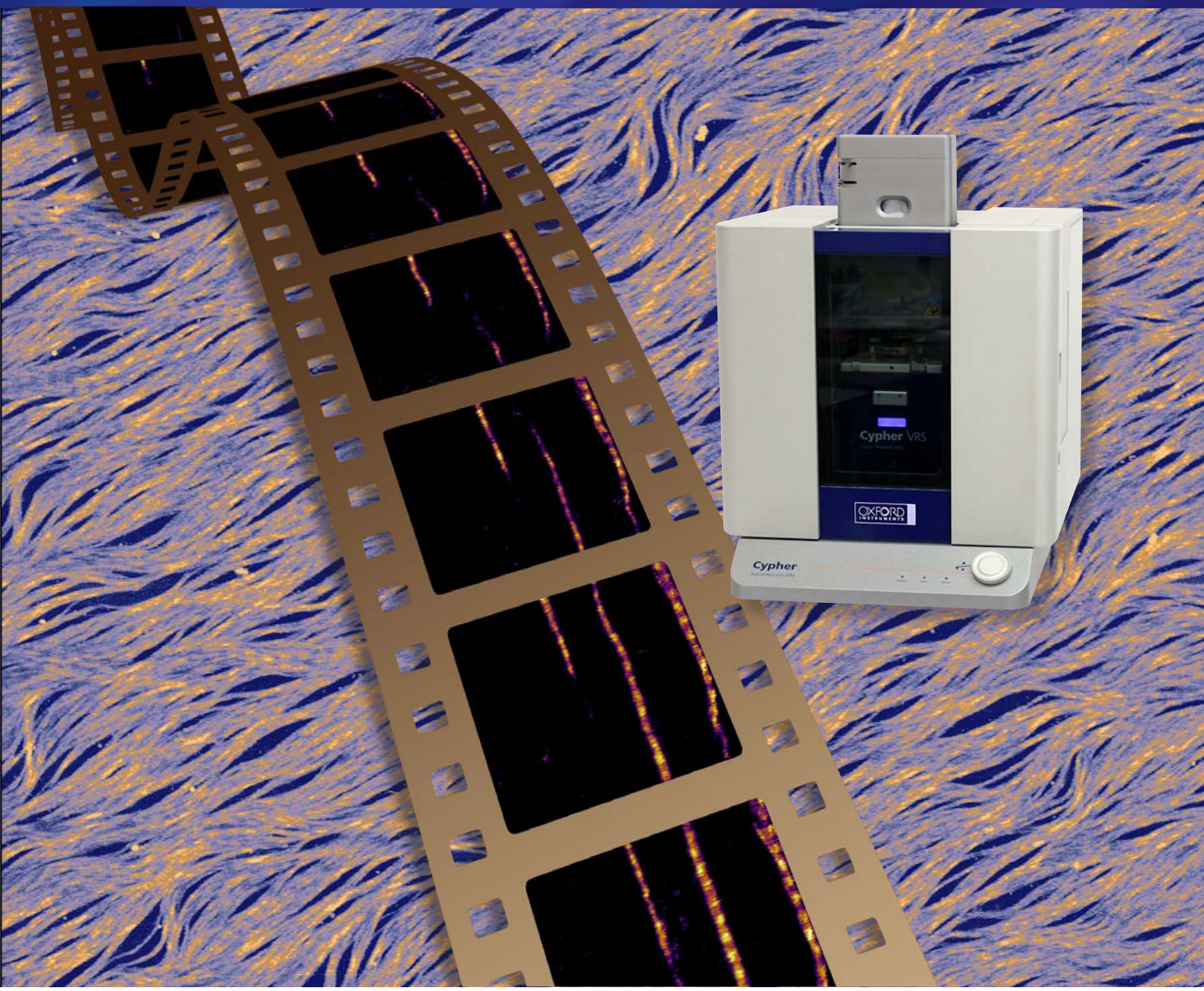
Asylum Research

Cypher VRS Video-Rate AFM

The First and Only Full-Featured Video-Rate AFM



OXFORD INSTRUMENTS

The Business of Science®

#NoOtherAFM

The Video-Rate AFM You've Been Waiting For

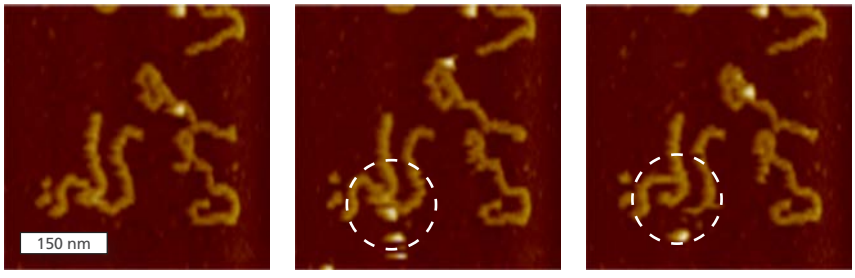
Unprecedented speed, resolution, versatility, and ease of use

The **Cypher VRS** AFM is the first and only full-featured video-rate AFM. Finally, researchers can measure nanoscale dynamic processes at video-rate speeds with all of the resolution, versatility, and ease of use that are the hallmarks of an Asylum Research Cypher™ AFM.

