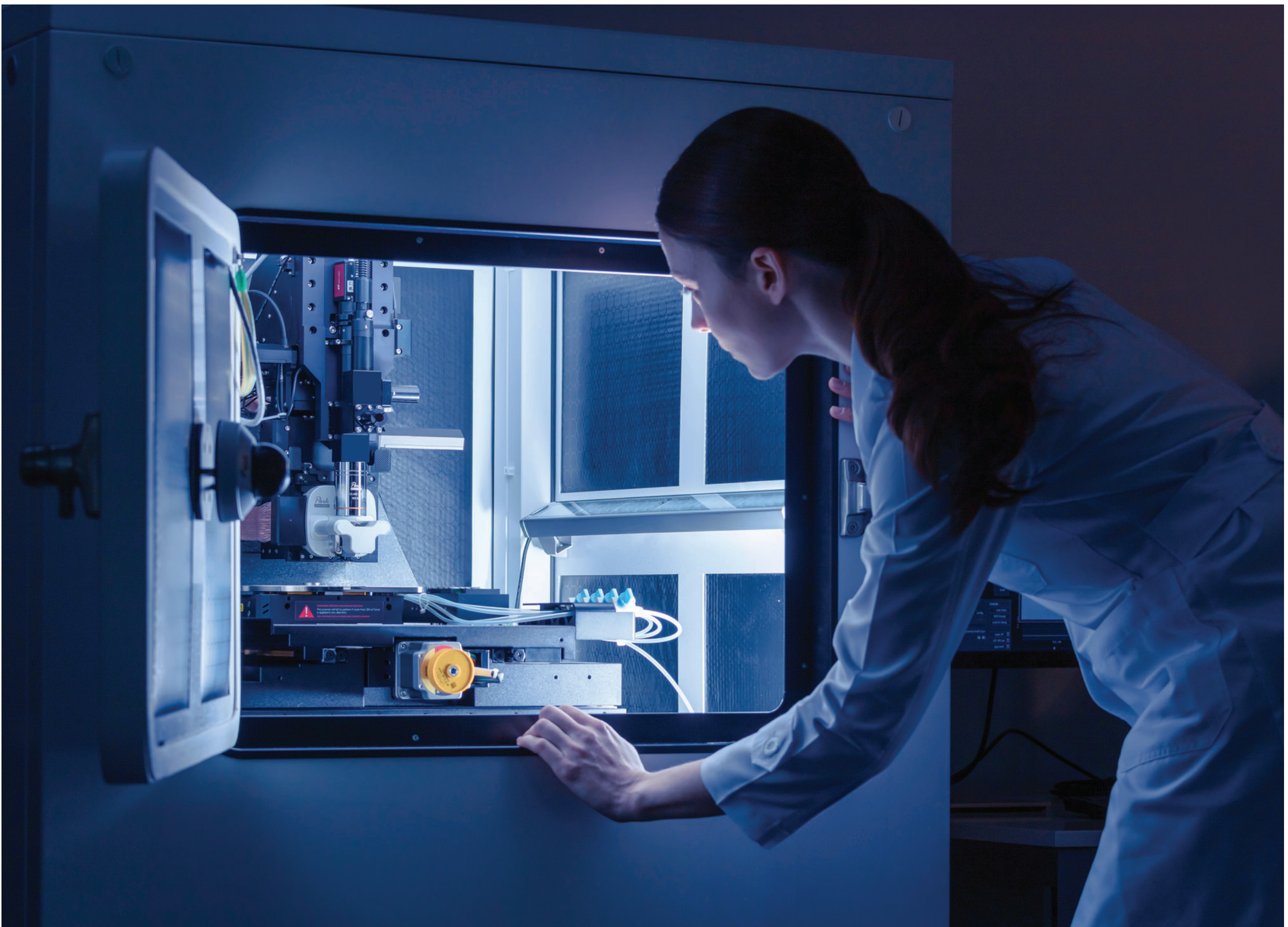
Enabling Nanoscale Advances

Park FX Large Sample AFM

The Most Advanced AFM for samples from small sizes up to 200 mm and 300 mm



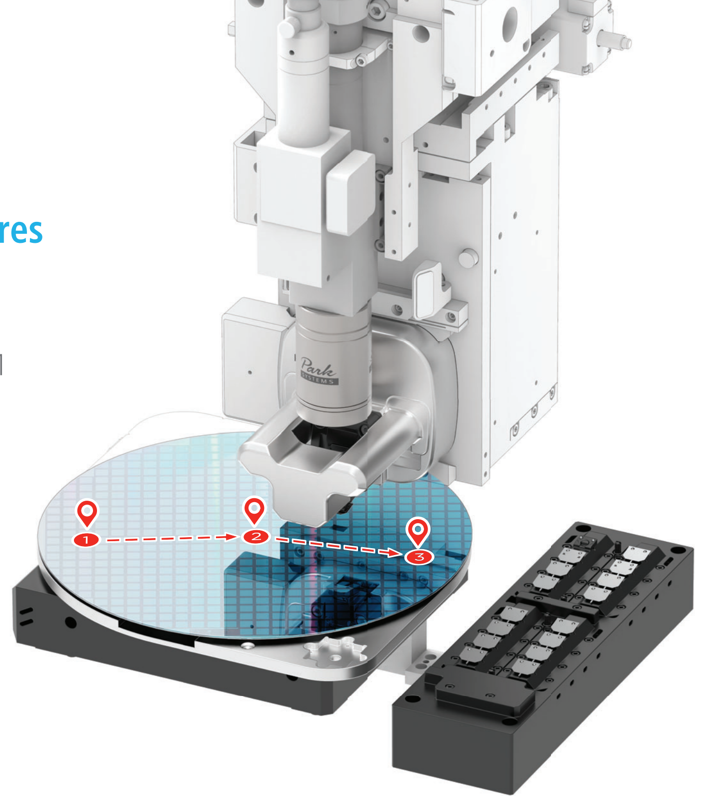
High-Precision and Versatile AFM Systems for up to 200 mm and 300 mm Wafers

Park FX Large Sample AFM Series is designed for high-precision and versatile surface characterization, ideal for both research and industrial settings. Supporting samples from small size up to 300 mm wafers, it is the ultimate solution for semiconductor manufacturing, materials research, quality assurance, and a range of other nanoscale applications including chemical analysis at nanoscale. These systems deliver precise measurements and flexible configurations, ensuring reliable and accurate analysis across various applications.

Key Performance and User Convenience

- Unmatched Sample Capacity: Supports samples from small sizes to 300 mm wafers, ideal for semiconductor and materials research.
- High-Precision IR Spectral Measurement with PiFM: Delivers ~ 5 nm resolution and FTIR-comparable nanoscale chemical analysis.
- Automated Probe Exchange & Laser Alignment: Ensures accuracy and optimizes high-throughput analysis.
