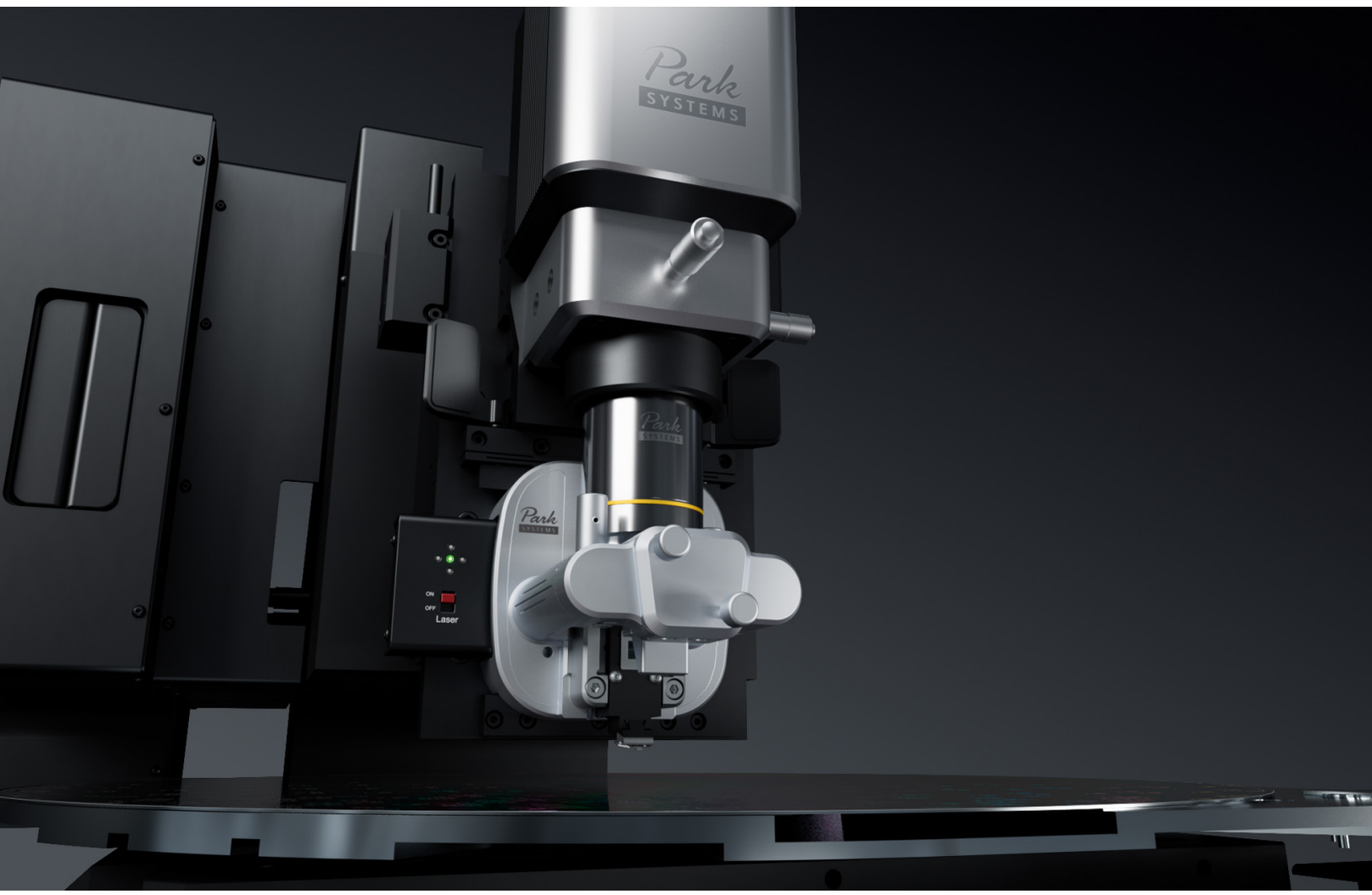
Park NX20 300 mm

The Leading Nanometrology Tool Bridging Research and Industry



Park
SYSTEMS

Park NX20 300 mm is an atomic force microscope (AFM) designed for large-sample research and 300 mm wafer failure analysis, making it a key platform for industrial R&D. As Park Systems' original 300 mm sample AFM, it delivers precise and repeatable nanoscale measurements and is also widely used in academia. Building on these strengths, NX20 300 mm serves as a bridge for facilities transitioning from research-scale AFM to inline production.

