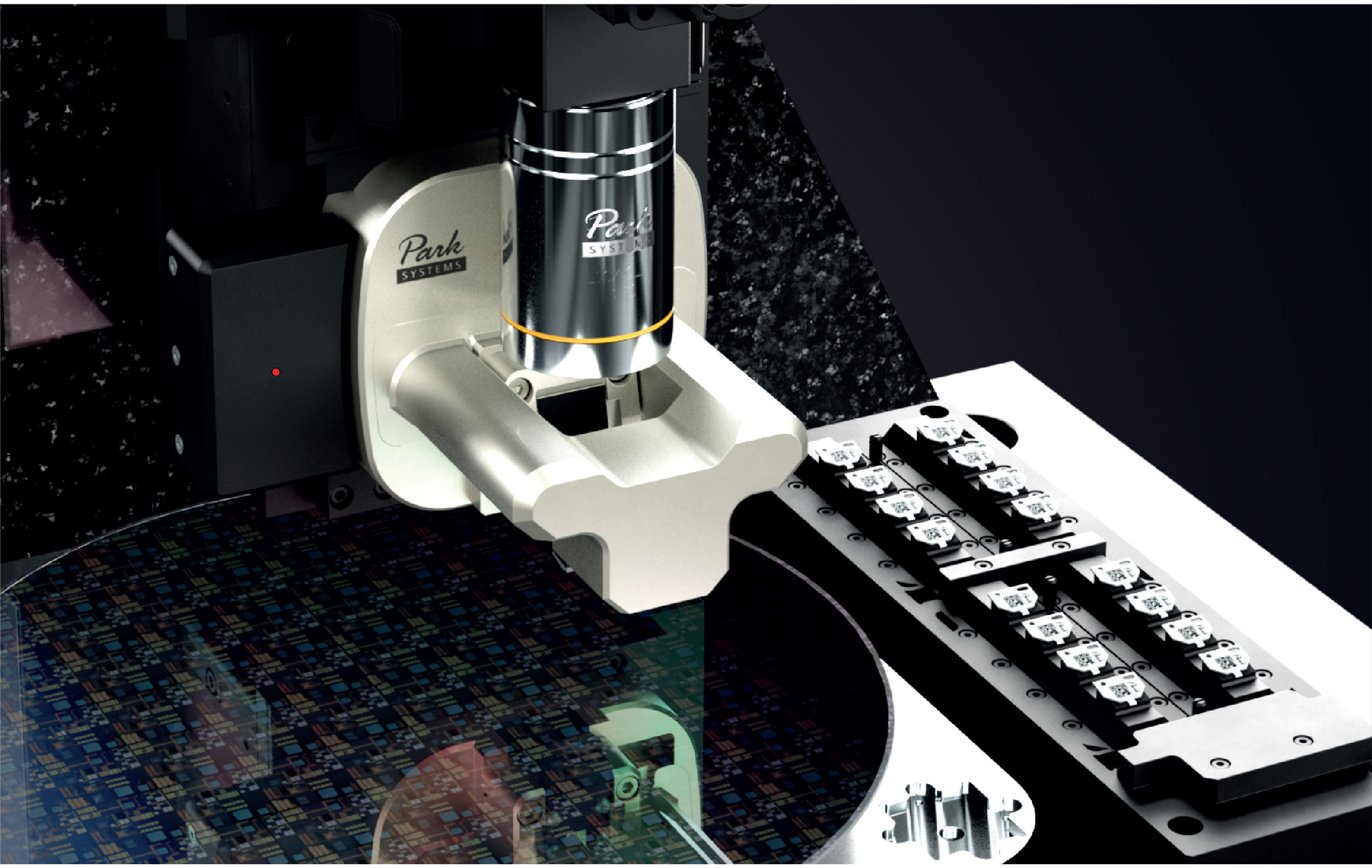
Park FX200

The Most Advanced AFM for 200 mm Samples



Park SYSTEMS

Park FX200 is Park Systems’ latest innovation in atomic force microscopy (AFM), designed to accommodate samples up to 200 mm. With a low noise floor, minimal thermal drift, and enhanced mechanical stability, the FX200 delivers unmatched precision and reliability.

Like all Park AFMs, FX200 features an orthogonal scan system and True Non-contact™ mode, enabling accurate, high-resolution metrology, even on the most delicate or fragile samples.

Key features of FX200 include automatic probe exchange, automatic laser beam alignment, and a full 200 mm sample view camera; the signatures of FX-series AFMs that streamline operation and enhance productivity. Additional capabilities such as automated scan parameter optimization, optical autofocus, sequential measurements across multiple positions, and powerful data analysis tools further simplify even the most complex workflows.

With advanced capabilities and a user-friendly interface, the FX200 offers a versatile solution for nanoscale imaging and analysis across both research and industrial settings.

FX200 – Key Features

Superior AFM Performance

- Lower Noise Floor
- Minimal Thermal Drift
- Orthogonal Scan System
- True Non-Contact™ Mode

