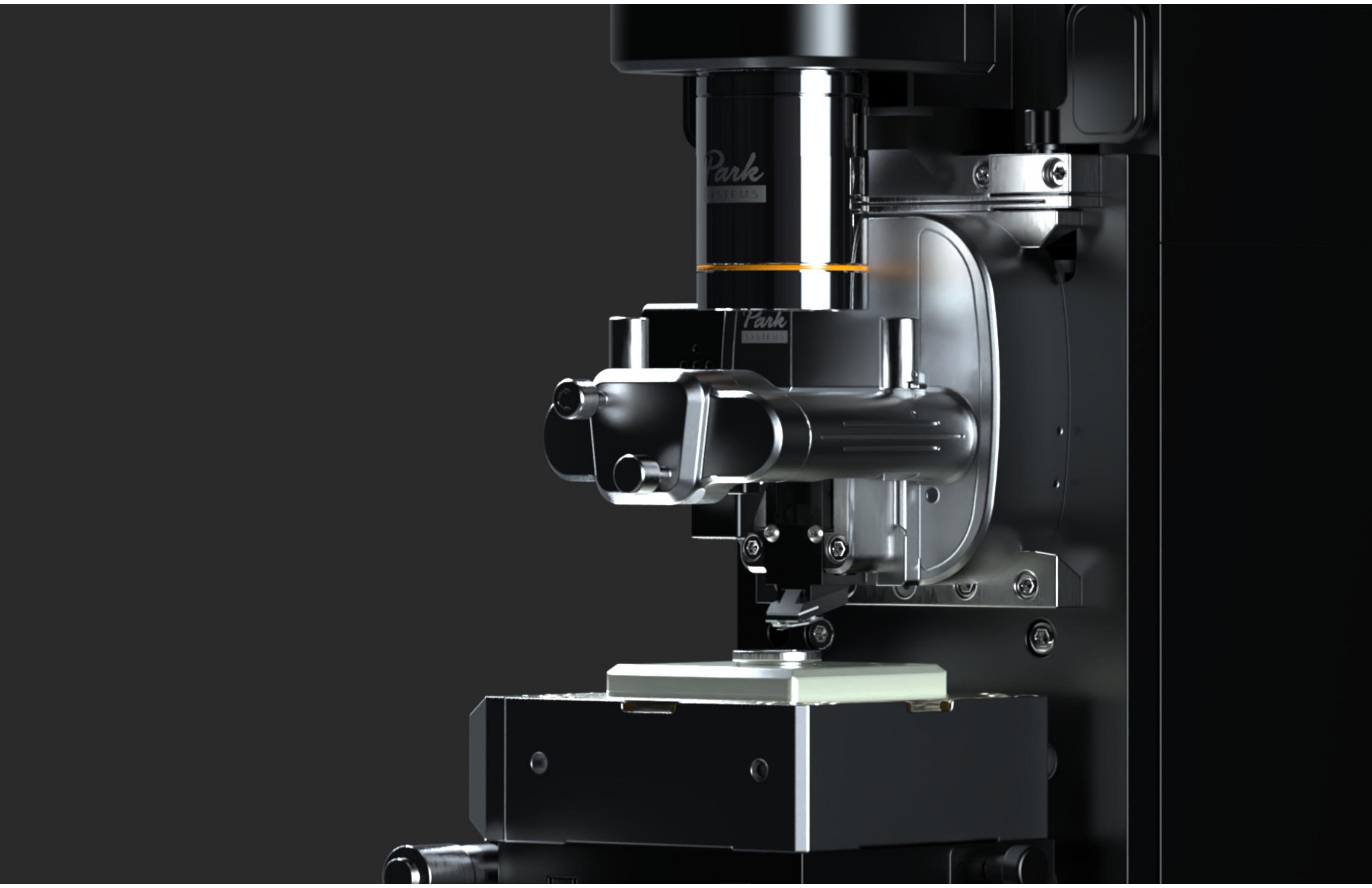
Park NX7

Accessible Nanometrology for Academic Research



Park SYSTEMS

Park NX7 is a compact atomic force microscope (AFM) designed for accessible nanoscale research. Its table-top format makes it especially suitable for educational environments and laboratories with limited space, while still delivering reliable high-resolution imaging.

At the core of NX7 are Park's proprietary orthogonal scan system and True Non-contact™ mode, innovations that virtually eliminate lateral motion artifacts while protecting both tip and sample. Together, these technologies ensure artifact-free, high-resolution imaging even for the most delicate or challenging samples.

From materials science to polymers and bioengineering, NX7 delivers robust performance and dependable results, making it a trusted platform for advanced nanoscale metrology.

NX7 – Key Features

Outstanding AFM Performance

- True Non-Contact™ Mode
- Orthogonal Scan System
- Fast Z-Servo Speed

User Convenience

- Easy Probe Exchange
- Intuitive Laser Beam Alignment

Additional Features

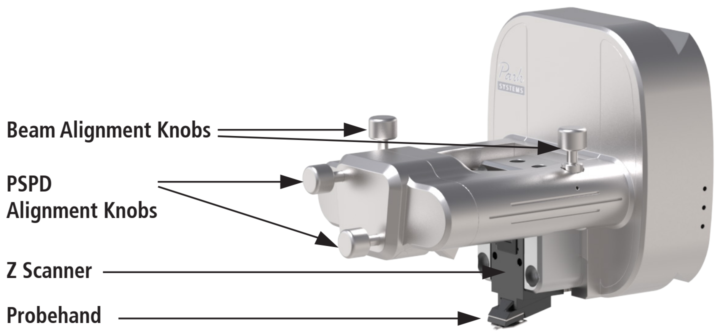
- Comprehensive Selection of AFM Modes
- Various Sample Holder Options

