

Cypher VRS1250

The highest resolution and only full-featured video-rate AFM for capturing nanoscale dynamics

The Cypher VRS1250 from Oxford Instruments Asylum Research is the only full-featured video-rate AFM. Its ultra-stable imaging enables it to easily capture nanoscale dynamics at up to 1250 lines/s and up to 45 frames/s. But unlike other high-speed AFMs, it also offers all the capabilities and performance of the Cypher ES AFM. That means that it can easily achieve higher resolution than most AFMs. It also uses the same fully-sealed sample chamber as the Cypher ES, which enables it to use a full range of environmental control accessories. There's no other high-speed AFM with the versatility of the Cypher VRS1250, which makes it great for interdisciplinary research groups and shared imaging facilities.



The first and only full-featured video-rate AFM

- The Cypher VRS1250 is the only video-rate AFM that offers a complete range of imaging modes and environmental control accessories, which makes it a highly versatile AFM for multidisciplinary research.

Designed for video-rate and ultra-high resolution

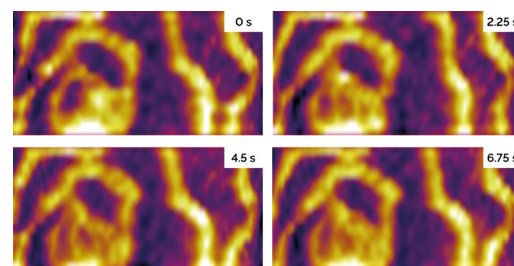
- Image at frame rates up to 45 frames/second or increase spatial resolution by collecting more image pixels at slightly lower frame rates.

Stable imaging makes continuous imaging easy

- A fully-sealed sample cell, advanced low-drift design, and blueDrive photothermal excitation keep imaging stable for continuous high-speed imaging at high resolution without sample damage.

Every step is simpler for remarkable productivity

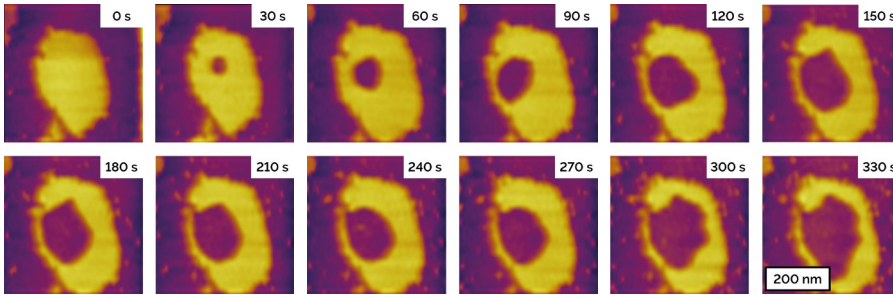
- Modern design with motorized laser and detector alignment, simple probe loading, and a sealed sample cell that eliminates worries about liquid leaks.



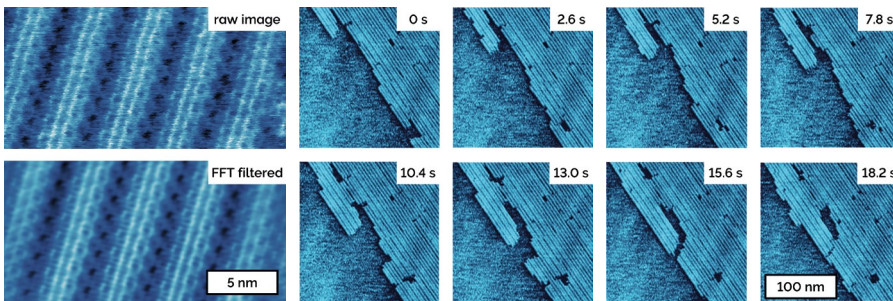
DNA imaged at 45 frames/s. The DNA was loosely bound, allowing the strands to randomly move about. Here, the still images highlight motion in the two strands on the right. The full movie shows additional dynamics. Full video is available at: AFM.oxinst.com/Video-Rate-AFM-Movies

Find the optimal balance between ultra-high speed and ultra-high spatial resolution