- Advanced Mechanical Structure: Low noise, minimal thermal drift, and stable long-term performance.
- Optimized Optical Vision: High-power optics and macro vision for precise large-wafer analysis.

Park FX Large Sample AFM
Simplified Workflow with Automated Features

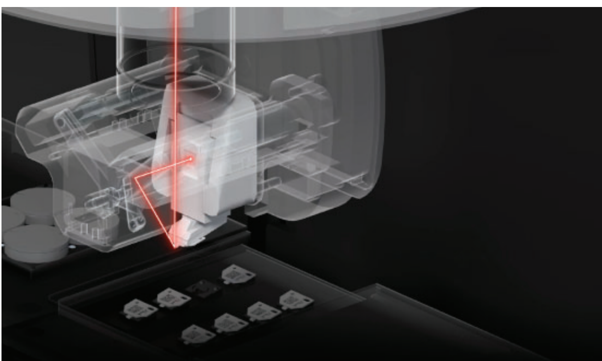


Park FX Large Sample AFM Series streamlines the AFM measurement process by automating key preparation steps–such as probe mounting and laser alignment–significantly reducing setup time. This automation allows users to concentrate on data collection and analysis.

Designed for maximum efficiency, this minimizes user intervention while ensuring consistent, reliable measurements, making it ideal for both research and industrial applications.

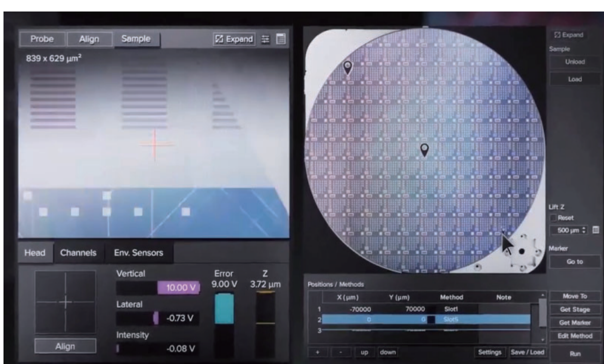
Automatic Probe Recognition and Exchange

- Identifies probe information via built-in QR codes
- Automatically picks up and places the probes
- Accommodates up to 16 probes through magnetic control



Automatic Laser Beam Alignment

- Automatically aligns the SLD and PSPD laser beams
- Streamlines setup with automated tip mounting and laser alignment
- Significantly reduces preparation time for faster measurements

