range of accessories
- Flexible mounting for various sample shapes and sizes
- Quantitative nanoindentation
### Specifications

**Head/Optical Lever**

- **DC Detector Noise**: <5pV
- **AC Detector Noise**: <25mV/√Hz above 100kHz
- **Photodiode Bandwidth**: DC to 7MHz

**Light Source**: User selectable/exchangeable. Options include superluminescent diodes and laser diodes. Wavelength is fixed at 850nm.

**Spot Size**: User selectable/exchangeable. Focused spots range in size from 10x30µm down to 3x9µm.

**Controls**: Focused spot positioning and photodiode centering controls are motorized and fully controllable from the software.

**Scanner**

A variety of scanner modules are available depending on application. All scanner modules include XYZ actuation as well as a motorized cantilever engage stage. The standard scanner module specs are listed below:

- **Scan Range**: XY range is 30/40µm (closed/open loop). Z range is 5/7µm.
- **XYZ Sensor Noise**: NPS™ Digital LVDT sensors. XY noise is <60pV. Z noise is <50pV. Closed loop scan performance achieves lattice resolution (<10nm scans) with feedback gains equivalent to large scan (<1µm) values.
- **XYZ Open Loop Noise**
  - **XY**: <8pV in 1Hz to 10kHz BW
  - **Z**: <4pV in 1Hz to 10kHz BW
- **Vibration Immunity**: <10µin coupling into deflection for 1mm/s² floor acceleration.
- **XY Drift**: <20/2000nm/°C (with/without temperature control module).

**Out-of-Plane Motion**: <3nm over closed loop scan range.

**Sample Dimensions**: 15/7mm (diameter/thickness)

**Sample Environment**: Standard environments are ambient, droplet, or low evaporation/perfusion chamber.

**System**

- **DC Height Noise**: <1pV (<5pV in quiet environments)
- **AC Height Noise**: <15pV

**View Module**

A variety of view modules providing top-down optical view of the sample/cantilever are possible depending on the application. The standard view module specifications are listed below:

**Configuration**: Bright field/reflected light illumination: LED based Köhler illumination with manual controls for the aperture and field diaphragms. Intensity is software controlled.

**Resolution**: Diffraction limited performance (<1µm) with apochromatic correction. NA = 0.45.

**Field of View**: 690x920µm

**Camera**: 3.1 megapixel CMOS camera with FireWire interface. Digital zoom/pan/capture; software controlled white balance, shutter speed, and binning.

### Electronics

| ADCs | Two 16-bit, 80MHz  
|      | One 16-bit, 5MHz  
|      | Six 18-bit, 2MHz  
|      | Five 16-bit, 100kHz  
| Capture Buffer | 512MB  
| DACs | Four 16-bit, 40MHz  
|      | One 16-bit, 10MHz  
|      | Four 24-bit, 1.25MHz  
|      | One 24-bit, 400kHz  
|      | Five 24-bit, 100kHz  
| Firmware Devices | Firmware upgradable devices that run real-time SPM specific operations. Modules included are: lock-in amplifiers, Q-control, IIR filters, and feedback loops.  
| FPGAs | Four Field Programmable Gate Arrays running at up to 667MHz.  
| Processors | Floating point DSP running at 80MHz Dual-core NIOS in FPGA.  
| Dual-Frequency Digital Lock-in Amplifiers | Two dual-frequency quadrature lock-ins, 20MHz.  
| Frequency Synthesizer | One dual-frequency quadrature lock-in, 5MHz.  
| Dual Quadrature Outputs | Two dual-frequency synthesizers output at 40MHz. Frequency range DC to 15MHz in 9MHz steps. One dual-frequency synthesizer output at 10MHz. Frequency range DC to 2MHz in 2MHz steps.  
| Digital Q-control | 2kHz – 20MHz  
| Feedback loops | Multiple proportional-integral-gain controllers and more advanced controllers (such as H∞). At a minimum there are: Six loops running at 100kHz  
| IIR Filters | Ten loops running at 2MHz  
| Crosspoint Switches | One 32 by 32 digitally controlled switch.  
| Power Supplies | Low voltage: ±15, ±7, 3.3V  
| Software Controlled Relays | High voltage: ±15V  
| USB Computer to Controller Communication | Optional: ±150V for PFM  
| USB Computer to Controller Communication | XY high voltage  
| High Voltage Noise | 2kHz – 20MHz Laser power  
| High Voltage Noise | Compatible with most computers running WinXP or Windows 7 (including laptops)  
| High Voltage Noise | <70µV Adev in 1Hz to 10kHz bandwidth (50µV typ.) in all three axes.  

### Data Acquisition

Data size is limited only by the memory on the PC (10 million point and 8k x 8k images are possible). Additionally, a continuously running circular fast capture buffer allows high speed data to be sent to the computer at any time.

**Computer**

Minimum: Dell Precision T3500 mini-tower, 2.80GHz Quad Core, 6GB RAM, dual 320GB RAID 1 hard drives, 16x DVD writer, dual 20" LCD panels (30" optional), 1GB video card, 8 USB ports, 2 Fire Wire ports, Windows 7 64bit (WinXP optional).

**Software**

The software is based in IGOR Pro by WaveMetrics, a powerful scientific data acquisition and analysis environment. The software is user programmable.

### Features include:

- Nonlinear curve fitting to arbitrary user-defined functions.
- Extensive image analysis including 2D FFTs, wavelet transformations, convolutions, line profiles, particle analysis, edge detection (eight methods, including Sobel), and thresholding (five methods, including fuzzy entropy).
- Automatic spectral fitting and calibration of cantilever spring constants using thermal noise and Sader method.
- Easy generation of scientific publication-quality graphs and page layouts.

**ARgyle™**

- OpenGL® 3D rendering technology for advanced image display.
- Generate, display, and visualize 3D images in real-time while scanning or doing off-line processing.
- Overlap alternate channel data with primary to view feature correlation.
- Independent scaling of axes for true 1:1 aspect ratio.
- Mouse-driven rotating, panning, scaling, and lighting control of images.
- Export 3D images to clipboard, JPEG, TIFF, BMP, PNG.
- Stereo anaglyph creation from 3D images.

### Instrument Isolation

**Vibration**: Includes passive vibration isolation with f =7Hz, Q=1. The Cypher AFM exhibits exceptional vibration immunity, and even for high resolution work no further isolation is necessary in typical lab environments. Additional isolation may be needed for unusually noisy environments.

**Acoustic**: Included acoustic enclosure provides 20dB of isolation.

**Temperature**: Included enclosure allows for 0.1°C temperature stabilization with optional temperature control module.

### Cypher is a Class 1 Laser Product

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Specifications subject to change without notice.

**Cover Image**: Closed loop AC mode image of HF-etched mica showing atomic steps, 6µm scan. 5-2012

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