User Convenience

- Automatic Probe Exchange
- Automatic Laser Beam Alignment
- Sample-View Camera

Additional Features

- Improved Acoustic Enclosure
- Live Monitoring Camera
- FX AFM Controller

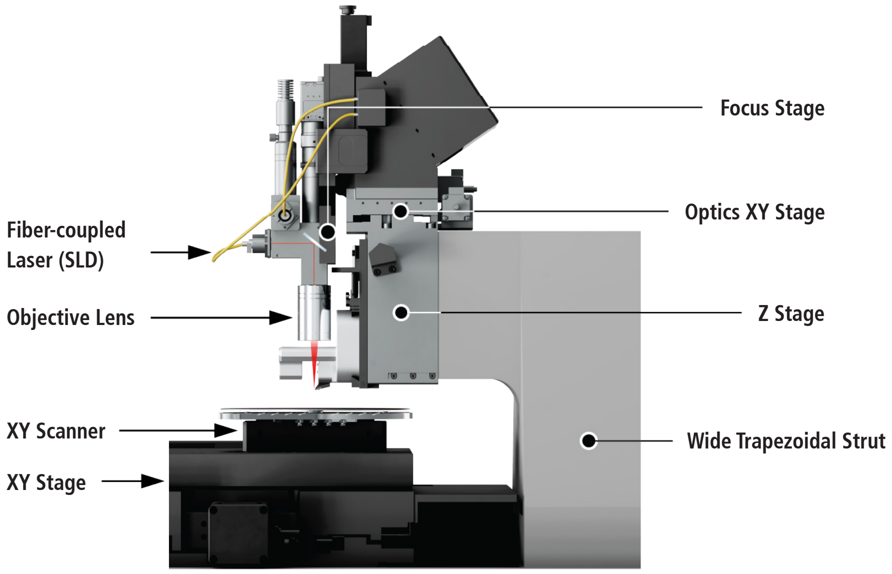
Park FX200

The Most Advanced AFM for 200 mm Samples

Superior FX Mechanical Design

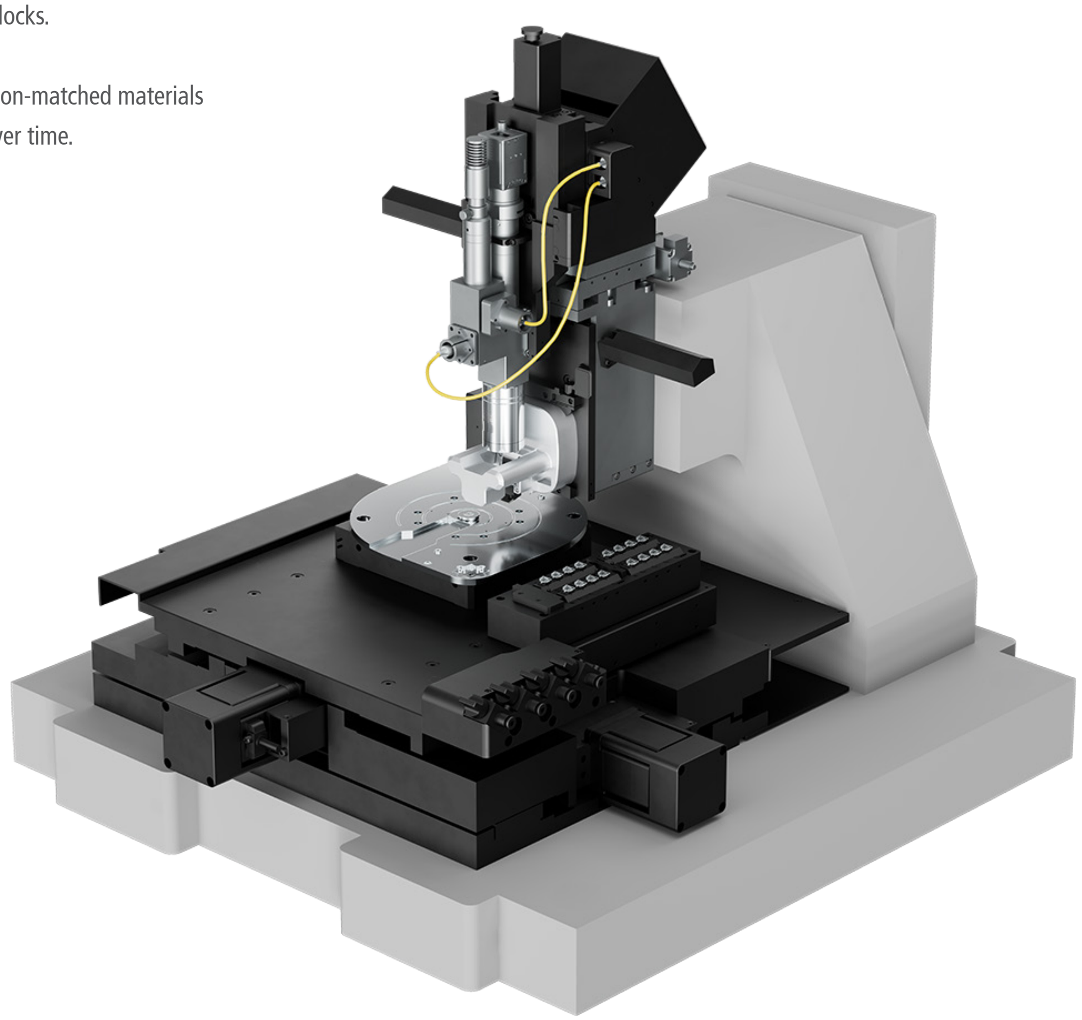
The FX-series AFMs are designed for minimal mechanical noise. The optical microscope is decoupled from the Z stage, lowering the weight on the Z stage and thus reducing susceptibility to mechanical disturbances.
The Z stage itself is built more robustly with a high-stiffness cross-roller guide and two bearing blocks.

A wide trapezoidal strut reinforces the mechanical rigidity of the FX200, while the use of expansion-matched materials with low thermal expansion coefficients mitigates thermal drift, ensuring reliable performance over time.



FX Laser Beam Path

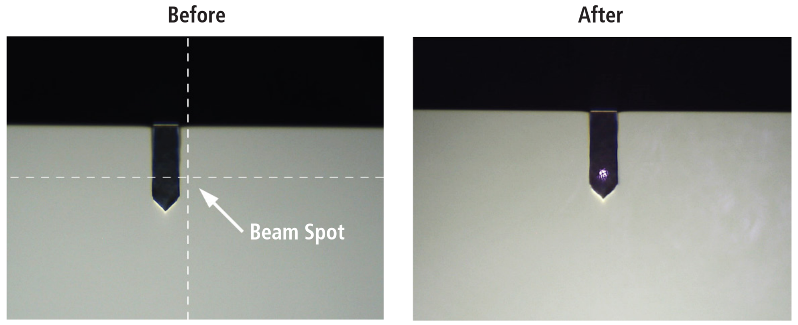
The FX optics structure integrates a fiber-coupled laser (superluminescent diode; SLD) into the optical microscope assembly. The laser beam is focused through the objective lens and remains fixed at the center of the optical field of view.



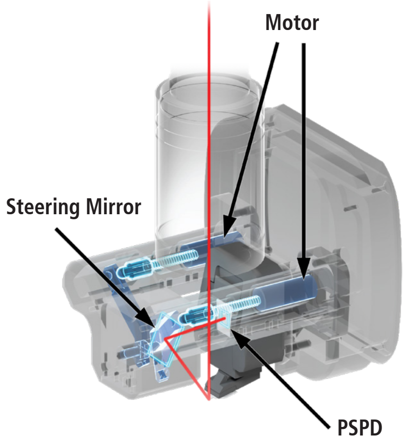
Automatic Laser Beam Alignment

The vision-guided alignment system detects the cantilever shape and position and then moves the optics XY stage to align the cantilever at the center of the field of view, precisely where the laser beam is focused.