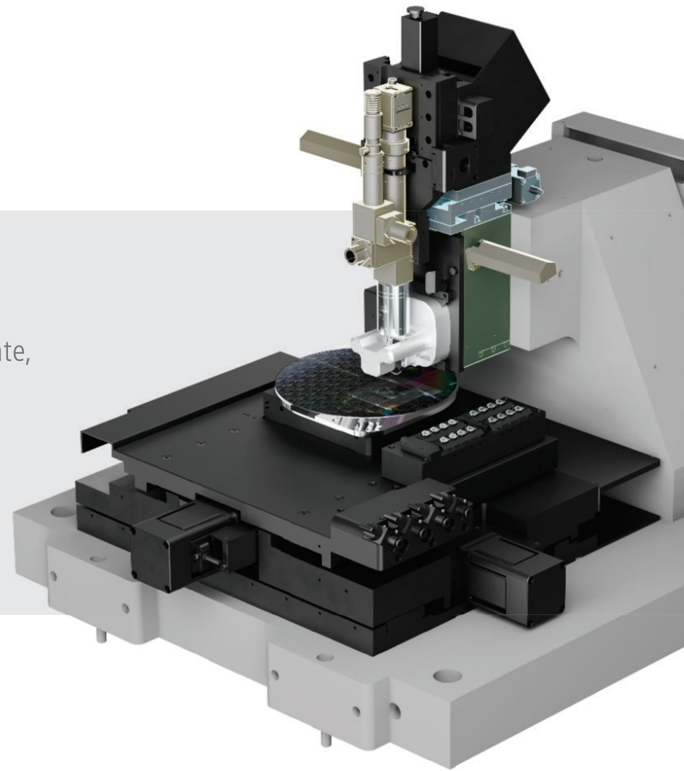


Simplified Workflow

- Macro optics for 200 mm sample overview
- Enhanced StepScan™ feature for automatic sequential measurements at multiple positions
- Supports a wide range of measurement modes, including topography, electrical, mechanical, magnetic, and thermal properties

Park FX Large Sample AFM

Enhanced AFM Core Technology

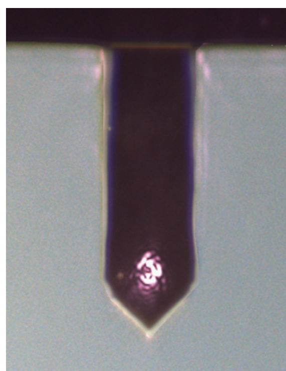


Lower Noise & Minimal Drift

- Optics stage is decoupled from the Z-stage's moving plate, reducing the overall mass on the Z-stage
- High-stiffness cross-roller guide, paired with two bearing blocks, ensures exceptional Z-stage stability
- Optimized to compensate for thermal expansion, enhancing measurement reliability

Advanced Control with the FX AFM Controller

- Enhanced lock-in performance supports a broader range of optional modes
- Increased tip bias modulation bandwidth for advanced applications, including Contact Resonance PFM and Heterodyne KPFM
- Head crash prevention safeguards delicate samples and probes
- Upgraded environmental sensors ensure reliable results under varying environmental conditions

NX laser spot	FX laser spot
	

Optic view of 'PPP-NCHR'

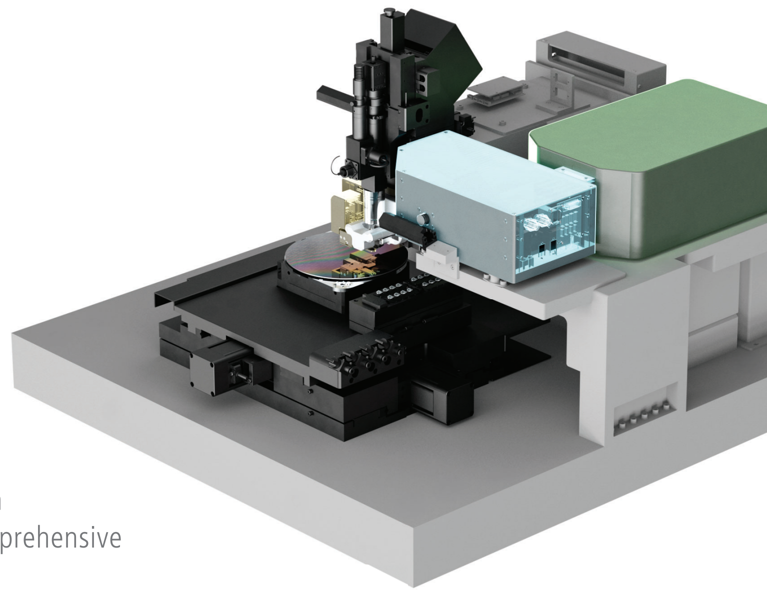
Laser Beam Spot Size has been reduced from 25 μm × 45 μm (Elliptical) to 11 μm × 11 μm (Circular)

Small Laser Spot Size

- Laser spot size is minimized to 11 μm by focusing the beam through an objective lens directly onto the cantilever
- Improves performance for high-speed and biological sample measurements