Park NX7

Next-Generation AFM for Small Sample

Fast Z Servo and High Resolution

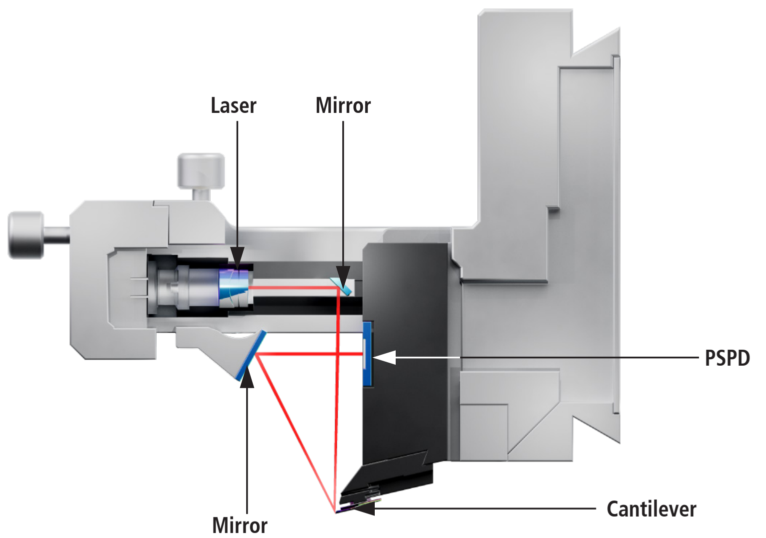
The resolution of the images in Park NX series has been further enhanced. The NX Z scanner, built with a stacked piezo actuator and a strain gauge sensor, delivers fast and precise measurements across a wide range of surfaces. From extremely flat to rough samples, it maintains consistent roughness linearity regardless of scan size, ensuring reliable results in any measurement.



NX Laser Beam Path

The NX head integrates a superluminescent diode that provides low coherence illumination, minimizing interference for stable signal detection. The laser beam is guided through precision mirrors to the cantilever and position-sensitive photodetector (PSPD), ensuring accurate signal alignment.

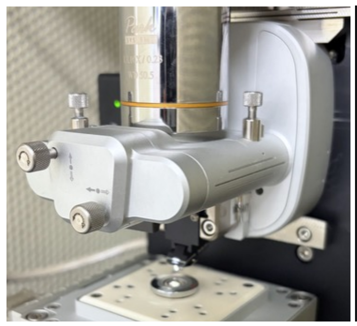
The knobs move the laser beam directly along the X and Y axes, allowing intuitive adjustment of the beam position and effortless realignment during probe replacement.



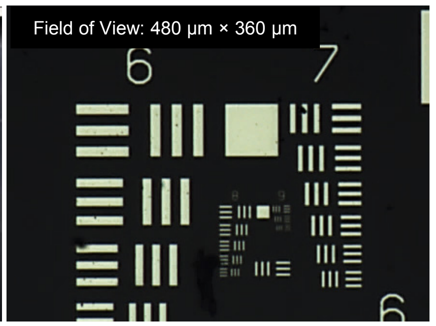
On-Axis Optical Microscope

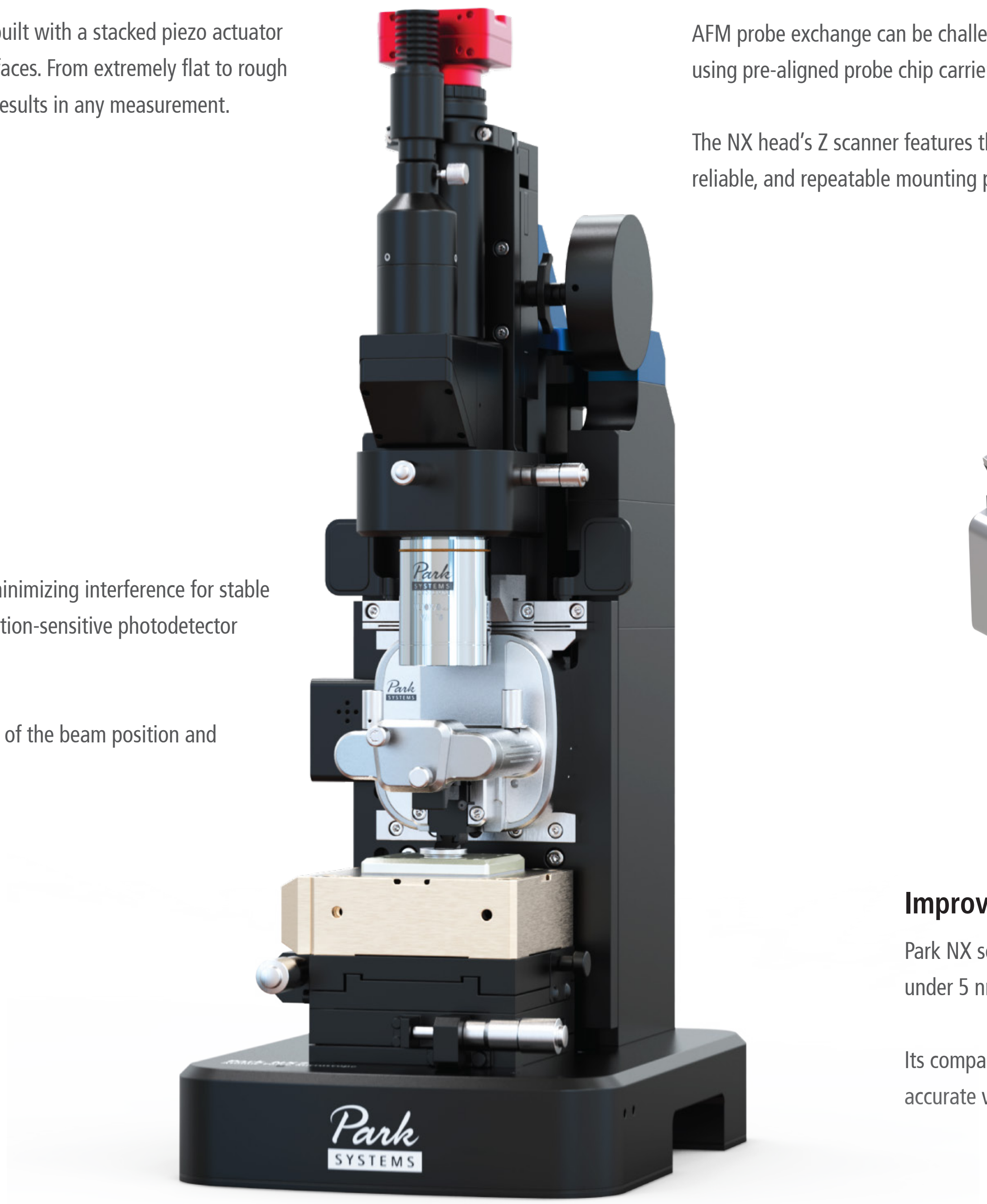
The high-power on-axis optical microscope provides a clear view of the sample surface. A software-controlled LED light source illuminates the sample surface for better observation.