- **High resolution video-rate imaging** at up to 625 lines per second
- **Exceptional ease of use—** even at 10 frames per second
- **Full range of modes and accessories—** unlimited capabilities at normal scan speeds

oxinst.com/CypherVRS
Scan for the movie

BIOCHEMICAL REACTIONS AT VIDEO-RATE SPEEDS



DNA cleaved by DNase1 enzyme

Lambda DNA was bound to a mica substrate with MgCl2 buffer, and DNase was introduced. In the first image (left), several DNA strands are observed. In the second image (center), note the DNase enzyme bound to one of the overlapping strands (circle). In the third and last image (right), this strand has cleaved at the binding point. Imaged at a line rate of 625 Hz at 320×64 pixels with an Olympus AC10 probe for a frame rate of 8.7 fps.

"Many scientists, like myself, have been inspired by early video-rate AFM results, but have been reluctant to invest in a single purpose AFM with a constrained sample configuration and limited range of scan sizes. What impresses me about the Cypher VRS is that it can achieve high speed without these constraints while maintaining the microscope's versatility and ease of use, whether for imaging or force spectroscopy."

-Jim De Yoreo, Chief Scientist at Pacific Northwest National Laboratory

Fiercely Fast

Speed that Goes Beyond Fast Scanning AFMs

Cypher VRS sets a new speed benchmark with superb imaging resolution

Cypher VRS is faster—*much faster*—than current generation "fast scanning" AFMs

- Scan at up to 625 lines per second, about 300× faster than normal AFMs and at least 10× faster than current "fast scanning" AFMs.
- Capture images at high pixel density (512×512) in just over a second, or reduce scan lines to achieve video rates >10 fps.

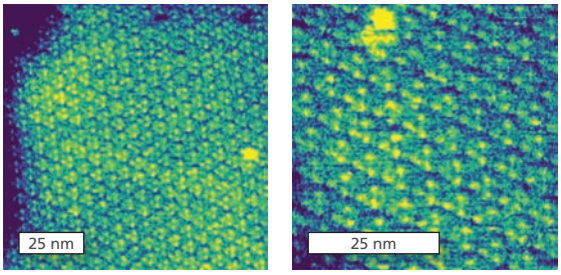
Powered by Asylum Research's Unrivalled Technology Leadership

- Modular high-speed Z scanner lets you to quickly switch between video-rate imaging and other modes and accessories without replacing the whole scanner.
- State-of-the-art piezo-driven XY flexure scanner incorporates ultra-low-noise LVDT sensors for accurate scanning and offsets.
- Sine-wave scanning extends XY scanner performance without sacrificing accuracy.
- Proprietary high-speed high-voltage amplifier increases imaging bandwidth.
- Small spot laser and blueDrive photothermal excitation enable use of the smallest, fastest, lowest noise AFM probes.
- Same compact, rigid construction as other Cypher AFMs achieves noise levels at least 50% lower than any other AFM.

Cypher VRS achieves higher resolution than ever before at video-rate speeds

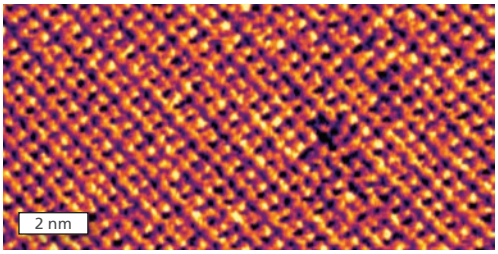
- Same fast, consistent high resolution imaging as the rest of the Cypher family.
- Maintains high resolution even on soft and loosely bound biological samples.

HIGH RESOLUTION



Bacteriorhodopsin protein membrane

Topography images taken in tapping mode in buffer at a line rate of 280 Hz with 512×256 pixels for a frame rate of 1 fps. Sample courtesy of Tom Perkins, JILA, Univ. of Colorado at Boulder.



Atomic defects in a calcite crystal

Topography image taken tapping mode in water at a line rate of 100 Hz with 512×100 pixels for a frame rate of 1 fps.