The focused beam has a reduced spot size, minimizing spillover and enabling easy adoption of small, high-frequency cantilevers.



Two precision motors in the FX head then adjust the steering mirror to align the laser beam with the center of the position-sensitive photodetector (PSPD).

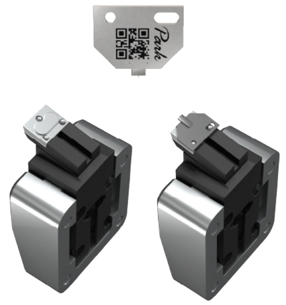


Automatic Probe Exchange

AFM probe exchange can be challenging, even for experienced users, often resulting in cantilever breakage. Park AFMs address this difficulty by using pre-aligned probe chip carriers with kinematic mounting points for reliable and consistent tip positioning.

Each chip carrier is marked with a QR code containing detailed information, including probe type, serial number, date manufactured, and specifications.

The FX head's Z scanner features three precision ball seats for kinematic mounting, complemented by magnets at the base to ensure a secure, reliable, and repeatable mounting position.

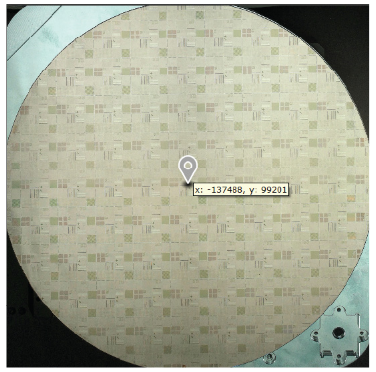

Probe Chip Carrier

The automatic tip exchanger (ATX) module stores up to 16 pre-mounted probes. After the ATX camera scans the probes' QR codes, the SmartScan™ AFM operating software displays probe information for each slot, allowing the user to select occupied or vacant probe slots with a simple mouse click.

After a slot is selected, the AFM head moves down to pick the probe up from or park the currently mounted probe into the slot, depending on the position of the strong magnet underneath.

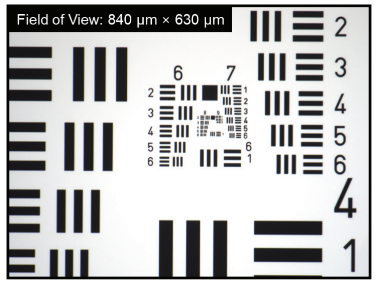
Sample-View Camera

The sample view camera captures a macro image of the entire sample. Users can point and click on the sample view image to move the XY stage to the desired location, making it easy to locate areas of interest and return to the same spot, even for large samples such as a 200 mm wafer.



Improved On-axis Optics

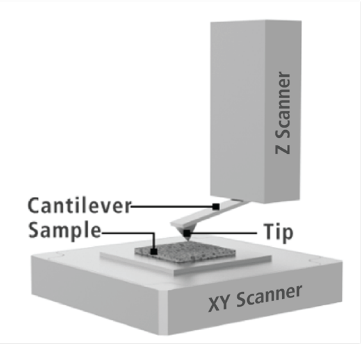
The unobstructed optical microscope provides a clear field of view and can resolve line widths down to 0.87 µm.



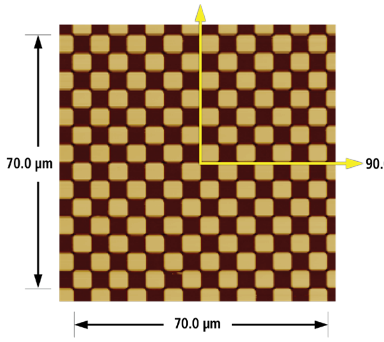
Park AFM Technology

Orthogonal Scan

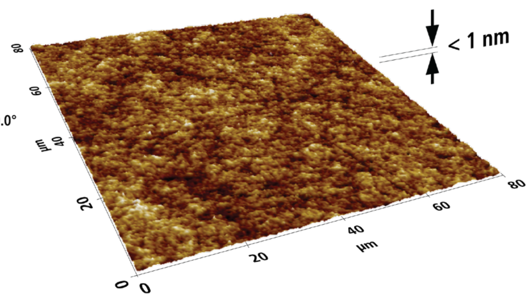
Conventional AFMs with tube scanners suffer from out-of-plane motion and axes crosstalk, resulting in image distortion, especially over large scan areas. FX200, like all Park AFMs, employs an advanced orthogonal scan system featuring a flexure-guided architecture: a 2D flexure scanner moves the sample in the XY plane, while a separate 1D flexure scanner independently controls the probe's Z-axis motion. This separated scanner system ensures highly orthogonal, linear scans with minimal out-of-plane motion and fast dynamic performance.



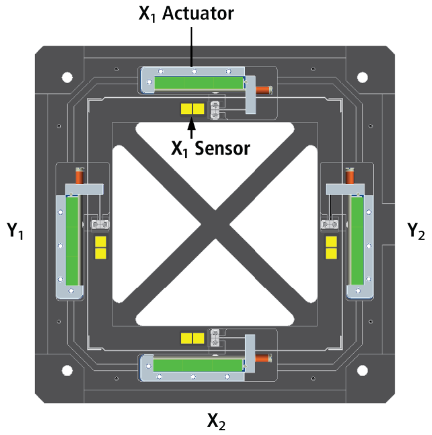
10 µm Pitch Calibration Grating



Optical Flat (80 × 80 µm)



Equipped with low-noise optical sensors for XY feedback and an ultra-low-noise strain gauge sensor for Z control, a closed-loop servo control system ensures precise and repeatable scanning across all axes.



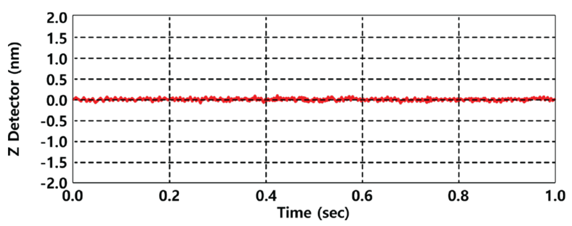
For large samples, a single-servo XY scan architecture can be vulnerable to the rotational motion of the sample chuck. This rotational motion can introduce positioning errors that increase with distance from the position sensor.

The FX200 resolves this issue with a dual-servo XY scanner architecture, with two pairs of actuators and position sensors mounted on opposite sides of each axis. All four actuators are controlled independently to ensure accurate positioning across the entire 200 × 200 mm² sample area.