On-Axis Optical Microscope



Vision from NX Optics



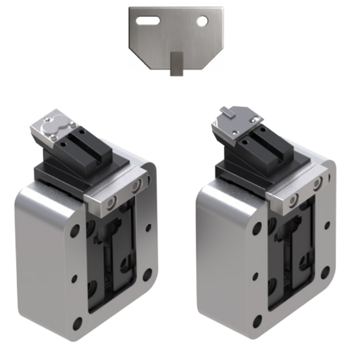


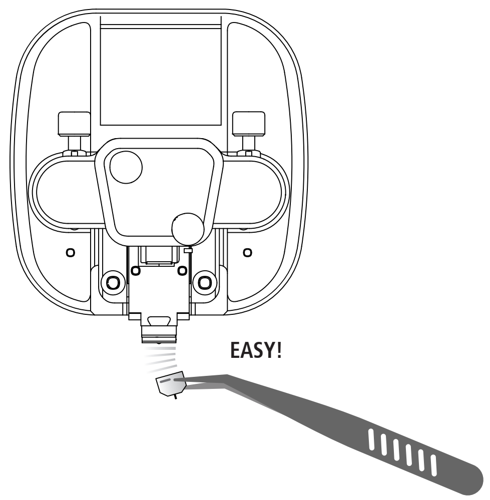
Pre-Mounted Probe

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

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

Probe Chip Carrier

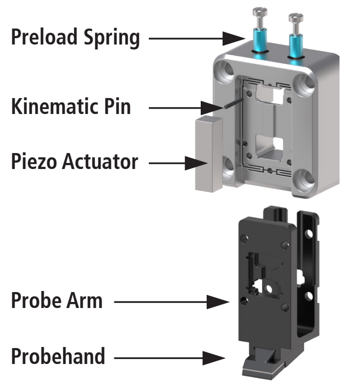




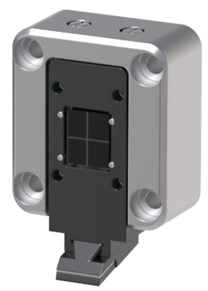
Improved Z Scan Straightness

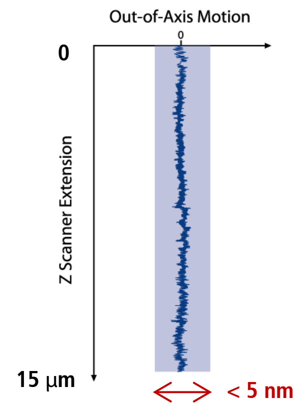
Park NX series Z scanner maintains straightness within 0.1% across the usable range, with out-of-axis motion under 5 nm even at a full 15 μm extension.

Its compact assembly, combining a preload spring, kinematic pin, and piezo actuator, minimizes drift and ensures accurate vertical motion for reliable, distortion-free nanoscale measurements.



Z Scanner Assembly



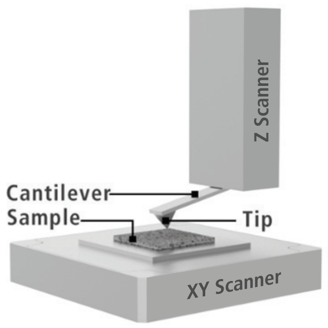


Park AFM Technology

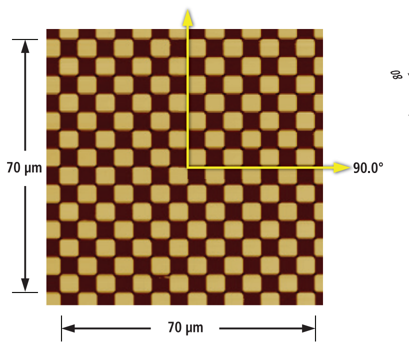
Orthogonal Scan

Conventional AFMs with tube scanners suffer from out-of-plane motion and axes crosstalk, resulting in image distortion, especially over large scan areas. NX7, 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.

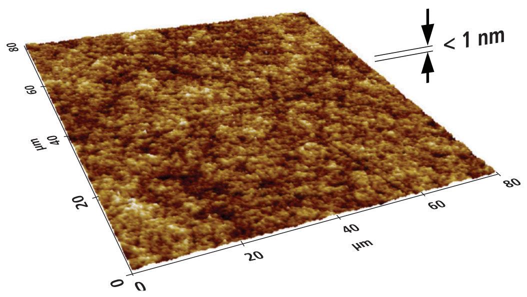
Equipped with low-noise optical sensors for XY feedback and an ultra-low-noise strain gauge sensor for Z control, this separated scanner system ensures highly orthogonal, linear scans with minimal out-of-plane motion and fast dynamic performance.