At the core of the NX20 300 mm are Park Systems' 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 and semiconductors to polymers and bioengineering, the NX20 300 mm delivers robust performance and dependable results, making it a trusted platform for advanced nanoscale metrology.

NX20 300 mm – Key Features

Outstanding AFM Performance

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

User Convenience

- Easy Probe Exchange
- Intuitive Laser Beam Alignment
- Recipe-Based Sequential Measurement

Additional Features

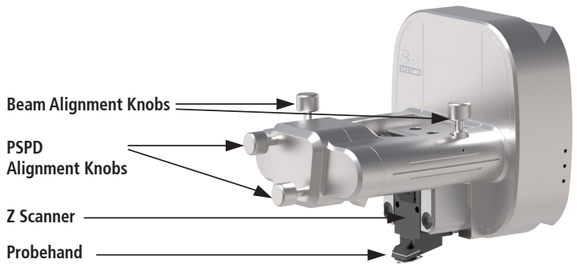
- Comprehensive Selection of AFM Modes
- Various Sample Chuck Options

Park NX20 300 mm

Next-Generation AFM for Large Samples

Fast Z Servo and High Resolution

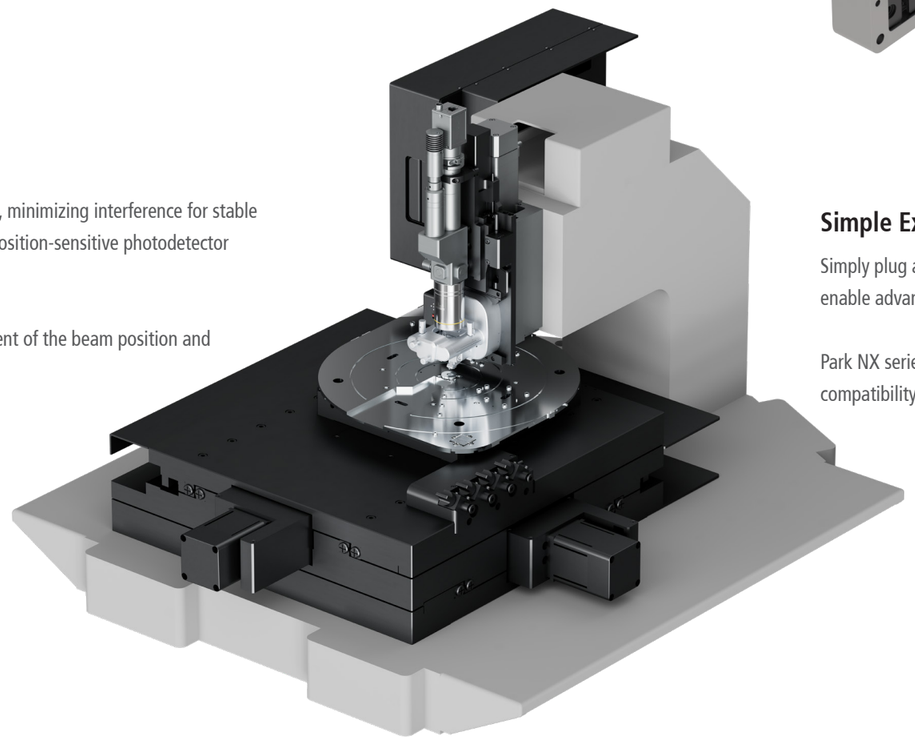
The resolution of the images in Park NX series has been further enhanced. The NX Z scanner, built with a stacked piezo actuator and a strain gauge sensor, delivers fast and precise measurements across a wide range of surfaces. From extremely flat to rough samples, it maintains consistent roughness linearity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

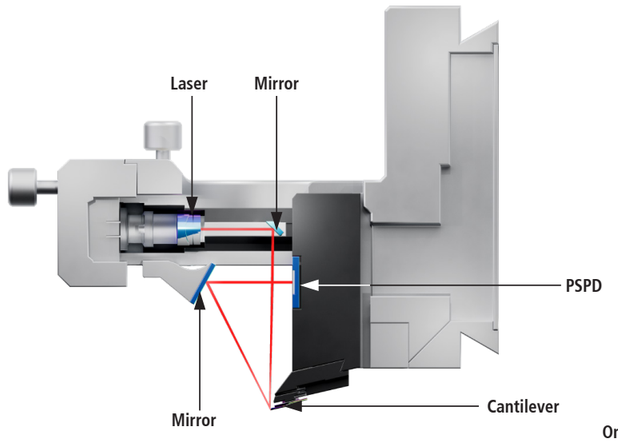


NX Laser Beam Path

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.