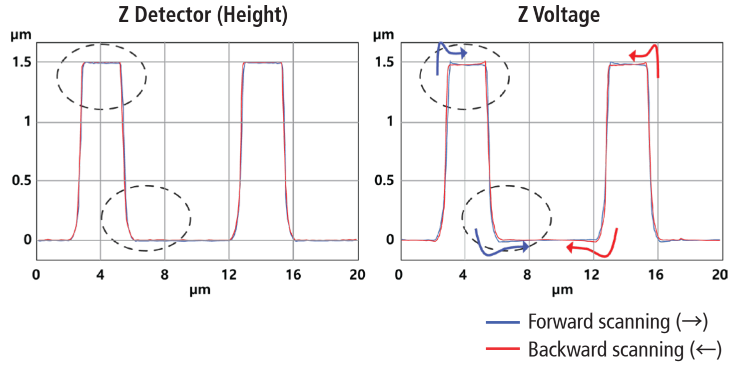
Low Z Detector Noise

The Z detector has a noise level of less than 0.02 nm, enabling height measurements with sub-nanometer accuracy, down to 0.1 nm. Unlike conventional Z voltage mapping, which often overshoots at stiff walls, the Z detector provides precise, conformal surface tracing.

Z Detector Noise

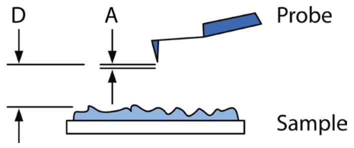


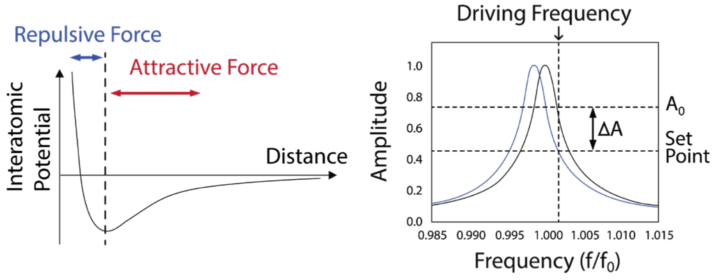
0.02 nm (rms), 1 kHz BW



True Non-Contact™ Mode

FX200 features True Non-contact™ mode, a proprietary technology exclusively offered by Park Systems. True Non-contact mode obtains topography by detecting the attractive van der Waals force between the AFM tip and the sample surface.



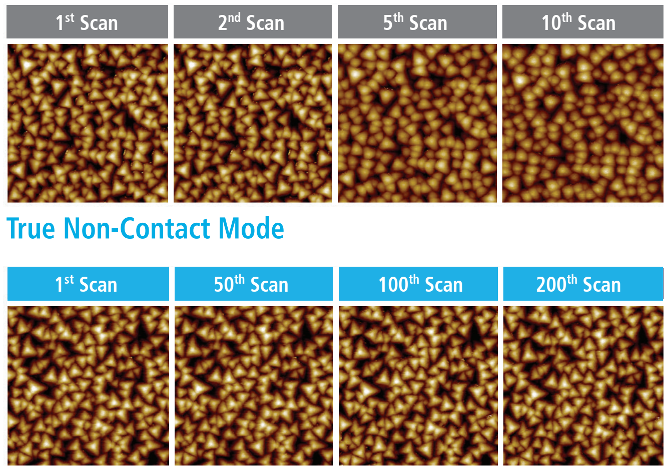


In True Non-contact mode, the tip oscillates at a frequency slightly higher than its resonance frequency, where the amplitude-frequency curve has its steepest slope.

As the tip approaches the sample, the attractive force causes a downshift in the effective resonance frequency, leading to a decrease in oscillation amplitude at the driving frequency. The Z-servo maintains this new amplitude as the set point, keeping a constant tip-sample interaction while the tip scans in the XY direction.

An important advantage of True Non-contact mode, compared to tapping mode, is the prevention of tip wear and sample damage. The results of repetitive scans on a chromium nitride (CrN) tip-checking sample show that while the tapping mode image became blurry after just a few scans due to tip wear, the True Non-contact mode image remained sharp even after 200 scans.

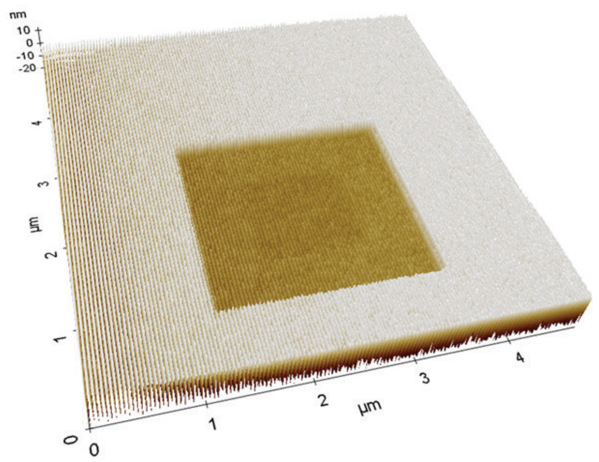
Tapping Mode



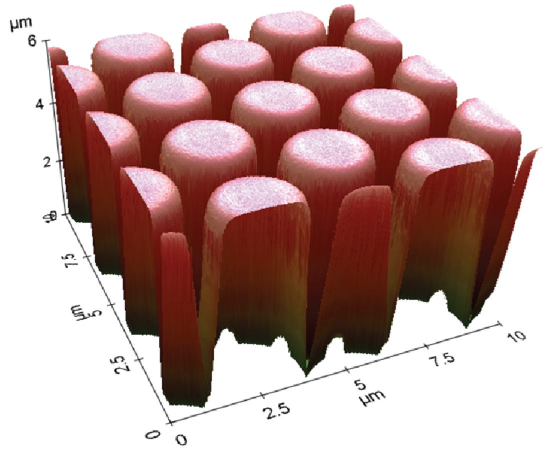
True Non-contact mode can measure soft and sticky samples as well as the most delicate and brittle samples, which cannot be imaged with tapping mode AFM. The image below is the topography of an unbaked photoresist acquired with True Non-contact mode, showing damages induced by electron beam irradiation during SEM scanning.

True Non-contact mode can also scan tall features. By sensing attractive forces not only at the apex of the tip but also along its sides, the Z-servo quickly retracts the tip as it approaches vertical features. With True Non-contact mode, deep holes and tall pillars like molds for nanoimprint can be measured, as in the image below.