Park FX Large Sample AFM

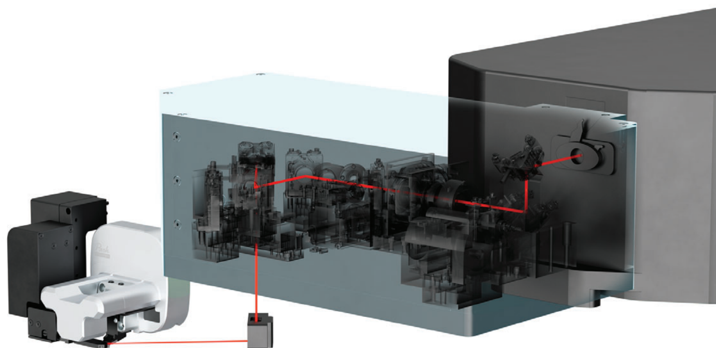
Combining AFM with IR Spectroscopy



Combining AFM with IR Spectroscopy for Advanced Analysis

Park FX200 IR and FX300 IR systems feature integrated Photo-induced Force Microscopy (PiFM) for high-resolution IR spectra and nanoscale chemical mapping, ensuring comprehensive molecular-level insights.

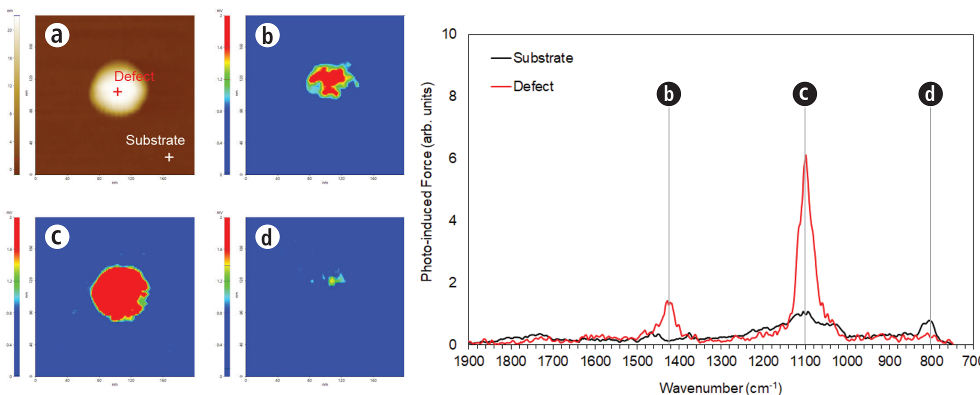
PiFM enables users to analyze molecular vibrations at nanometer-scale precision, making it a powerful tool for advanced material characterization in both research and industrial applications. By combining AFM and IR spectroscopy, it broadens the scope of surface analysis, providing valuable insights into chemical and physical properties.



Automated IR Laser Beam Alignment

- Automated IR laser beam alignment with FX automation reduces setup time.
- Streamlined setup with automated probe mounting and laser alignment.

PiFM Provides Insights into Molecular Analysis at Nanoscale by Providing both IR Absorption Spectra and Chemical Mapping with ~ 5 nm Spatial Resolution



Defect analysis with PiFM enables precise identification and mapping of material defects at the nanoscale.

- a Height image
- b PiFM image at 1450 cm^{-1}
- c PiFM image at 1100 cm^{-1}
- d PiFM image at 800 cm^{-1}

Park FX Large Sample AFM

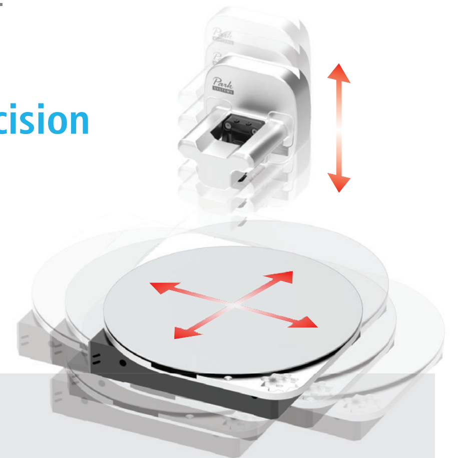
AFM Technology

Flat Orthogonal XY Scanning without Scanner Bow

Park's Crosstalk Elimination scanner structure removes scanner bow, allowing flat orthogonal XY scanning regardless of scan location, scan rate, and scan size. It shows no background curvature even on the flattest samples, such as an optical flat, and with various scan offsets. This provides you with a very accurate height measurement and precision nanometrology for the most challenging problems in research and engineering.

Decoupled XY and Z Scanners for Unmatched Precision

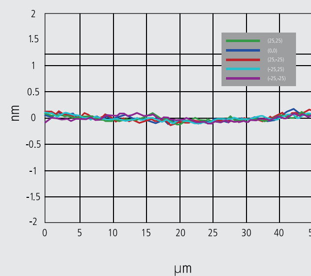
The fundamental difference between Park and its closest competitor is in the scanner architecture. Park's unique flexure based independent XY scanner and Z scanner design allows unmatched data accuracy at nano resolution in the industry.

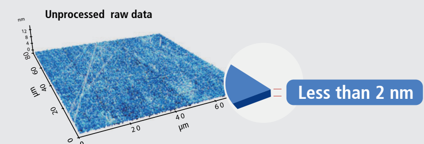


Accurate Surface Measurement

"Flat" sample surface as it is!