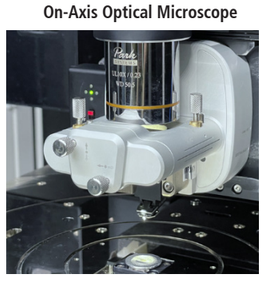




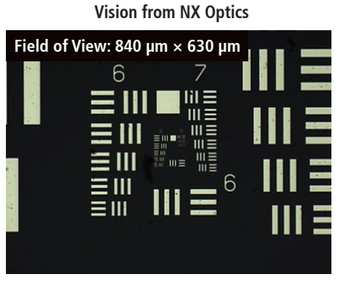
On-Axis Optical Microscope

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



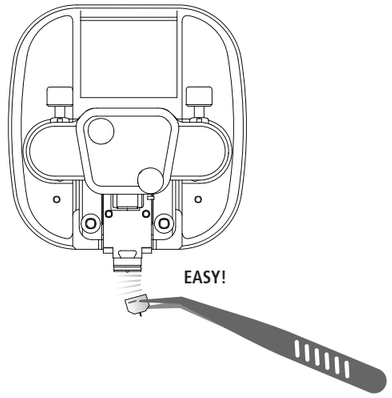
Vision from NX Optics



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.



Simple Expansion Slot for Modes and Options

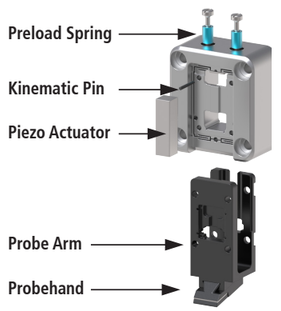
Simply plug an option module into the expansion slot to enable advanced AFM modes.

Park NX series AFM features a modular design, ensuring compatibility with options across its product line.

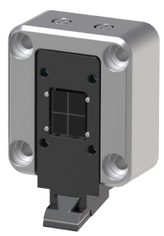
Improved Z Scan Straightness

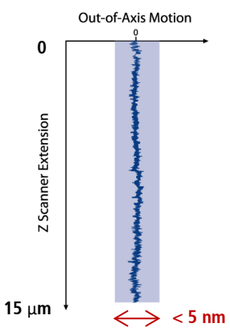
Park NX series Z scanner maintains straightness within 0.1% across the usable range, with out-of-axis motion under 5 nm even at a full 15 µm extension.

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

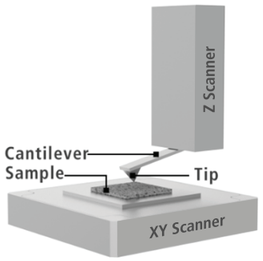




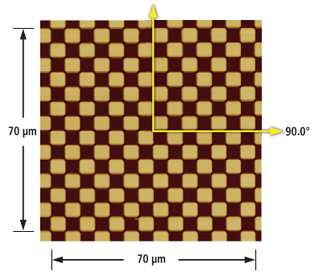
Park AFM Technology

Orthogonal Scan

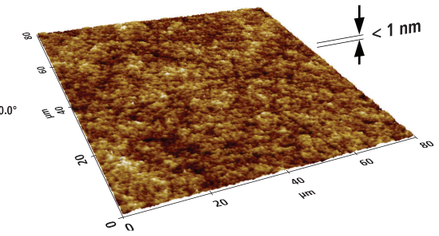
Conventional AFMs with tube scanners suffer from out-of-plane motion and axes crosstalk, resulting in image distortion, especially over large scan areas. NX20 300 mm, like all Park AFMs, employs an advanced orthogonal scan system featuring a flexure-guided architecture: a 2D flexure scanner moves the 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.