Unbaked Photoresist



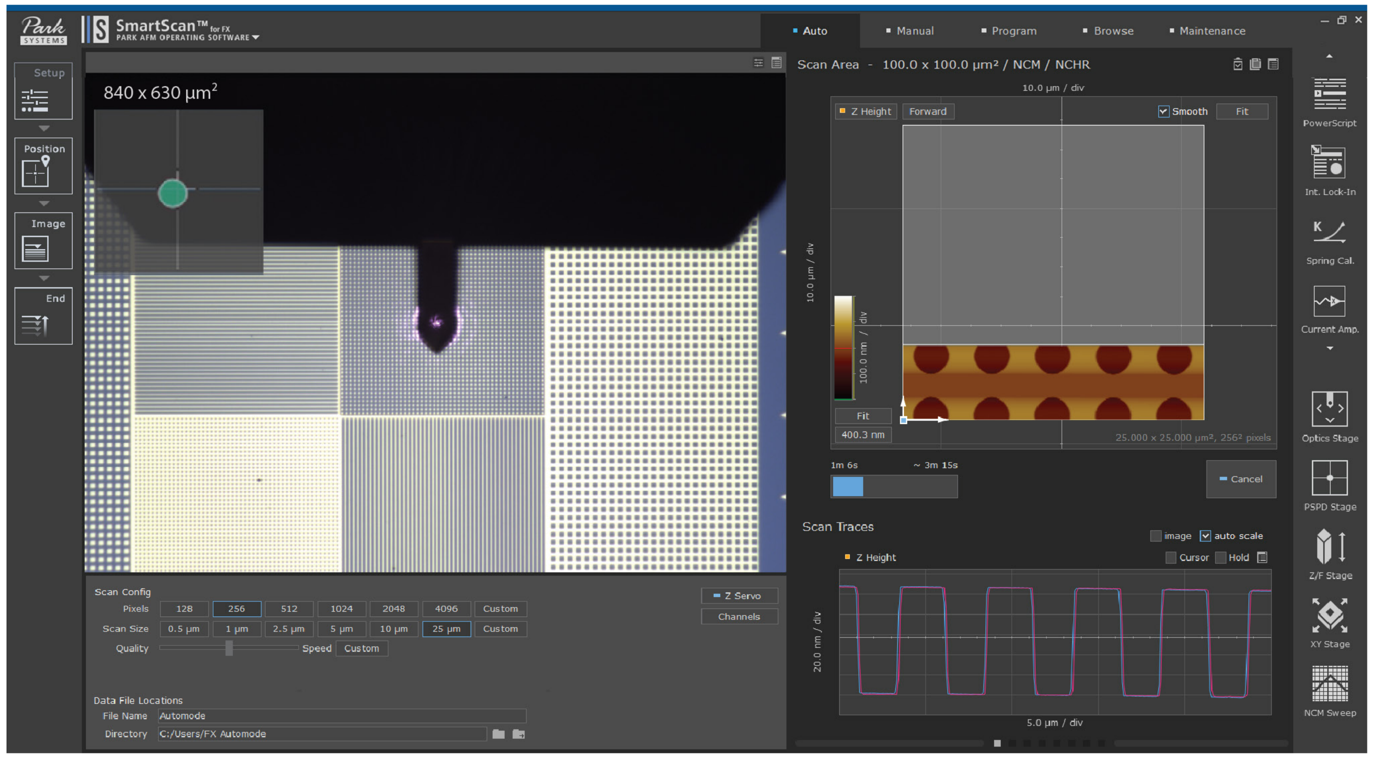
Mold for Nanoimprint



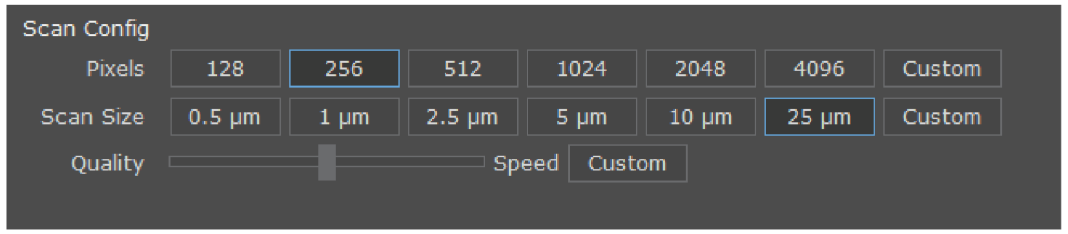
Park SmartScan™

Bringing the Power and Versatility of AFM Technology to Everyone

FX200 comes with Park SmartScan™, an advanced AFM operating software that simplifies image acquisition and enhances usability with its intuitive interface and powerful automation features.



In conventional AFM systems, users must manually adjust numerous parameters, such as Z servo gains, force set point, and XY scan speed, often through trial and error. SmartScan eliminates this complexity by allowing users to choose only three parameters: pixel density, scan size, and quality vs. speed preference. Then, all other settings are automatically optimized in real time by analyzing sample geometry and obtaining the best possible AFM images. SmartScan reduces the operational burden and makes high-quality imaging accessible to users of all experience levels.

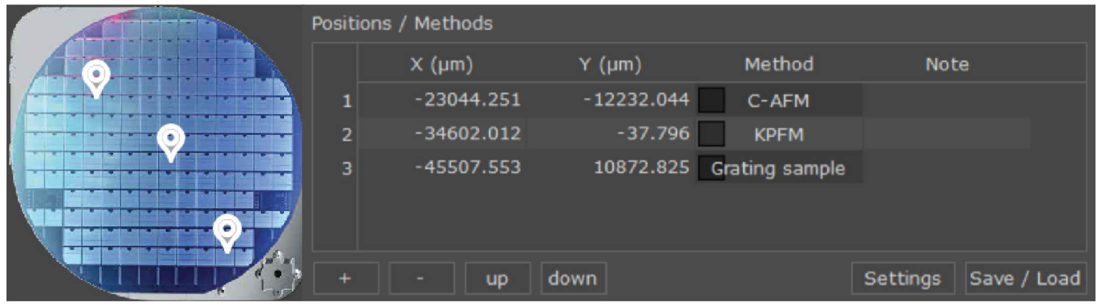


Scan Config

Pixels	128	256	512	1024	2048	4096	Custom
Scan Size	0.5 µm	1 µm	2.5 µm	5 µm	10 µm	25 µm	Custom
Quality			Speed	Custom			

StepScan™

StepScan™ allows users to select multiple points on the macro sample image, assign specific scan recipes to each location, and automatically carry out sequential measurements.