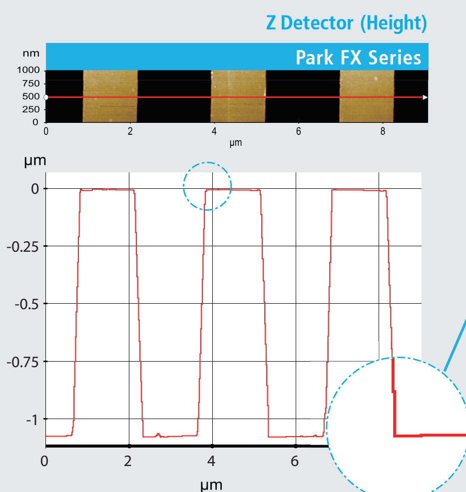
- Low residual bow
- No need for software processing
- Accurate results independent of scan location





Industry Leading Low Noise Z Detector

Park AFMs are equipped with the most effective low noise Z detectors in the field, with a noise of 0.02 nm over a large bandwidth. This produces highly accurate sample topography and no edge overshoot. Just one of the many ways Park FX series saves you time and gives you better data.



No creep effect

Accurate Sample Topography Measured by Low Noise Z Detector

- Uses low noise Z detector signal for topography
- Has low Z detector noise of 0.02 nm over a large bandwidth
- Has no edge overshoot at the leading and trailing edges
- Needs calibration done only once at the factory

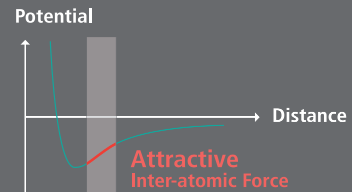
Sample: 1.2 µm Nominal Step Height
(9 µm x 1 µm, 2048 pixels x 128 lines)

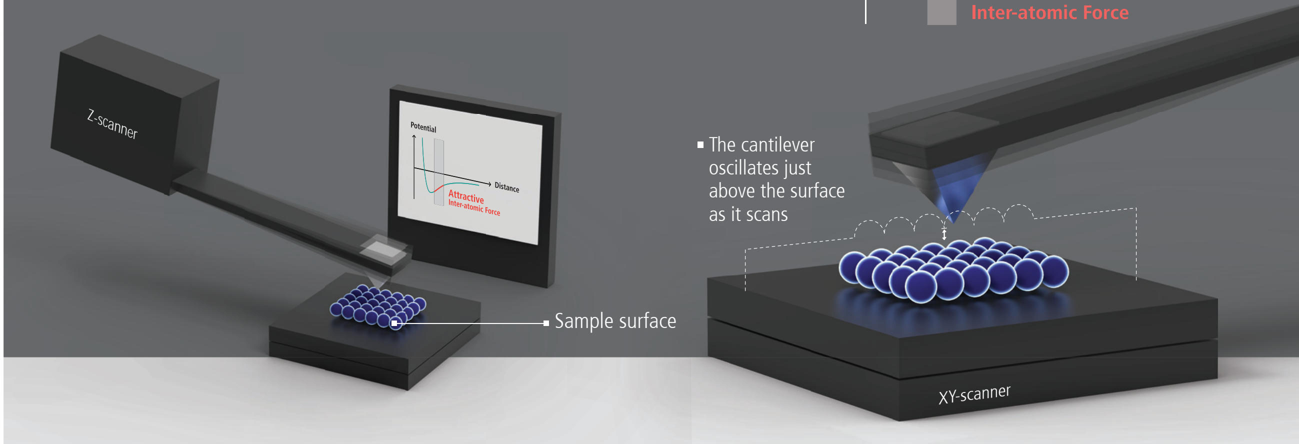
True Non-Contact™ Mode

True Non-Contact™ Mode is a scan mode unique to Park AFM systems that produces high-resolution and accurate data by preventing destructive tip-sample interaction during a scan.

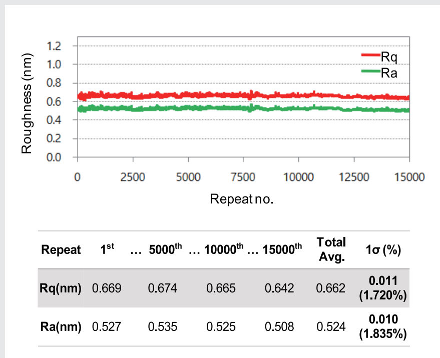
Accurate Feedback by Faster Z-servo enables True Non-Contact AFM

- Less tip wear → Prolonged high-resolution scan
- Non-destructive tip-sample interaction → Minimized sample modification
- Maintains non-contact scan over a wide range of samples and conditions

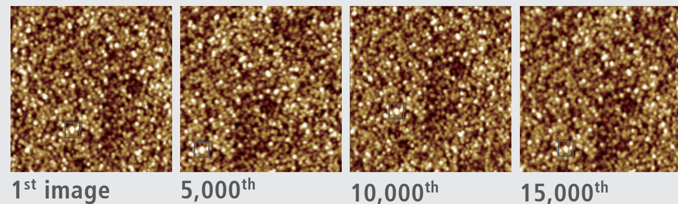




Unlike Contact Mode, where the tip contacts the sample continuously during a scan, or in Tapping Mode, where the tip touches the sample periodically, a tip used in Non-contact Mode does not touch the sample. Because of this, using Non-contact Mode has several key advantages. Scanning at the highest resolution throughout imaging is now possible as the tip's sharpness is maintained. Non-contact mode avoids damaging soft samples as the tip and sample surface avoid direct contact.