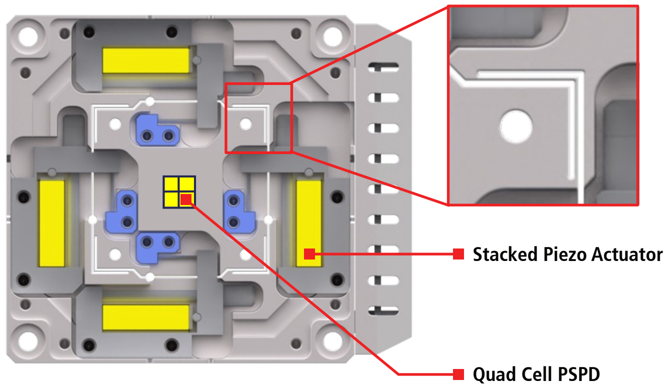
10 µm Pitch Calibration Grating



Optical Flat (80 × 80 µm)



Inside View of XY Scanner

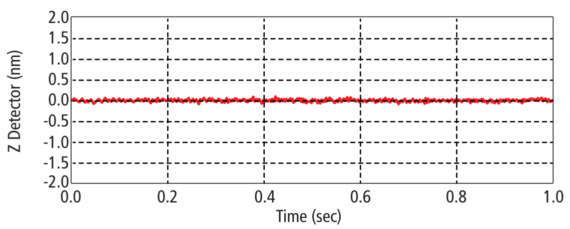


The XY scanner is designed to achieve flat, purely horizontal motion without vertical interference by using stacked piezo actuators and flexure hinge structures. A position sensor is located at the center of the scanner to provide direct feedback for servo control, minimizing positioning errors across the scan area. This design ensures consistent accuracy and stability, even when scanning large samples.

Low Z Detector Noise

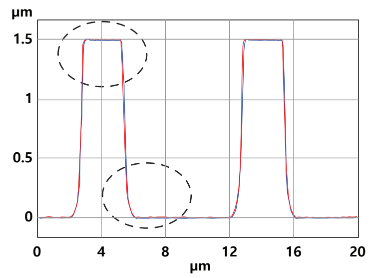
The Z detector has a noise level of less than 0.02 nm, enabling height measurements with sub-nanometer accuracy, down to 0.1 nm. Unlike conventional Z voltage mapping, which often overshoots at stiff walls, the Z detector provides precise, conformal surface tracing.

Z Detector Noise

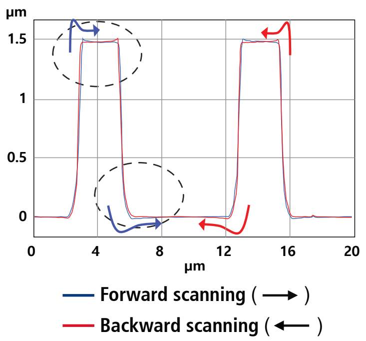


0.02 nm (rms), 1 kHz BW

Z Detector (Height)

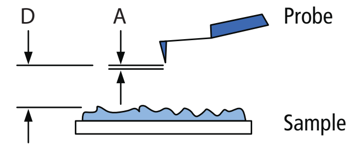


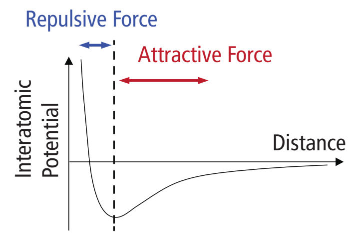
Z Voltage

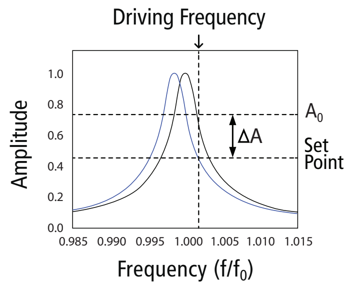


True Non-Contact™ Mode

NX7 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.





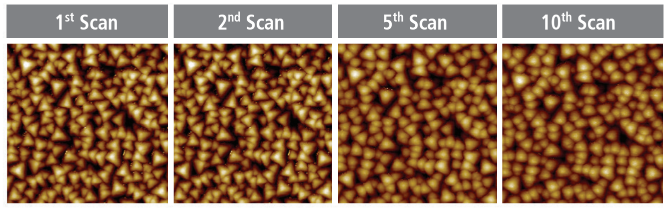


In True Non-contact mode, the tip oscillates at a frequency slightly higher than its resonance frequency, where the amplitude-frequency curve has its steepest slope.

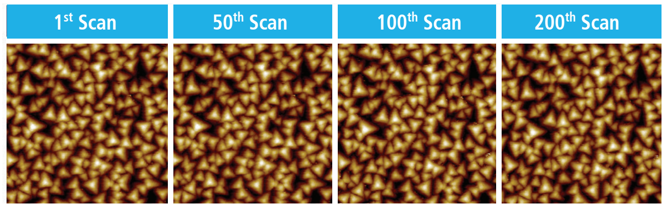
As the tip approaches the sample, the attractive force causes a downshift in the effective resonance frequency, leading to a decrease in oscillation amplitude at the driving frequency. The Z-servo maintains this new amplitude as the set point, keeping a constant tip-sample interaction while the tip scans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