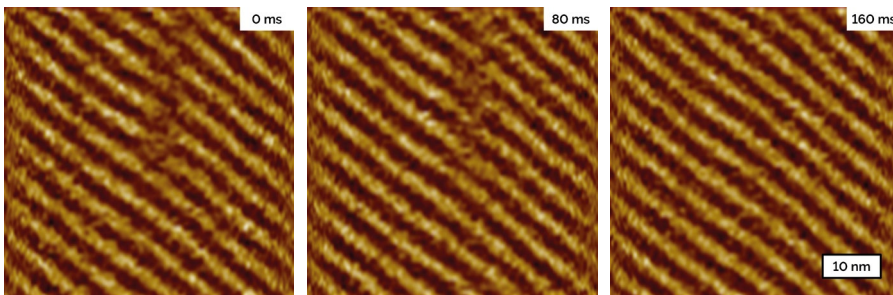
- Like all digital imaging techniques, there's a balance between high frame rates and image pixel resolution. By scanning at up to 1250 lines/s, the Cypher VRS1250 can achieve high frame rates (45 frames/s) with good pixel resolution or even higher resolution at more modest frame rates (e.g. 2-15 frames/s).
- High-bandwidth scanner, feedback electronics, and cantilever detection are all optimized for high-speed tapping mode imaging, ensuring that even delicate samples can be imaged continuously without damage.
- 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.



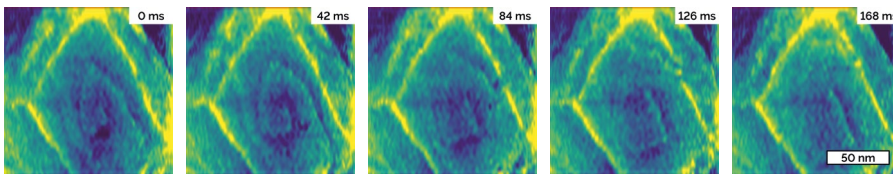
Degradation of lipid bilayer by antimicrobial peptide, PG-1, was monitored by video-rate imaging at 28 fps, acquired at 1250 lines/second and 160×32 pixels. The lipid patch was imaged continuously for almost 7 minutes during which almost 12,000 image frames were acquired. Observation of similar patches in the absence of the peptide did not result in any degradation of the bilayer.



Crystallization of MoS₂-binding peptide was imaged with ultra-high resolution contact mode imaging (left), resolving the molecular structure of peptide crystals with sub-nm spatial resolution. High-speed tapping mode images (right) were captured at 2.6 seconds per frame, which allowed the nucleation dynamics to be measured while also clearly resolving nucleated islands as small as 4×9 nm (only ~8 peptide dimers). Data courtesy of Prof. Jim De Yoreo, Univ. Washington and PNNL. Published in: Chen, J. et al. (2018) *Science* **362** (6419): 1135-1139.



Cetyl palmitate self-assembles on HOPG in a pattern that templates the HOPG substrate. Here, the sample was imaged at 962 lines/second and 208×64 pixels for a frame rate of 13 fps. Shown here is a process whereby a defect in the pattern anneals out, leaving lamellae rows that run parallel across the 40 nm scan area.



Etching of Copper by ammonium persulfate is a common step in the deposition of graphene on copper. Here, the process was imaged at 1250 lines/s and 160×40 pixels for a frame rate of 24 fps. The frames here show a spiral etching process, apparently the result of a screw dislocation defect. Sample courtesy of Mitsubishi Materials Corporation.

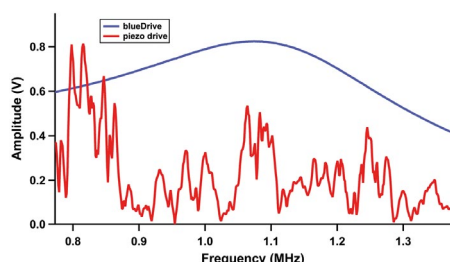
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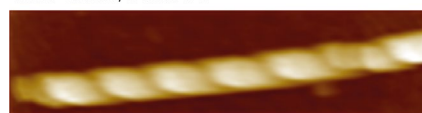
Stable imaging makes it easy to image continuously without sample damage

- blueDrive photothermal excitation keeps the tapping mode amplitude constant for stable imaging.
- Fully-sealed sample chamber eliminates evaporation, enabling imaging over long durations.
- Perfusion option makes it easy to exchange liquid with minimal disruption to imaging.