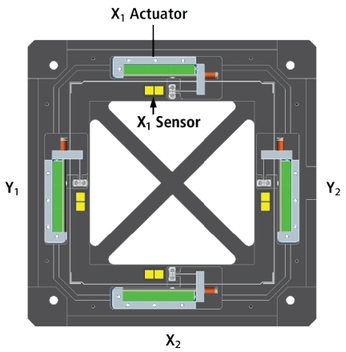


10 µm Pitch Calibration Grating



Optical Flat (80 × 80 µm)





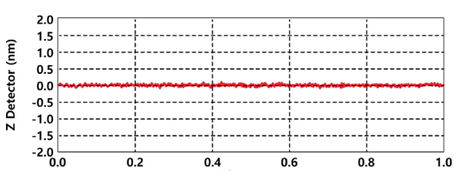
For large samples, a single-servo XY scan system is not sufficient, as rotational motion of the sample chuck can introduce positioning errors that increase with distance from the position sensor.

In the NX20 300 mm, the XY scanner features a dual-servo system, with pairs of actuators and position sensors placed on opposite sides of each axis. All four actuators are independently controlled to ensure accurate positioning across the entire 300 × 300 mm sample area.

Low Z Detector Noise

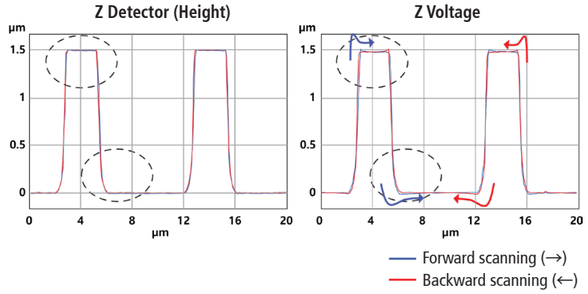
The Z detector has a noise level of less than 0.02 nm, enabling height measurements with sub-nanometer accuracy, down to 0.1 nm.
Unlike conventional Z voltage mapping, which often overshoots at stiff walls, the Z detector provides precise, conformal surface tracing.

Z Detector Noise



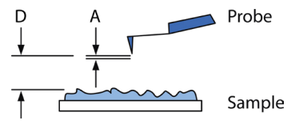
0.02 nm (rms), 1 kHz BW

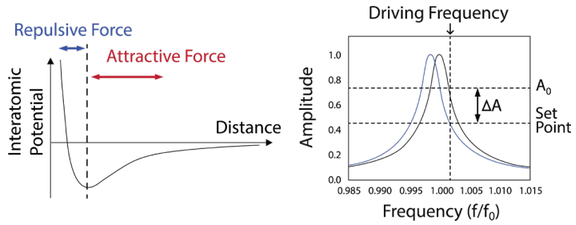
Z Detector (Height) / Z Voltage



True Non-Contact™ Mode

NX20 300 mm 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.



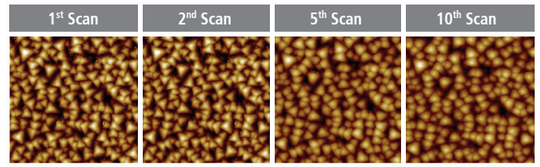


In True Non-contact mode, the tip oscillates at a frequency slightly higher than its resonance frequency, where the amplitude-frequency curve has its steepest slope.

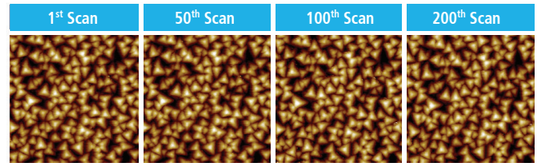
As the tip approaches the sample, the attractive force causes a downshift in the effective resonance frequency, leading to a decrease in oscillation amplitude at the driving frequency. The Z-servo maintains this new amplitude as the set point, keeping a constant tip-sample interaction while the tip scans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