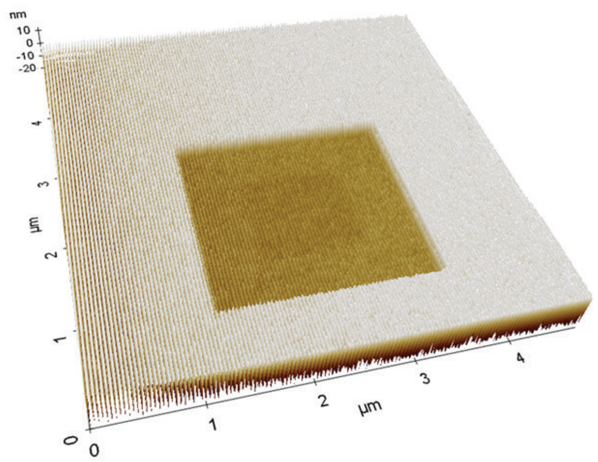


CrN Tip-checking Sample

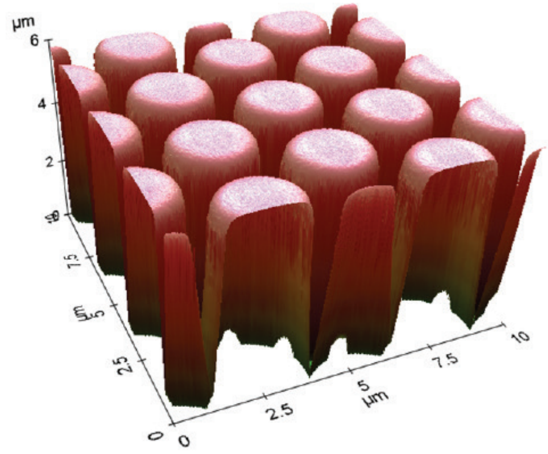
True Non-contact mode can measure soft and sticky samples as well as the most delicate and brittle samples, which cannot be imaged with tapping mode AFM. The image below is the topography of an unbaked photoresist acquired with True Non-contact mode, showing damages induced by electron beam irradiation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



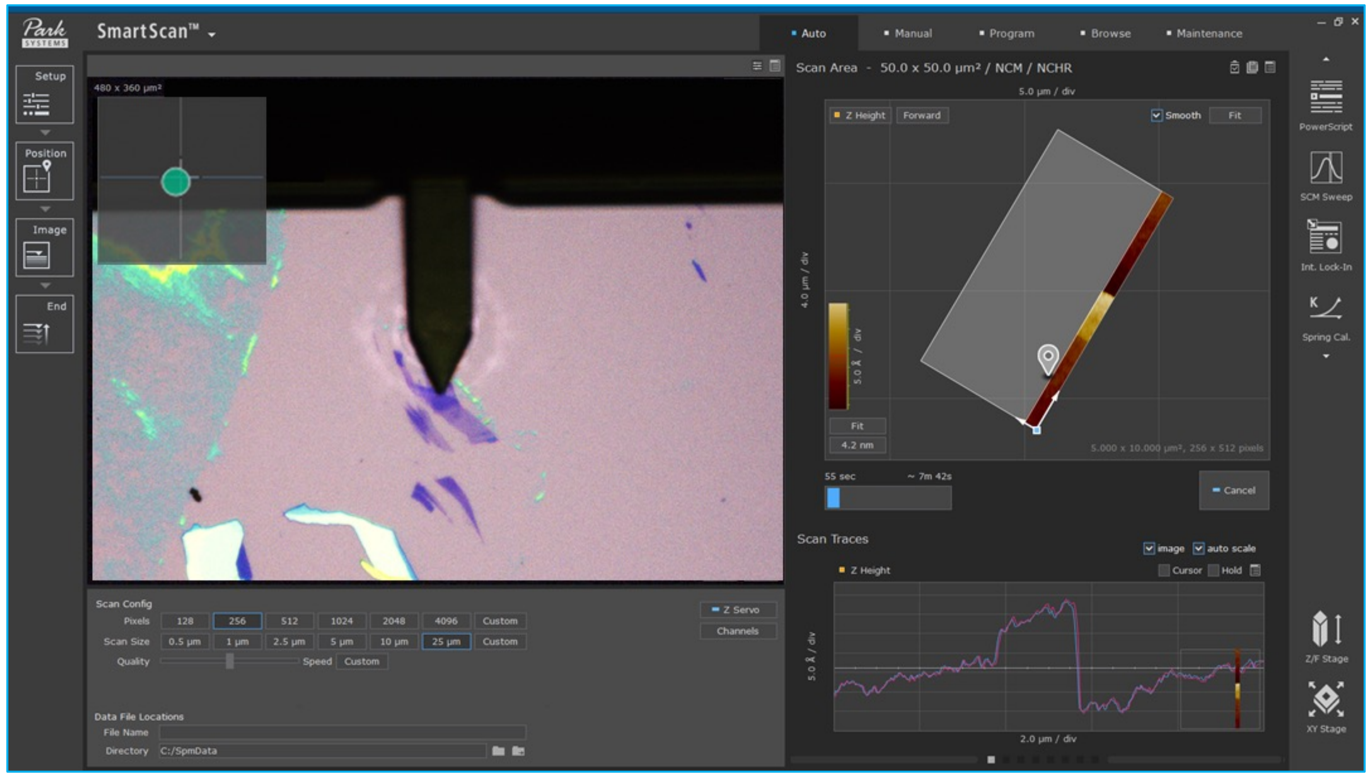
Mold for Nanoimprint



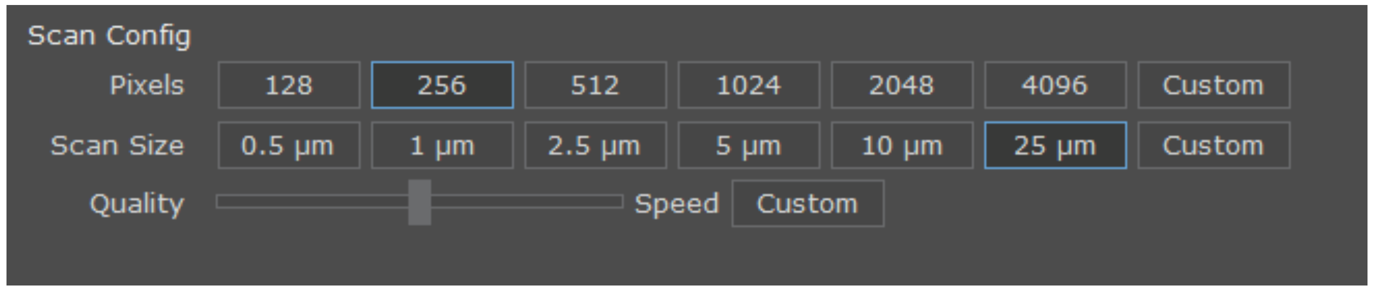
Park SmartScan™

Bringing the Power and Versatility of AFM Technology to Everyone

NX7 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 setpoint, 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.