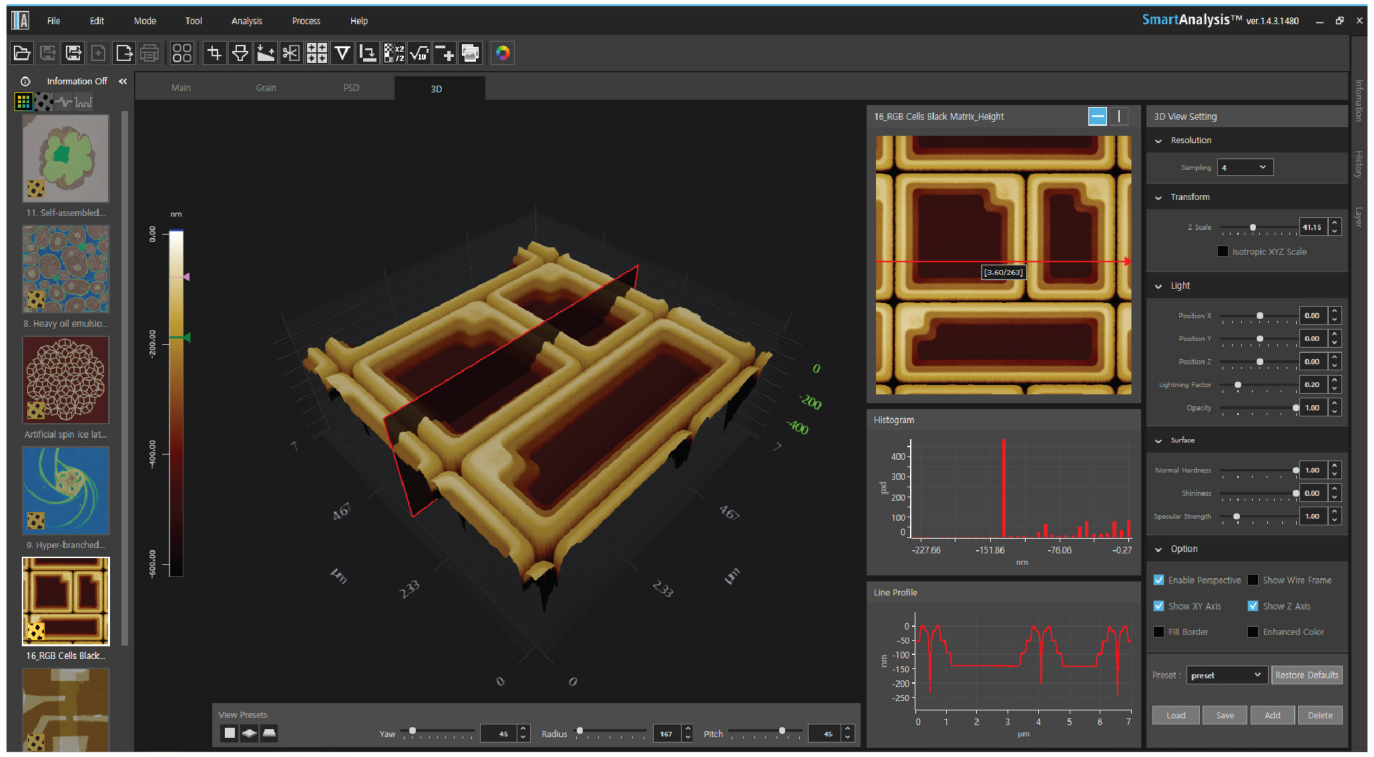
Positions / Methods

	X (µm)	Y (µm)	Method	Note
1	-23044.251	-12232.044	C-AFM	
2	-34602.012	-37.796	KPFM	
3	-45507.553	10872.825	Grating sample	

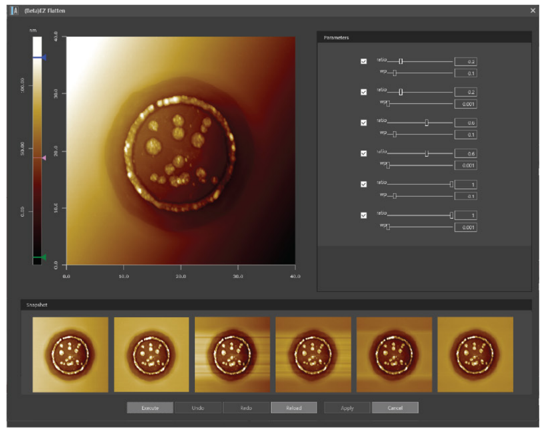
Park SmartAnalysis™

Streamlining AFM Data Workflow

Scan data from the FX200 can be analyzed with Park SmartAnalysis™, a powerful AFM image analysis software that enables fast image processing, comprehensive data analysis, and efficient result publication.



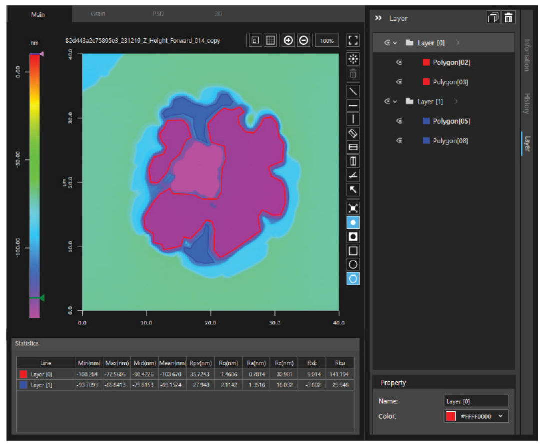
Through Silicon Via (TSV) - Cu pad Topography
Postprocessed with EZ Flatten



EZ Flatten

Postprocessing AFM data to correct artifacts such as noise, sample tilt, and surface irregularities is a manual, tedious, and time-consuming task. SmartAnalysis simplifies this process through the EZ Flatten function. With six automatically flattened results using different flattening parameter sets, users can choose the version that most accurately represents the data.