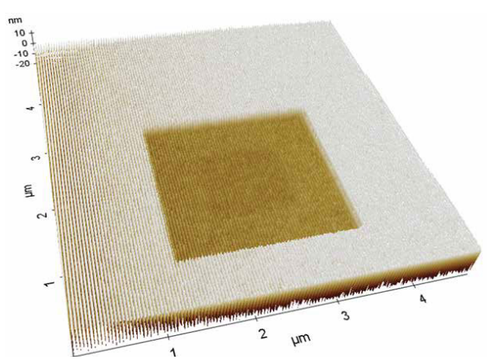
True Non-Contact Mode



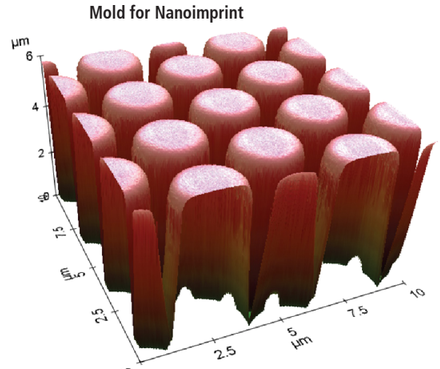
True Non-contact mode can measure soft and sticky samples as well as the most delicate and brittle samples, which cannot be imaged with tapping mode AFM. The image below is the topography of an unbaked photoresist acquired with True Non-contact mode, showing damages induced by electron beam irradiation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



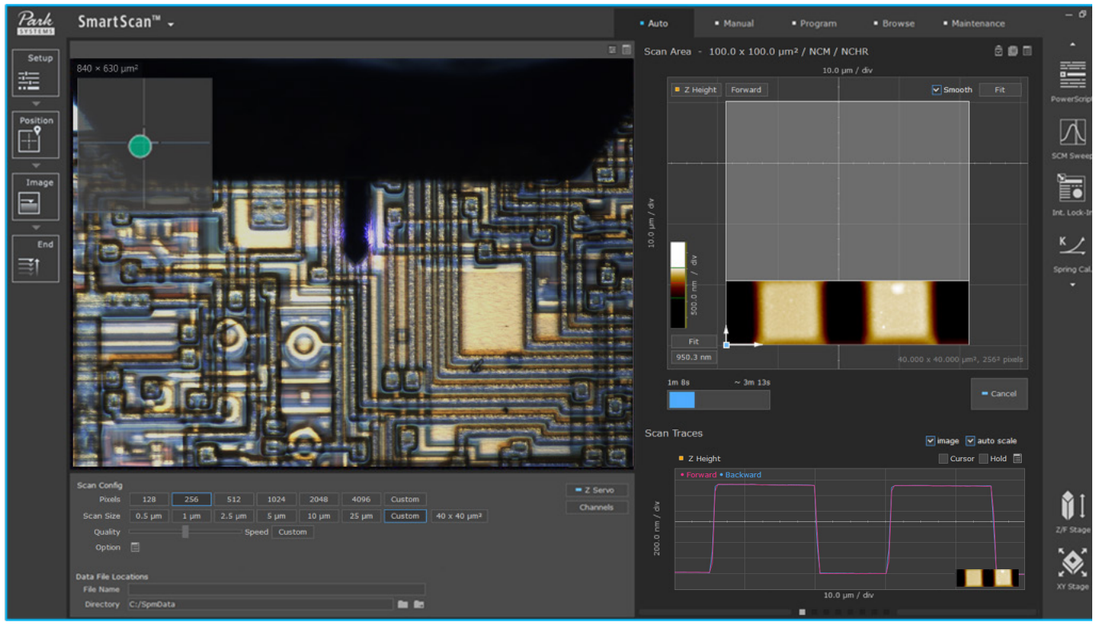
Mold for Nanoimprint



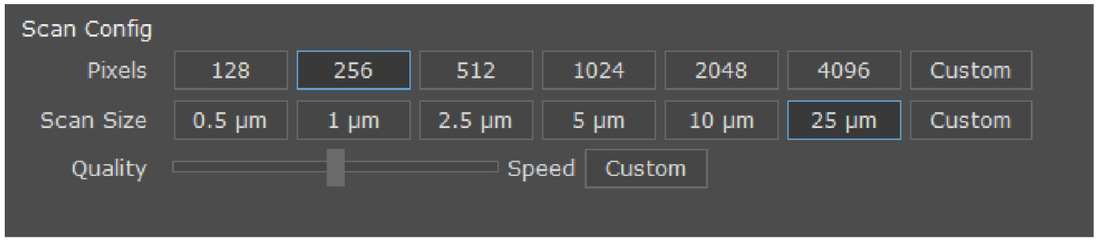
Park SmartScan™

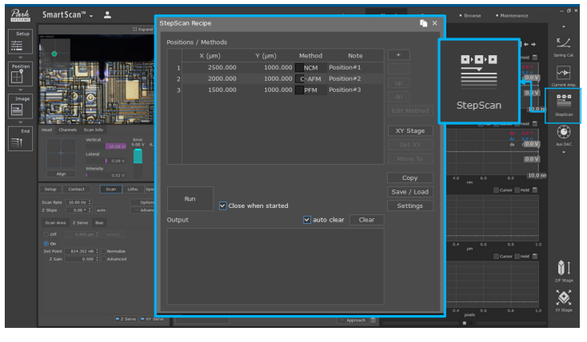
Bringing the Power and Versatility of AFM Technology to Everyone

NX20 300 mm 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.