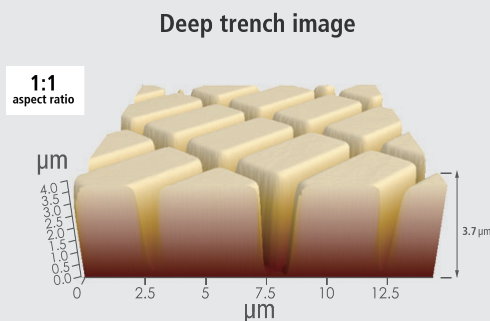
Repeat	1st	... 5000th	... 10000th	... 15000th	Total Avg.	1σ (%)
Rq(nm)	0.669	0.674	0.665	0.642	0.662	0.011 (1.720%)
Ra(nm)	0.527	0.535	0.525	0.508	0.524	0.010 (1.835%)



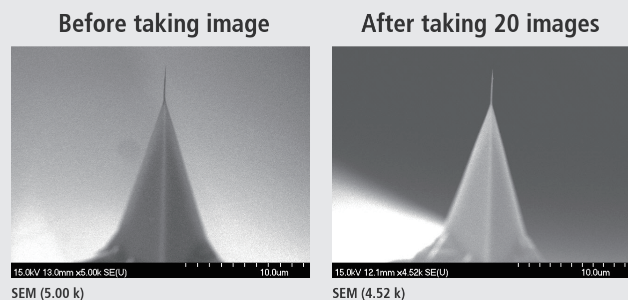
1st image 5,000th 10,000th 15,000th

Furthermore, Non-contact Mode senses tip-sample interactions occurring all around the tip. Forces occurring laterally to tip approach to the sample are detected. Therefore, tips used in Non-contact Mode can avoid crashing into tall structures that may suddenly appear on a sample surface. Contact and Tapping Modes only detect the force coming from below the tip and are vulnerable to such crashes.

Deep trench image



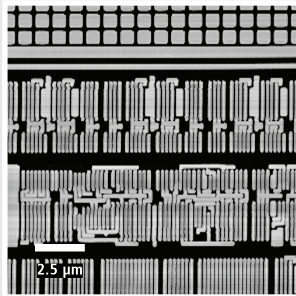
Before taking image **After taking 20 images**



Park FX Large Sample AFM
Designed for Your Applications

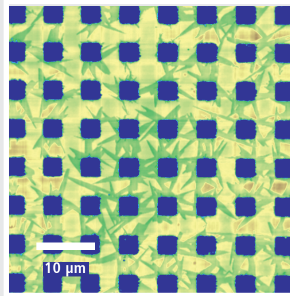
Park FX Large Sample AFM provides precise measurements from the small sizes up to 300 mm wafers, making it the ideal solution in research and industry fields.

Semiconductor



- **Patterned Si Device**

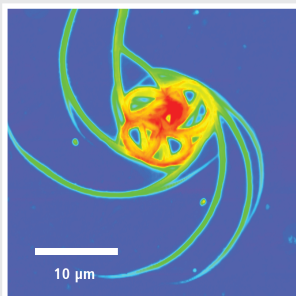
  The structure of the device is evaluated using the Non-contact Mode. The image shows the width and depth of the patterned Si device.



- **Cu Pad**

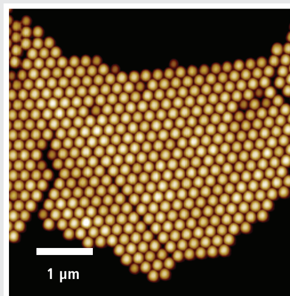
  Cu pad image provides high-resolution analysis of surface roughness and structural features.

Polymer



- **Hyper-branched Polymer**

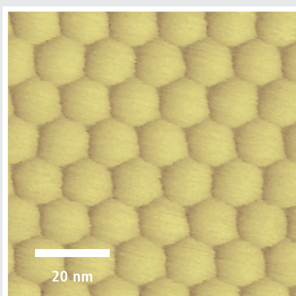
  3D macromolecules with numerous reactive chain-ends and low viscosity.