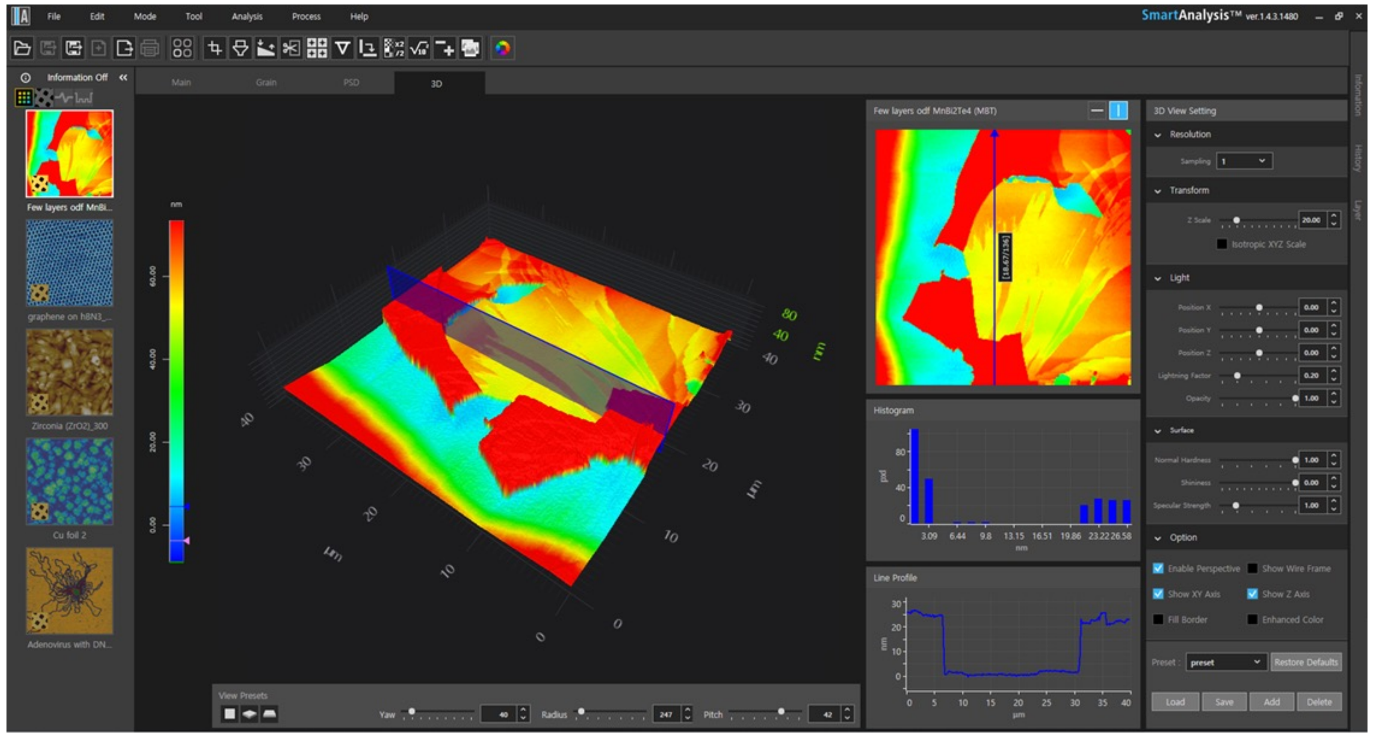


The Quality–Speed control in Auto Mode is powered by Park's AdaptiveScan™ technology, which intelligently adjusts the scan speed according to surface variations. It slows down in regions with large height differences and accelerates over flatter areas, maintaining a balance between image quality and measurement efficiency. This advanced control minimizes tip wear and image distortion while ensuring consistent imaging performance.

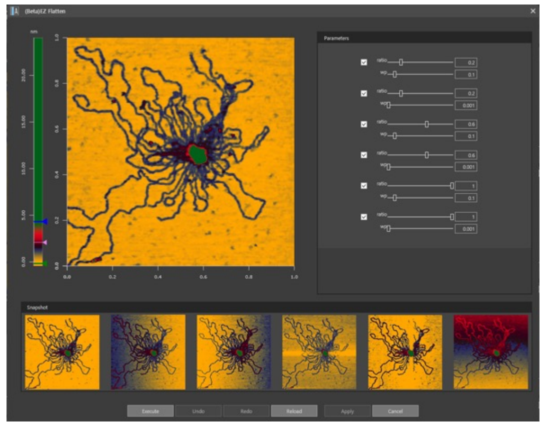
Park SmartAnalysis™

Streamlining AFM Data Workflow

Scan data from NX7 can be analyzed with Park SmartAnalysis™, a powerful AFM image analysis software that enables fast image processing, comprehensive data analysis, and efficient result publication.



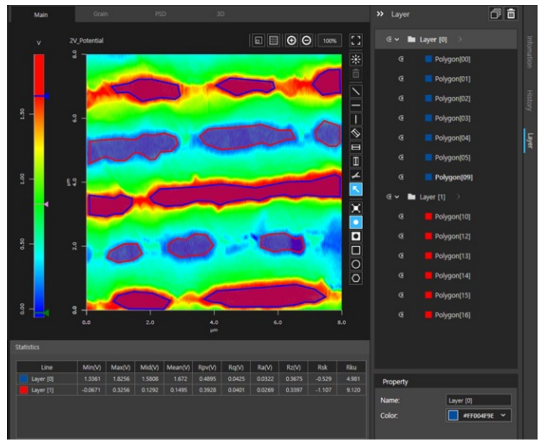
Adenovirus with DNA Bundle Topography
Postprocessed with EZ Flatten



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.