Self-assembled Block Copolymer Topography
Multiple Areas of Interest Assigned



Multilayer Analysis

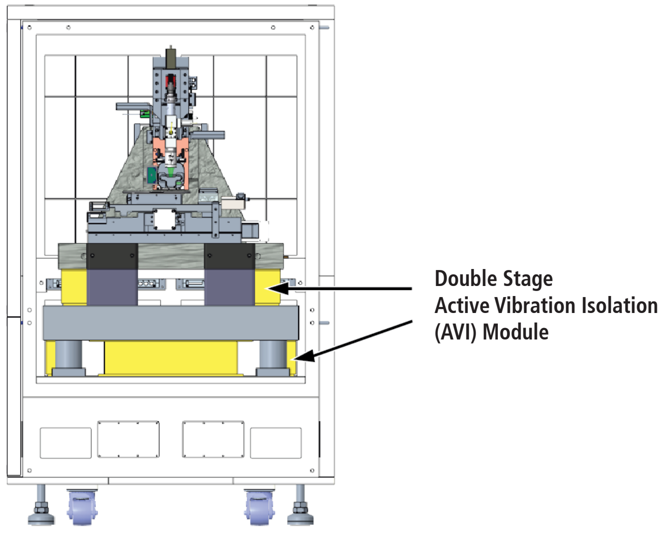
Users can analyze and compare multiple areas of interest at once using a polygonal freeform area drawing tool. Unlike conventional AFM data analysis software that allows inspection of one region at a time, SmartAnalysis provides various metrics for all selected areas simultaneously.

Park FX200

Additional Features

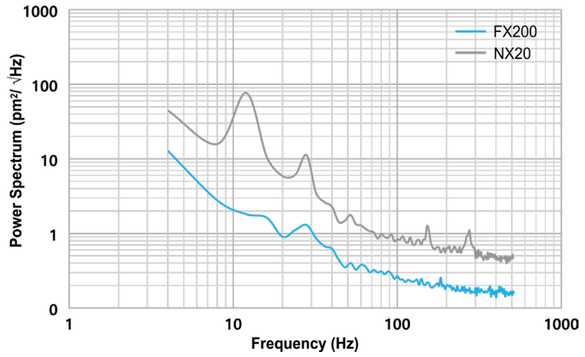
Upgraded Vibration Isolation & Acoustic Enclosure

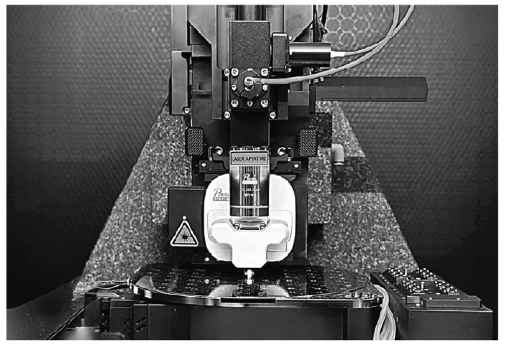
FX200 is equipped with an upgraded vibration isolation system and a redesigned acoustic enclosure. The double-layer modulator isolation elements and reinforced base frame significantly minimize the noise floor.



Combined with the advanced mechanical design of the FX series, the FX200 delivers substantially lower noise levels than its last generation counterpart, Park NX20.

Noise Floor Comparison between FX200 and NX20



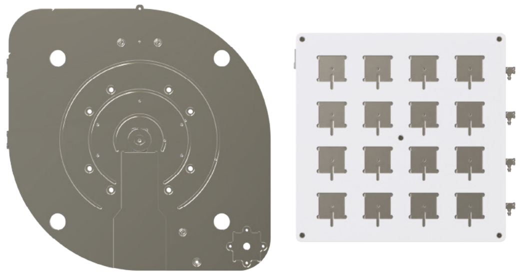


Live Monitoring Camera

The live monitoring camera is attached to the acoustic enclosure door to allow users to observe inside the enclosure in real time, even when the acoustic enclosure door is closed.

Sample Chuck Options

Two sample chuck options are available: a wafer sample chuck for wafers up to 200 mm in diameter and a multi-sample chuck for up to 16 coupon-sized samples. Both options provide vacuum chuck systems for secure sample positioning.



FX AFM Controller

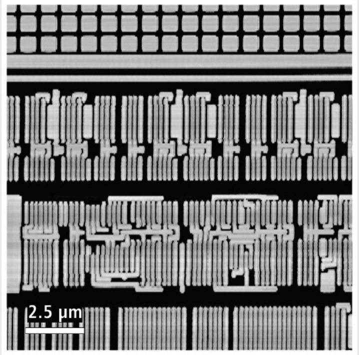
The FX AFM controller offers high-speed control via 1 Gbps communication with the PC, enhancing precision by eliminating communication lags. The 8-channel lock-in amplifier enables capturing images with multiple properties in a single scan. The 5 MHz bandwidth for tip bias modulation expands versatility in advanced mode measurements, such as contact resonance PFM and heterodyne KPFM, without attaching extra modules. In addition, the FX controller supports an AFM head crash prevention feature for safe measurements.

Park FX200

Designed for Your Applications

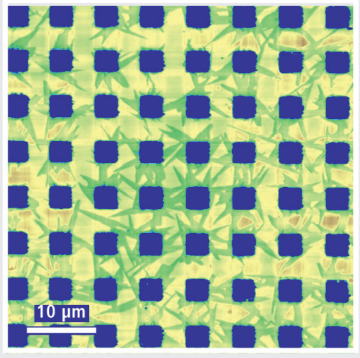
FX200 offers precise measurements for a wide range of research and industrial applications, from small samples to full 200 mm wafers.

Semiconductor



Patterned Si Device

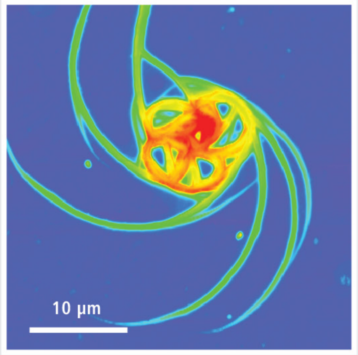
A patterned silicon (Si) device was measured in True Non-contact™ mode to acquire surface topography. The scan data revealed a peak-to-valley height difference of 40.2nm, and the image shows the width and depth of the patterned Si device.



Cu Pad

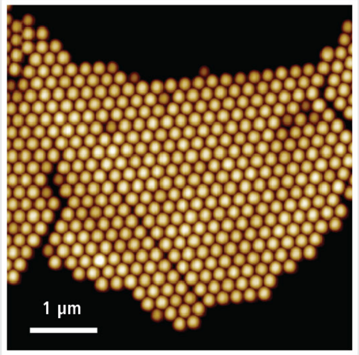
A copper (Cu) pad was scanned using True Non-contact™ to acquire surface topography. The scan data revealed a peak-to-valley height difference of 99 nm, and the image shows fine surface roughness and structural features of the Cu pad.