- **Polystyrene Beads on Mica**

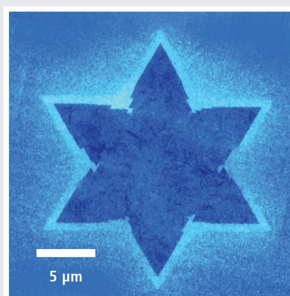
  203 nm-diameter nanospheres deposited on a mica substrate, capturing their topographical and morphological characteristics at the nanoscale.

2D materials



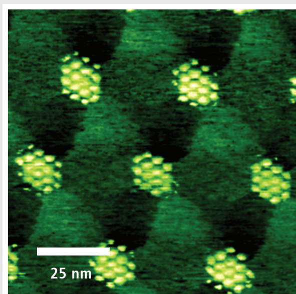
- **Twisted Bilayer Graphene on hBN**

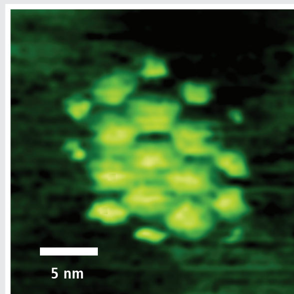
  Current image of tBG/hBN shows the moiré patterns at nanoscale.



- **$MoSe_2$ on WSe_2 Heterostructure**

  KPFM potential image shows the surface potential of $MoSe_2/WSe_2$ Heterostructure.





- **Moiré Superlattice in Twisted Bilayer Graphene on hBN**

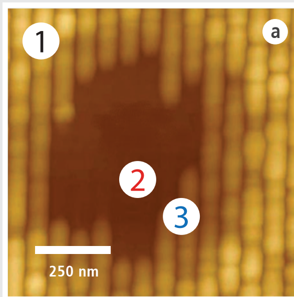
  The two moiré patterns interfere, leading to a dual moiré superlattice.

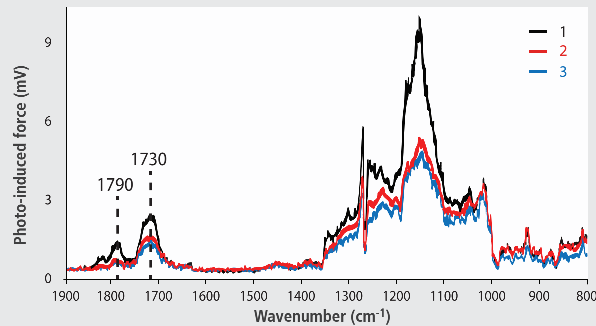
Park FX Large Sample AFM

Enabling Researchers with Versatile AFM Solutions

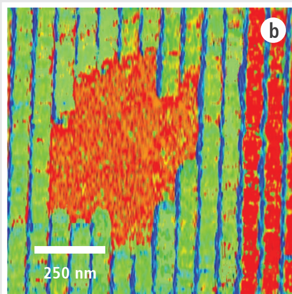
Designed with users in mind, the Park FX Large Sample AFM offers unparalleled accuracy and user-friendly operation across diverse applications, including advanced electrical and chemical characterization.

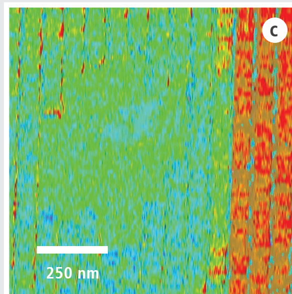
Nanoscale IR spectroscopy





PiFM Spectrum on
① Normal PR pattern
② Defect
③ Edge of PR pattern

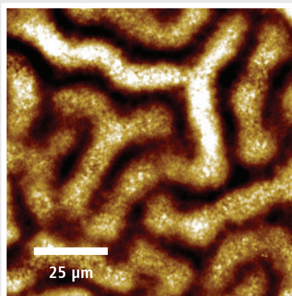


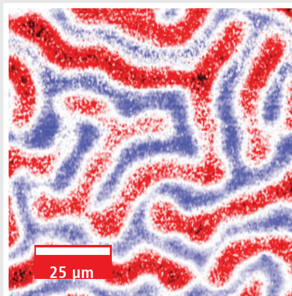


- **PiFM Image on e-Beam Damaged ArF Photo Resist**

  ⓐ Height image
  ⓑ PiFM image at 1730 cm^{-1}
  ⓒ PiFM image at 1790 cm^{-1}

Nanoelectrical applications

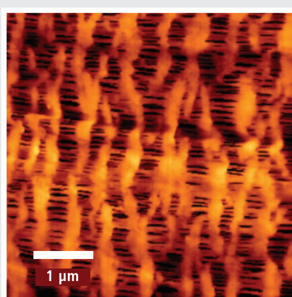


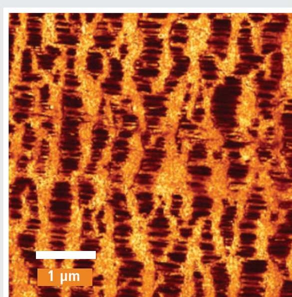


- **Perovskite**

  Current image confirms the conductivity of the perovskite material.
  Current image reveals spatial variations in electrical properties.
  Height image (left), current image (right).