Multi-Layer Ceramic Capacitor Potential
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 NX7

Expanding Research Possibilities

Electrical Property Modes

NX7 supports advanced AFM modes beyond topography, including electrical property measurements. Heterodyne KPFM provides higher sensitivity and resolution for quantitative surface potential mapping, while Contact Resonance PFM improves piezoresponse detection with much clearer contrast compared to conventional PFM.

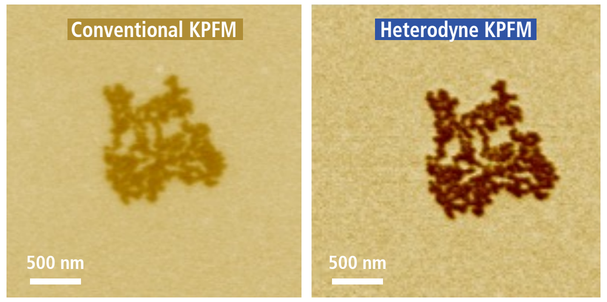
Heterodyne KPFM

Provides higher sensitivity and spatial resolution for quantitative surface potential measurements

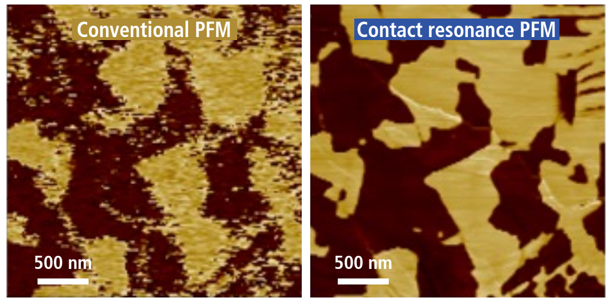
Contact Resonance PFM

Enhances piezoresponse detection with improved sensitivity at contact resonance

KPFM Surface Potential of $F_{14}H_{20}$



PFM Phase of PMN-PT



Mechanical Property Modes

For mechanical properties, NX7 offers Fast PinPoint™ for high-speed nanomechanical mapping, Dynamic Mechanical Analysis for nanoscale viscoelastic behavior, and Torsional Force Microscopy to study lateral interactions. These modes together expand AFM research capabilities well beyond imaging, supporting advanced studies across various materials.

Fast PinPoint™

Enables high-speed quantitative measurement of nanomechanical properties such as modulus and adhesion

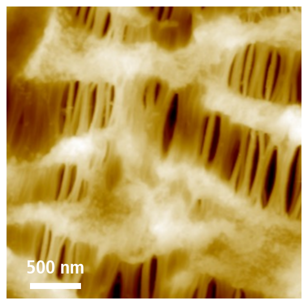
Dynamic Mechanical Analysis

Measures nanoscale viscoelastic behavior by applying dynamic excitation to the sample

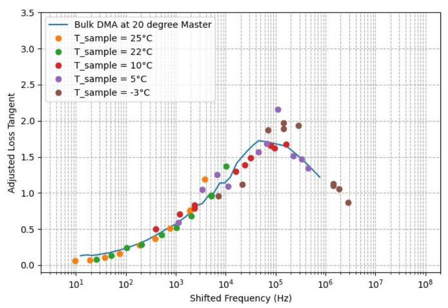
Torsional Force Microscopy

Analyzes lateral interactions by detecting the cantilever's torsional resonance response

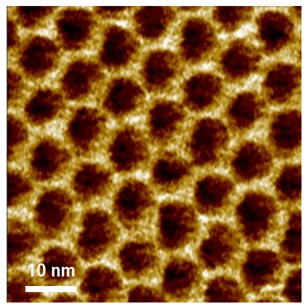
Height of Cell Guard



Loss Tangent Master Curve at 20°C

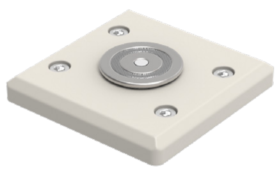


TFM Phase of tBG on hBN

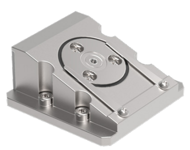


Sample Holder Options

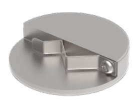
The magnetic sample holder allows quick and easy sample loading using metal disks, ensuring stable attachment across various sample types. NX7 supports multiple sample holder options, including a wedge-type sample holder for sidewall analysis, and a cross-sectional holder.



Magnetic Sample Holder



Wedge-Type Sample Holder



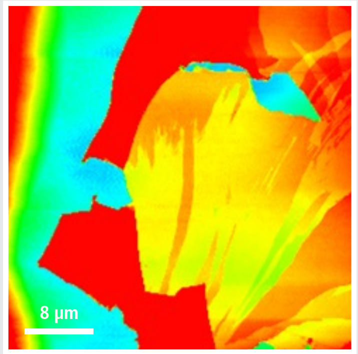
Cross-Sectional Sample Holder

Park NX7

Designed for Your Applications

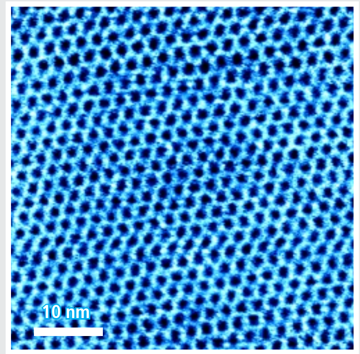
NX7 offers precise measurements for a wide range of academic and advanced research applications.