Stunningly Simple

Amazingly Easy to Use, Even at Video-Rate Speeds

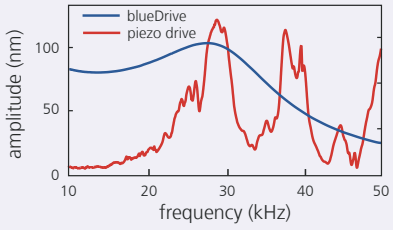
Cypher VRS lets you concentrate on your research instead of your AFM

Cypher VRS is video-rate AFM made simple

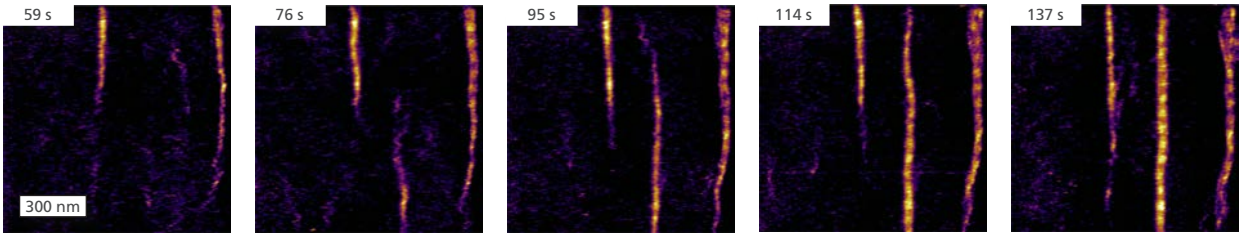
- Scanner is extremely robust and fully sealed against liquid spills for complete reliability.
- Probes are easily loaded and clamped in place, just like a regular Cypher probe holder.
- Probe holder is available with or without perfusion ports for liquid exchange.
- Easy sample mounting with no extreme limits on the maximum sample size.
- Motorized laser and detector alignment makes quick work of instrument setup.
- All imaging controls are accessed though a simple software user interface.
- Powerful built-in movie maker generates spectacular publication-quality results.

blueDrive™ makes video-rate AFM simple and stable on the Cypher VRS

blueDrive uses light to drive the cantilever oscillation. Unlike a tapping piezo, it acts directly on the cantilever and doesn't excite other system resonances. The result is clean tunes that make it easy to use small, fast cantilevers. blueDrive keeps the drive response constant even as liquids are exchanged or perfused, providing stable imaging without any need to adjust the setpoint.



Tune of a small, fast AC40 cantilever driven with blueDrive closely matches the theoretical response, while the piezo-driven response has multiple peaks.

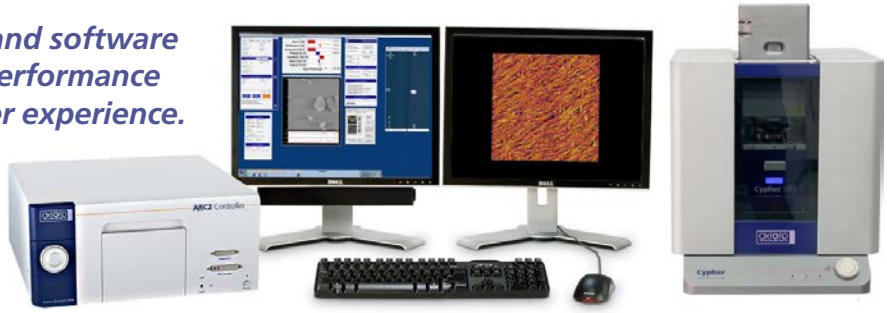


Assembly of collagen fibrils on mica (Front cover and above)

The movie begins with imaging bare mica in tapping mode in buffer at a line rate of 400 Hz with 512×256 pixels for a frame rate of 1.5 fps. A dilute solution of collagen molecules is added, and the self-assembly of ordered fibrils begins. The still frames above were captured at the times shown. The full movie contains many intermediate frames that show the process with much greater temporal detail. The background image on the front cover was prepared with a higher collagen concentration to more fully cover the mica surface. Sample courtesy of J. Tao and J. De Yoreo, Pacific Northwest National Laboratory.

oxinst.com/CypherVRS
Scan for the movie

Fully integrated electronics and software deliver extraordinary AFM performance with a stunningly simple user experience.



Very Versatile

The First and Only Full-Featured Video-Rate AFM

Cypher VRS is not a "one-trick pony," it's a workhorse for the whole lab

More than just a video-rate AFM—also supports all Cypher ES modes and accessories

Buying an AFM that can only be used on certain projects can be difficult to justify. So we built the Cypher VRS with unprecedented versatility. It can be used by your whole lab and fully satisfy the diverse needs of large interdisciplinary research groups.

Capabilities at video-rate scan speeds

- Video-rate imaging is currently available in tapping mode (incl. phase) and contact mode.
- Image under ambient conditions in air or liquids. (Cypher ES environmental control accessories cannot be used while imaging at video rates.)
- Operate in a fully sealed sample chamber or use the optional perfusion probe holder.