Nanomechanical applications





- **Battery Film Diaphragm**

  PinPoint™ images provides quantitative modulus of battery film.
  Height image (left), modulus image (right).
  Modulus: 2.2 GPa (peak to valley)

Park FX Large Sample AFM
Product Lineup

Park FX200

The most advanced research AFM for samples from small sizes up to 200 mm

- Enhanced convenience with FX automation features: automated probe exchange, automated laser beam alignment, and macro optics
- Advanced system performance through improved mechanical design and FX AFM controller
- StepScan automates measurements with programmable recipes and multiple modes for faster results and greater productivity
- Highly versatile for a wide range of advanced AFM application modes and options

Park FX300

Premier 300 mm AFM for research, quality control, and assurance

- With the FX automation features, fully capable of 300 mm wafer measurements
- Highly versatile for a wide range of advanced AFM application modes and options
- Specialized industrial R&D applications with recipe-based routine measurements, long-range profiling, and a rotatable stage
- Reliable system safety with integrated industrial-grade facility

Park FX200 IR / FX300 IR

AFM-integrated nanoscale IR spectroscopy for precise chemical analysis

- Versatile sample measurements sized from small to 300 mm wafers
- High-precision IR spectral measurements with PiFM for superior spatial resolution and FTIR-comparable analysis
- Streamlined measurement setup with Automated IR Laser Beam Alignment
- Comprehensive advanced AFM applications, such as nanomechanical, electrical, and thermal property measurements

Park FX Large Sample AFM
Specifications

● Default ○ Optional - Not available

		FX200	FX300	FX200 IR / FX300 IR
System	Sample Size	200 mm x 200 mm	300 mm x 300 mm	200 mm x 200 mm / 300 mm x 300 mm
	XY Scanner	100 µm × 100 µm	100 µm × 100 µm	100 µm × 100 µm
	Z Scanner	15 µm	15 µm	15 µm
	XY Stage	300 mm x 200 mm	400 mm x 300 mm	300 mm x 200 mm / 400 mm x 300 mm
	Z Stage	22 mm	22 mm	22 mm
Automation	Auto Probe Exchanger	● (up to 16 slots)	● (up to 16 slots)	● (up to 16 slots)
	Auto Laser Alignment	●	●	●
	Digital Lock-in Channels	8 channels (FX Controller)	8 channels (FX Controller)	8 channels (FX Controller)
	Live Monitoring Camera	●	●	●
Optics	Macro Optics for Wafer Overview	●	-	● (Only for FX200 IR)
	Off-Axis Optics	-	○	-
System Base Option	Facility Controller	○	●	●
	Fan Filter Unit (FFU)	-	○	-
IR Laser	QCL Laser (3 modules)	-	○	●
	QCL Laser (4 modules)	-	○	○
	QCL+OPO, QCL+OPO/DFG	-	○	○
Industrial Application Options	Sliding Stage	-	○	-
	Rotation Stage	-	○	-
Sample Chuck	Multi-Sample Chuck (coupon sample)	○	○	○
Software	Park SmartScan Operating Software	●	●	●
	Park XEA Software Package	○	○	○
AFM Modes	Imaging mode	Contact, Non-contact, Tapping		
	Mechanical mode	F/d curve, F/d mapping, PinPoint nanomechanical, Nanoindentation, FMM, LFM		
	Magnetic mode	MFM, FM-MFM		
	Bio mode	Liquid AFM		
	Electrical mode	C-AFM, I/V Curve, PinPoint electrical mode, EFM/KPFM, Heterodyne KPFM, PFM, CR-PFM, SSRM, SCM, sMIM		
	Thermal mode	SThM		
	Lithography / Manipulation	Nanolithography		
	Electrochemical mode	EC-AFM		

Please consult Park Systems for more detailed information on modes and options

Committed to Contributing to Impactful Science and Technology

Park Systems Corporation is a leading manufacturer of nanoscale microscopy and metrology solutions that encompasses the atomic force microscopy, white light interferometry, infrared spectroscopy and ellipsometry systems. Its products are widely used for scientific research, nanoscale engineering, and semiconductor fabrication and quality assurance. Park Systems provides a full range of AFM products from desktop to fully automated systems with integrated robotic arms. Furthermore, its product line includes WLI AFM, nano-IR spectroscopy and ellipsometry systems for those in the chemistry, materials, physics, life sciences, and semiconductor industries.
In 2022, Park Systems acquired and merged Accurion GmbH, a leader in high-end ellipsometry and active vibration isolation, to form Park Systems GmbH, Accurion Division.

Park Systems is a publicly traded corporation on the Korea Stock Exchange (KOSDAQ) with corporate headquarters in Suwon, Korea, and regional headquarters in Santa Clara, California, Mannheim, Germany, Paris, France, Beijing, China, Tokyo, Japan, Singapore, India, and Mexico. Please visit www.parksystems.com or email inquiry@parksystems.com for more information.

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