Polymer



Hyper-branched Polymer

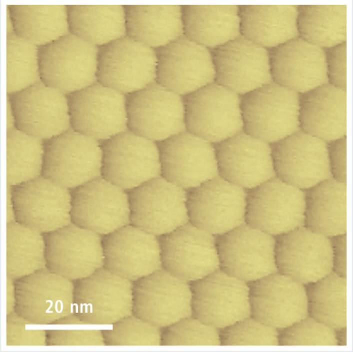
A hyper-branched polymer sample was scanned using True Non-contact™ mode to acquire surface topography. The scan image shows the 3D morphology of the macromolecules with their branched architecture.



Polystyrene Beads on Mica

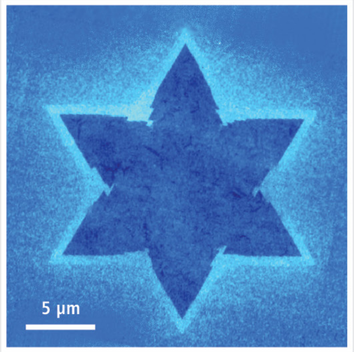
Polystyrene (PS) beads on mica were imaged in True Non-contact™ mode to obtain surface topography. The scan image revealed the nanoscale spherical morphology of the 203 nm-diameter beads distributed on the mica substrate.

2D material



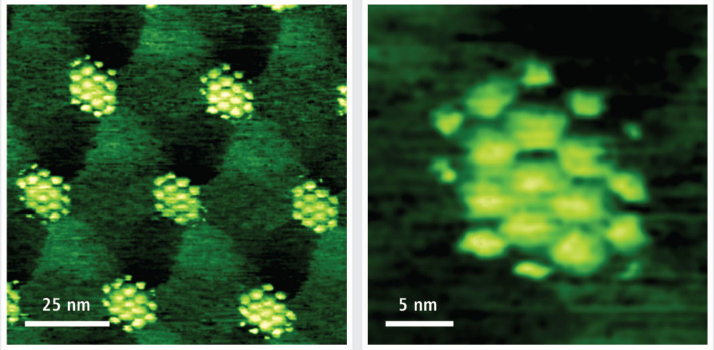
tBG on hBN

A twisted bilayer graphene (tBG) on hexagonal boron nitride (hBN) sample was imaged using C-AFM mode to obtain local current contrast. The scan image revealed moiré patterns of the sample at the nanoscale.



$MoSe_2$ on WSe_2 Heterostructure

A molybdenum diselenide ($MoSe_2$) on tungsten diselenide (WSe_2) heterostructure was imaged using KPFM mode to acquire surface potential contrast. The scan image revealed the surface potential distribution across the $MoSe_2$/WSe_2 heterostructure.



Moiré Superlattices of tBG on hBN

A twisted bilayer graphene (tBG) on hexagonalboron nitride (hBN) sample was imaged using C-AFM to acquire local current contrast. The scan image revealed dual moiré superlattices resulting from the interference between the moiré patterns of tBG and hBN.

Park FX200

Technical Specifications

AFM Modes

- Topographic Imaging
  - Contact Mode
    - Constant Height Mode
    - Constant Force Mode
    - Fast imaging Contact Mode (FiCM) *
  - True Non-ContactTM Mode
  - Tapping Mode
  - PinPoint^{TM} Mode
  - Fast PinPoint^{TM} Mode
- Mechanical Properties
  - PinPoint^{TM} Nanomechanical Mode
  - Fast PinPoint^{TM} Nanomechanical Mode
  - Force-Distance (F-D) Spectroscopy
  - Nanoindentation
  - Force Modulation Microscopy (FMM)
  - Dynamic Mechanical Analysis (DMA) **
  - Torsional Force Microscopy (TFM) *
  - Lateral Force Microscopy (LFM)
- Electrical Properties
  - Conductive AFM (C-AFM)*
    - Current-Voltage (I-V) Spectroscopy
    - Photocurrent Mapping (PCM)
  - Scanning Spreading Resistance Microscopy (SSRM) *
  - Scanning Capacitance Microscopy (SCM) *
  - Piezoresponse Force Microscopy (PFM)
    - Piezoreseponse Spectroscopy
    - Off-resonance PFM
    - Contact Resonance PFM (CR-PFM)
    - Dual Frequency Resonance Tracking PFM (DFRT-PFM) **
  - PinPoint^{TM} Nanoelectrical Modes *
  - Electrostatic Force Microscopy (EFM)
  - Kelvin Probe Force Microscopy (KPFM)
    - Heterodyne KPFM
    - Sideband KPFM
    - Amplitude Modulation KPFM (AM-KPFM)
  - Microwave Impedance Microscopy (MIM) *
- Magnetic Properties
  - Magnetic Force Microscopy (MFM)
    - Frequency Modulation MFM (FM-MFM)
    - Amplitude Modulation MFM (AM-MFM)
- AFM-IR
  - Photo-induced Force Microscopy (PiFM) **
- Thermal Properties
  - Scanning Thermal Microscopy (SThM) *
    - Temperature Mapping
    - Thermal Conductivity Mapping
- Nanolithography & Manipulation
  - Nanolithography *
  - Nanomachining *
- In-liquid Operation
  - In-liquid Topography *
  - Electrochemical AFM (EC-AFM) *

** Requires additional options*
*** Consult with Park Systems*

Scanner

- Dual-servo XY scanner (100 μm × 100 μm or 15 μm × 15 μm)
- Flexure-guided high-force Z scanner (15 μm or 30 μm)

Sample Mount

- Vacuum grooves for wafers (up to 200 mm)
- Up to 16 small samples with vacuum chuck (optional)

On-axis Optics

- Direct on-axis vision of sample surface and cantilever
- Field of view: 840 μm × 630 μm (w/ 10× objective lens)
- CCD: 5 M pixels

Sample View Camera

- Large field of view for 200 mm sample overview
- Resolution: 3,840 × 2,160 pixels

Stage

- XY stage: 300 mm × 200 mm
- Z stage: 22 mm

Automatic Tip Exchanger

- 16 pre-aligned probes with kinematic mount and QR code chip carrier

Dimension and Weight

- AE(Outer): 970 mm × 990 mm × 1530 mm
- Desk: 1,410 mm × 810 mm × 740 mm
- Total weight: 1,050 kg (AFM Body + AE)

Required Environment

- Required acoustic noise level: Below 65 dB
- Required floor vibration level: VC-D (6.25 μm/sec)
- Power: 1 kW (Maximum)

Park SYSTEMS
www.parksystems.com