2D Materials



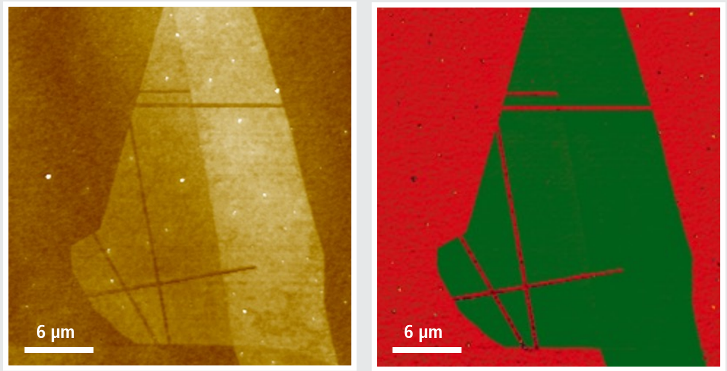
$MnBi_2Te_4$ (MBT)

Few-layer $MnBi_2Te_4$ (MBT), a material of interest in 2D materials research and topological insulators, was characterized in True Non-contact mode. The scan image reveals the layered surface topography with a peak-to-valley height of about 85.9 nm.



Graphene on hBN

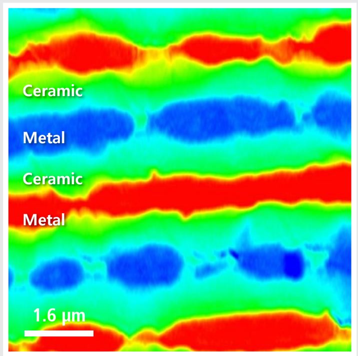
Graphene on hexagonal boron nitride (hBN), a widely studied 2D heterostructure, was characterized using Conductive AFM (C-AFM).
The current image reveals a Moiré pattern, with a peak-to-valley value of about 52.7 nA.



Cutting Graphene

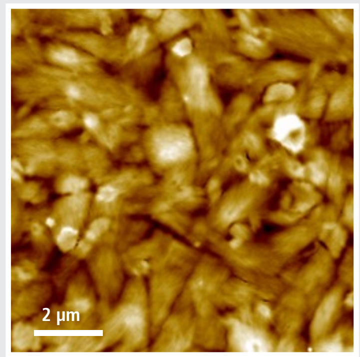
A graphene sample patterned by lithography was analyzed using Lateral Force Microscopy (LFM). The height image (left) and lateral image (right) show clear topographic and friction contrasts, corresponding to the regions patterned during the lithography process.

Metals & Ceramics



Multi-Layer Ceramic Capacitor (MLCC)

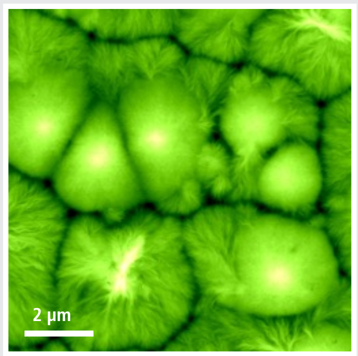
An MLCC is a multi-layer structure composed of alternating metal electrodes and ceramic dielectric layers. Using Kelvin Probe Force Microscopy (KPFM), the surface potential was observed under a 2 V bias applied between two metal electrodes, clearly revealing the voltage contrast across the capacitor structure.



Zirconia (ZrO_2)

Zirconia (ZrO_2), whose properties are strongly influenced by temperature, was characterized after heating to 300 °C using True Non-contact mode. The scan image reveals surface morphology changes with a peak-to-valley height of about 55.5 nm.

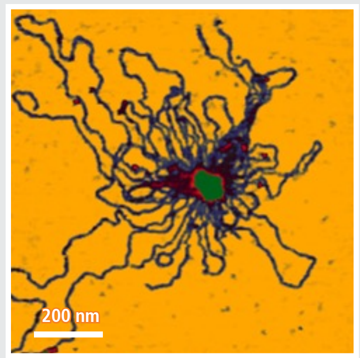
Polymers



Polyvinylidene Fluoride (PVDF)

The surface of PVDF beads dissolved by chloroform was imaged in True Non-contact mode. The scan image reveals nanoscale surface features with a peak-to-valley height of about 238.7 nm.

Biological Materials



Adenovirus with DNA Bundle

The adenovirus sample with a DNA bundle was characterized in True Non-contact mode. The scan image reveals the viral particle and associated DNA structures with a peak-to-valley height of about 24.5 nm.

Park NX7

Technical Specifications

AFM Modes

- Topographic Imaging
  - Contact Mode
    - Constant Height Mode
    - Constant Force Mode
  - True Non-Contact™ Mode
  - Tapping Mode
  - PinPoint™ Mode
  - Fast PinPoint™ Mode
- Mechanical Properties
  - PinPoint™ Nanomechanical Mode
  - Fast PinPoint™ 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 Tunneling Microscopy (STM) *
  - Scanning Capacitance Microscopy (SCM) *
  - Piezoresponse Force Microscopy (PFM)
    - Piezoresponse Spectroscopy
    - Off-resonance PFM
    - Contact Resonance PFM (CR-PFM) *
    - Dual Frequency Resonance Tracking PFM (DFRT-PFM) *
  - PinPoint™ 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)
- Nanolithography & Manipulation
  - Nanolithography *
  - Nanomachining *
- In-liquid Operation
  - In-liquid Topography *
- Electrochemical Properties
  - Electrochemical AFM (EC-AFM) *

Scanner

- XY scanner (50 µm × 50 µm, 100 µm × 100 µm or 10 µm × 10 µm)
- Flexure-guided high-force Z scanner (15 µm or 30 µm)

Sample Mount

- 50 mm x 50 mm (w × d), up to 23 mm thickness

On-axis Optics Microscope

- Direct on-axis vision of sample surface and cantilever
- Field of view: 480 µm × 360 µm (w/ 10× objective lens)
- CCD: 1.2 M Pixel
  5 M Pixel (optional)

Stage

- XY stage: 13 mm × 13 mm (Manual)
- Z stage: 26 mm (Motorized)
- Focus stage: 30 mm (Manual)

Dimension and Weight

- Table-top AE (Outer): 510 mm × 715 mm × 630 mm
- System Granite Table: 800 mm × 700 mm × 590 mm
- Desk: 1,410 mm × 810 mm × 740 mm
- Total weight: 223 kg (AFM Body + AE + Granite Table)

Required Environment

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

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

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