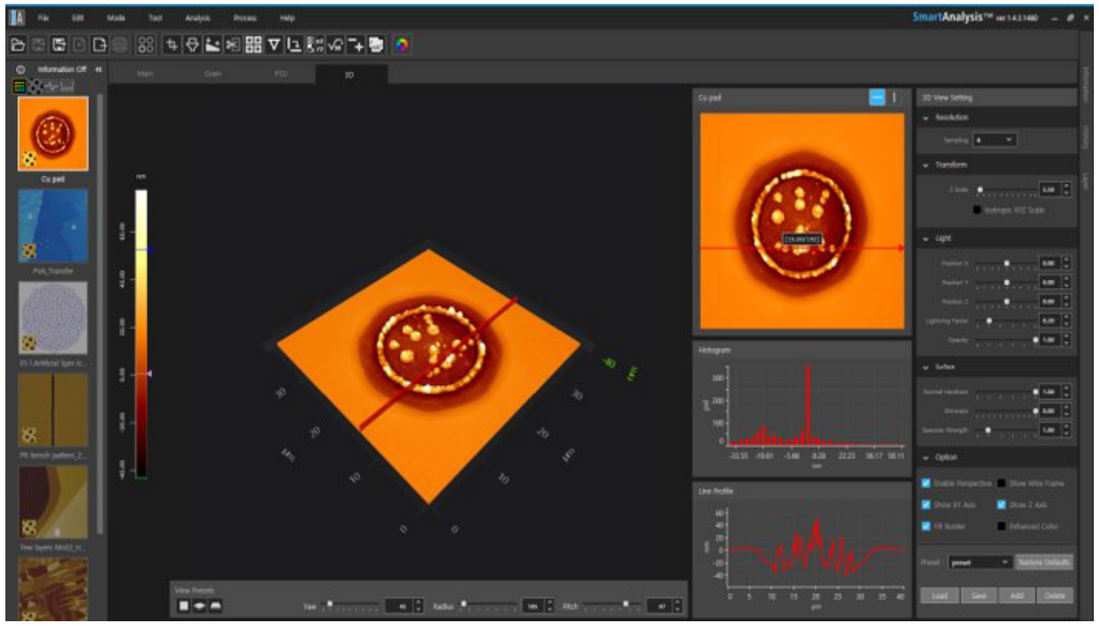
StepScan™

StepScan™ is an advanced Park SmartScan™ feature to pre-define measurement locations and recipes for efficient and consistent data acquisition.

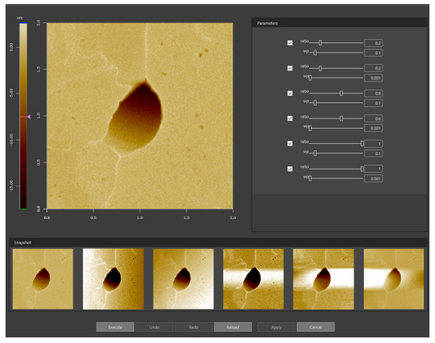
Park SmartAnalysis™

Streamlining AFM Data Workflow

Scan data from NX20 300 mm can be analyzed with Park SmartAnalysis™, a powerful AFM image analysis software that enables fast image processing, comprehensive data analysis, and efficient result publication.



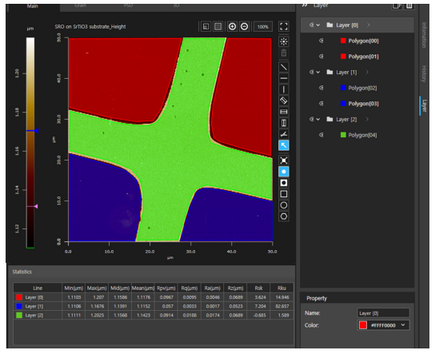
Defects on a Blanket Copper Topography Postprocessed with EZ Flatten



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.