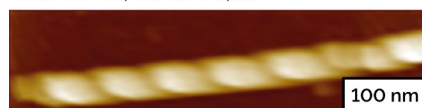


Cantilever tune using blueDrive on a small, fast Nanoworld USC-F1.5-k0.6 cantilever. The blueDrive tune in water closely matches the theoretical response, while the piezo-driven response has multiple peaks.

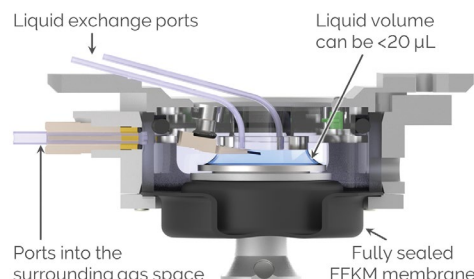
Time= 0 min, frame #0



Time= 15 min, frame #25,662



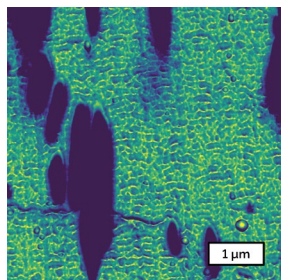
Insulin fiber imaged at 28 fps for 15 minutes
Over 25,000 frames were captured over 15 min with no imaging parameter adjustments. Imaging remained stable with no sample damage and with very little lateral drift, demonstrating remarkable stability at video-rate speeds.



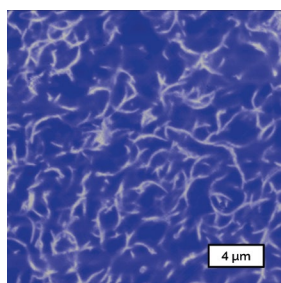
Unique fully-sealed sample chamber eliminates evaporation. Perfusion option enables liquid exchange. An integrated pressure sensor can be used to verify that the cell is airtight by applying a slight overpressure (5 psi / 35 kPa).

The only video-rate AFM with the versatility of a full-featured research AFM

- Other video-rate AFMs are limited to high-speed imaging and support few modes and accessories. The Cypher VRS1250 is unique because it supports the full range of Cypher ES modes and accessories.
- While configured for video-rate imaging, it operates in tapping mode or contact mode in air or liquid under ambient conditions using the fully-sealed sample chamber and optional liquid perfusion.
- While configured as a Cypher ES, it supports fast scanning (up to 156 lines/s) and supports all Cypher ES modes and environmental control accessories.



Modulus map of a polymer blend composed of isotactic polypropylene with rubber inclusions. Imaged using AM FM Viscoelastic Mapping Mode.



Carbon nanotubes in a polymer matrix visualized using electrostatic force microscopy (EFM).

Included Operating Modes

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

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)

Other Options and Accessories

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.

Cypher VRS1250 specifications

Video-Rate Scanning Performance

Maximum line scan rate Up to 1250 lines/s

Maximum frame rate Varies with the selected line scan rate and the pixel size of the image, with a maximum of 45 frames/s.

X&Y maximum scan size Varies with line scan rate, scaling from 30 μm for rates <640 Hz to 500 nm for rates >1000 Hz.

X&Y offset range Scan area can be located anywhere in the overall 30 μm XY scanner range.

X&Y sensor noise <60 pm

Z range >2 μm

Sample size Up to 15 mm diameter

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

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.

blueDrive Photothermal Excitation

Included with all Cypher VRS1250 systems.

blueDrive replaces the conventional "shake piezo" with a second laser source that drives the cantilever photothermally at its resonance for tapping mode techniques. The resulting response is very stable over time. This enables unattended imaging, preserves tip sharpness, and maintains gentle, high-resolution imaging.

Drive frequency Up to 8 MHz

Conventional and Fast Scanning Performance

Cypher VRS1250 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.

Scan speed Up to 40× faster than typical AFMs.

X&Y range 30 μm (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

DC height noise <15 pm

AC height noise <15 pm

Supported modes See previous page

Supported options See previous page

(Some modes and accessories require a quick swap of the video-rate sample stage for a different stage.)

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.

System Upgrades

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 VRS1250 is CE compliant.

Cypher VRS1250 is a Class 1 laser product.



(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.)

Contact us to find the best AFM for your research!

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