Unlimited capabilities at normal scan speeds

- Includes **all** of the modes included on the Cypher ES with blueDrive (see sidebar).
- Supports **all** of the optional modes available on the Cypher ES (see sidebar).
- Compatible with **all** of the Cypher ES optional accessories (see sidebar).

Already have a Cypher AFM?

- Existing Cypher S and Cypher ES systems can be upgraded to the Cypher VRS (inquire for details).
- Most options and accessories can be shared between separate Cypher ES and VRS systems.

Included Operating Modes

AM-FM Viscoelastic Mapping Mode; Contact mode; Contact Resonance Viscoelastic Mapping 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

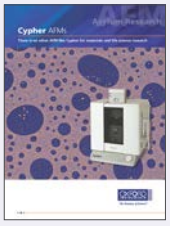
Optional Operating Modes

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 Tunneling Microscopy (STM)

Optional Accessories

- **Heating and cooling**: Maintain samples at temperatures between 0–100°C in gas or liquid environments.
- **Heating**: Heat samples at temperatures up to 250°C. Fully sealed chamber can control the gas environment.
- **Humidity sensing**: Fully sealed chamber with an integrated humidity sensor.
- **Liquid perfusion probe holder**: Ports allow exchange or perfusion of liquid.
- **Electrochemistry cell**: Sealed cell with integrated electrodes and potentiostat interface for electrochemical studies.

Want to see examples?



Check out the main Cypher brochure

oxinst.com/CypherBrochure

SPECIFICATIONS

Video-Rate Scanning Performance

Maximum data pixel rate Up to 500,000 pixels/s

Maximum line scan rate Up to 625 lines/s

Maximum frame rate Determined by the image pixel density selected by the user. The table below gives several examples.

	320 points	512 points	1024 points
40 lines	13.6	8.5	4.2
64 lines	8.7	5.4	2.7
128 lines	4.5	2.8	1.4
256 lines	2.3	1.5	0.7

X&Y range 10 µm for line scan rates >40 Hz (closed-loop scanning)

X&Y sensor noise <60 pm

Z range >2 µm

Sample size Up to 15 mm diameter, though for highest speed performance smaller is better. All results shown here were for samples at least 3 mm in diameter.

Sample mounting Samples are mounted to the sapphire end cap of the Z scanner using adhesive to maximize speed.

DC height noise <15 pm (<5 pm typical in quiet lab)

AC height noise <15 pm

Supported modes Tapping (with phase) or contact mode

Supported options Liquid perfusion probe holder

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 at normal speeds.

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

Laser Diode Small Spot Module: Modulated laser diode source with nominal 3×9 µm spot size. Required for tapping mode imaging at video rates.

SLD Small Spot Module: Superluminescent diode source with nominal 3×9 µm spot size. Suggested for contact mode imaging at video rates.

Wavelength 850 nm

DC detector noise <5 pm

AC detector noise <25 fm·Hz$^{-½}$ above 100 kHz

Detector bandwidth DC to 7 MHz

Spot positioning and detector adjustment Fully motorized and software controlled.

Normal-Rate Scanning Performance

Maximum data pixel rate Up to 50 kHz pixel rate

Maximum line scan rate Up to 156 lines/s

X&Y range 30 µm for line scan rates ≤40 Hz
10 µm for line scan rates >40 Hz
(closed-loop scanning)

X&Y sensor noise <60 pm

Z range >5 µm

Z sensor noise <50 pm

Sample size Up to 15 mm diameter

Sample mounting Samples are mounted magnetically.

DC height noise <15 pm (<5 pm typical in quiet lab)

AC height noise <15 pm

Supported modes See the full list inside for the modes that are included standard and those that are available options.

Supported options See the full list inside.

(Some modes and all environmental control accessories require a quick swap of the fast Z sample stage for a different stage.)

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.

blueDrive Photothermal Excitation

Included with all Cypher VRS systems.

User-adjustable DC power Five ranges (0.1 mW, 0.3 mW, 1 mW, 3 mW and 10 mW), appropriate for most conventional and small cantilevers in both air and liquid environments.

Drive frequency Up to 8 MHz

Safety Certified FDA/IEC Class 1 (non-hazardous) 405 nm laser diode with fail-safe interlocks.

Instrument Isolation

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

Acoustic Included enclosure provides 20 dB isolation.

Service and Support

Warranty Full two-year comprehensive warranty.

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

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

6310 Hollister Avenue
Santa Barbara, CA 93117
Phone +1-805-696-6466
www.oxford-instruments.com/AFM
sba.sales@oxinst.com

CE

OXFORD INSTRUMENTS
The Business of Science®