SrO on $SrTiO_3$ Substrate 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.

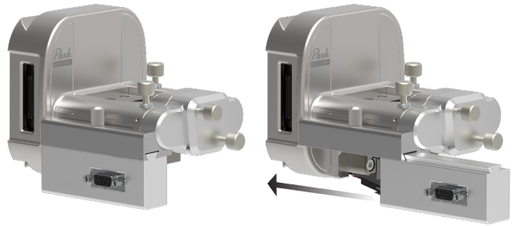
Park NX20 300 mm
Additional Features

Broadest Range of AFM Modes and Options

NX controller integrates four built-in lock-in amplifiers, allowing advanced modes such as KPFM and PFM to be performed in a single scan instead of the conventional double-pass method. This significantly improves measurement efficiency.
With the Head Extension Module (HEM), even more advanced capabilities become available, including Heterodyne KPFM and Contact Resonance PFM

Easy Head Extension Module (HEM) Setup

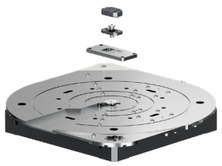
NX AFM heads are designed for seamless integration with Head Extension Modules (HEM). Depending on the application, an HEM can be quickly installed by sliding it into place and securing it with the top knob.



Sample Chuck Options

NX20 300 mm offers a versatile range of sample chucks to support diverse applications. Options include a multi-sample chuck that accommodates up to 16 samples, a wedge-type holder for sidewall measurements, and an AFM–SEM linkage holder for precise alignment across both AFM and SEM systems.

Vacuum Sample Chuck for 300 mm wafer
Achieve precise sample handling with our vacuum chuck, designed for wafers up to 300 mm. Accommodates small samples as well as 50 mm, 100 mm, 150 mm, and 200 mm wafers.



AFM –SEM Linkage Sample Holder
Align samples with precision across both AFM and SEM systems. This versatile holder is designed for accurate XY position alignment and supports standard coupon-size samples.

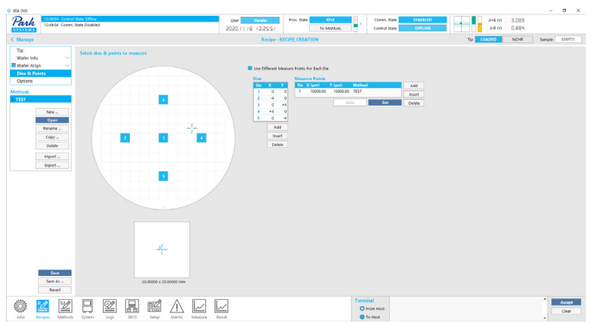
for 150 mm Wafer

for Small Sample

Wedge-Type Sample Holder
Compatible with Wedge Type Sample Holder, which supports 150 mm wafers as well as small samples with selectable tilt angles of 10°, 15°, and 20° for sidewall analysis.

Software Option

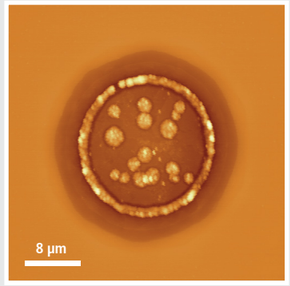
Automated Software (XEA) supports automated AFM measurement and analysis workflows. Users can create custom recipes to perform sequential scans and define analysis methods by selecting specific parameters and conditions. This enables consistent, high-throughput data acquisition and processing with minimal manual intervention.



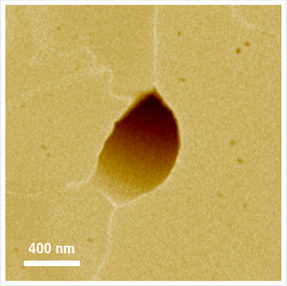
Park NX20 300 mm
Designed for Your Applications

Park NX20 300 mm offers precise measurements for large samples, making it the ideal solution in research applications.

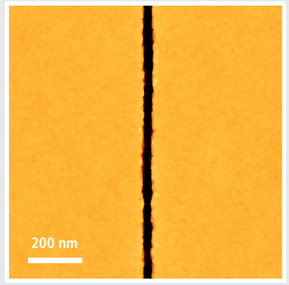
Semiconductors & Devices



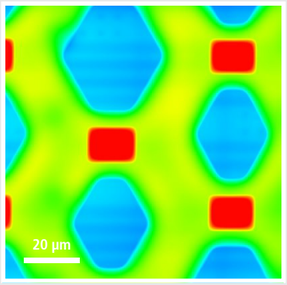
Cu Pad Oxidation
Oxidation on a Cu pad was characterized in True Non-contact mode. The scan revealed a peak-to-valley height difference of 120.7 nm, and the image shows localized oxidation features on the pad surface.



Defects on a Blanket Copper
Defects on a blanket copper sample were characterized in True Non-contact mode. The scan revealed a peak-to-valley height difference of 20.1 nm, highlighting surface irregularities associated with defect formation.

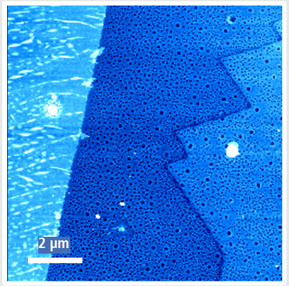


Photoresist Trench
A 29 nm-wide photoresist trench sample was measured in True Non-contact mode. The resulting topography image shows the well-defined trench structure with a peak-to-valley difference of 63.8 nm.

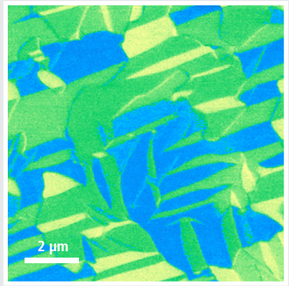


LCD Panel
The LCD panel sample was characterized in True Non-contact mode. The scan image reveals large-area surface patterns with a peak-to-valley height of about 3.82 µm.

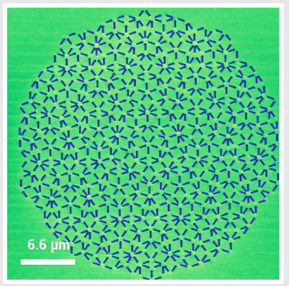
Functional & Advanced Materials



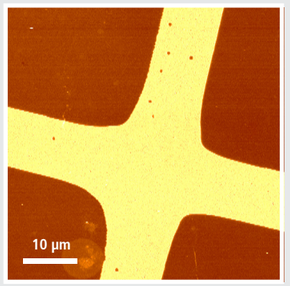
Polyvinyl Alcohol (PVA) Transfer
The surface of a polyvinyl alcohol (PVA) transfer sample was characterized in Tapping mode. The resulting image highlights significant roughness from the transfer process, with a peak-to-valley height difference of 168.2 nm.



PMN-PT
A PMN-PT sample was measured using Piezoresponse Force Microscopy (PFM). The lateral PFM phase image highlights the domain orientation and lateral response of the ferroelectric material.



Artificial Spin Ice Lattice
An artificial spin ice lattice was measured using Magnetic Force Microscopy (MFM), providing phase information of the magnetic response. The image highlights the characteristic ball-like arrangement of the artificial lattice.



SrO on $SrTiO_3$ Substrate
An SrO film on an $SrTiO_3$ substrate was characterized in True Non-contact mode. The image reveals a patterned surface structure with a peak-to-valley height difference of 100.2 nm.

Park NX20 300 mm

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 Spreading Resistance Microscopy (SSRM) *
  - Scanning Tunneling Microscopy (STM) *
  - 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™ 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)
- Thermal Properties
  - Scanning Thermal Microscopy (SThM) *
    - Temperature Mapping
    - Thermal Conductivity Mapping
- Nanolithography & Manipulation
  - Nanolithography *
  - Nanomachining *
- In-liquid Operation
  - In-liquid Topography *
- Electrochemical Properties
  - Electrochemical AFM (EC-AFM) *

** Requires additional options*

Scanner

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

Sample Mount

- Vacuum grooves for wafers (up to 300 mm)

Stage

- XY stage : 300 mm × 300 mm
- Z stage: 25 mm
- Focus stage: 8 mm

Dimension and Weight

- AE (Outer): 1220 mm × 1170 mm × 1470 mm
- Desk: 1410 mm × 810 mm × 740 mm
- Total weight: 1271 kg (AFM Body + AE)

On-axis Optical Microscope

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

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