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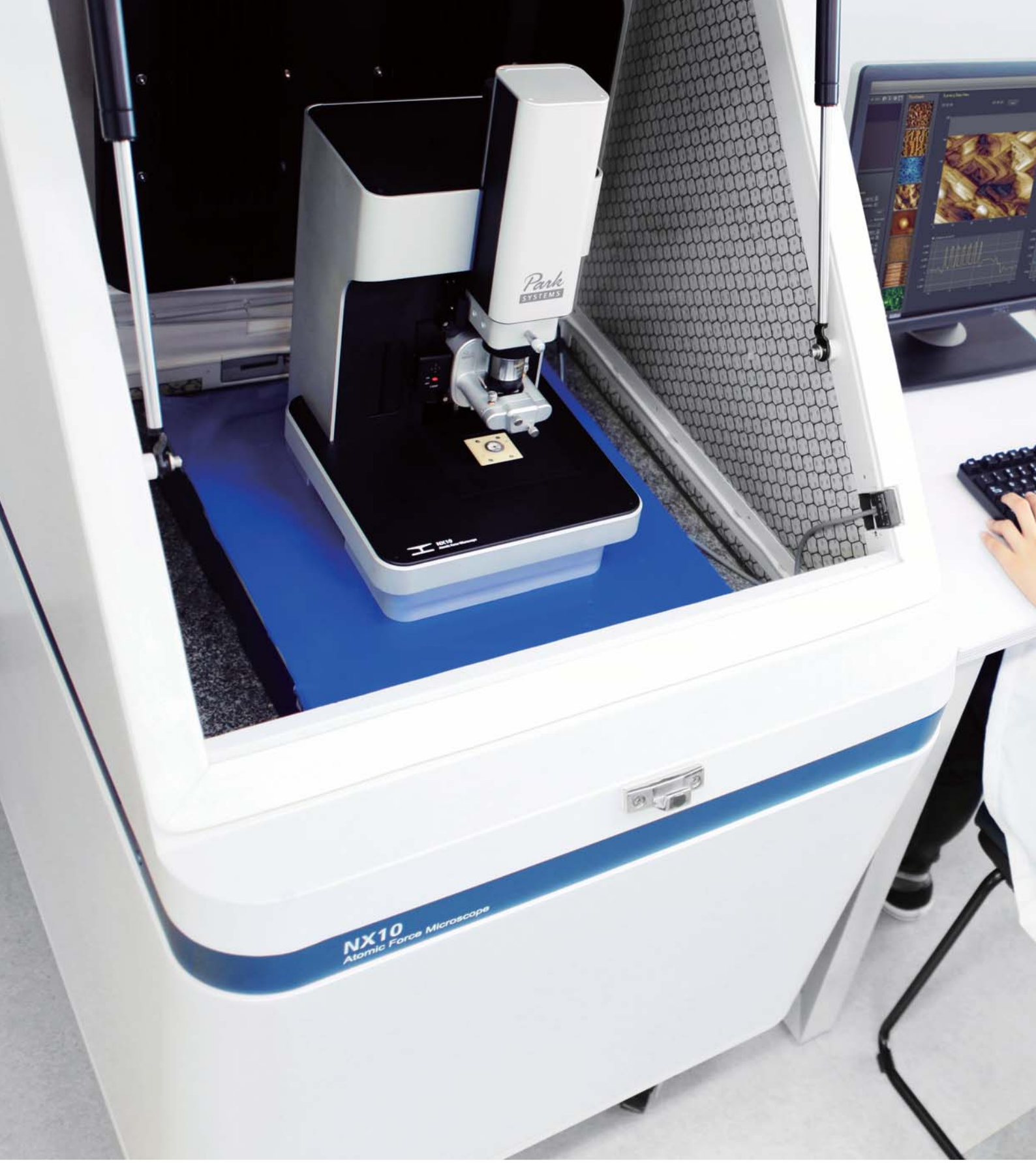
Park NX10

The most accurate and easiest to use Atomic Force Microscope

www.parksystems.com

Park SYSTEMS


Park
SYSTEMS
NX10
Atomic Force Microscope

Park NX10

The premiere choice for nanotechnology research

Better data

Park NX10 produces data you can trust, replicate, and publish at the highest nano resolution. It features the world's only true non-contact AFM that prolongs tip life while preserving your sample, and flexure based independent XY and Z scanner for unparalleled accuracy and resolution.

Better productivity

Powered by our revolutionary operating software **Park SmartScan™**, Park NX10 is capable of quicker, easier setup and more optimal data collection than ever before. Park SmartScan's **auto mode** allows novices to quickly collect high quality nanoscale images with just **three clicks** of a mouse while its manual mode provides all of the functionality necessary for veterans to **customize** their workflow as needed.

Better research

With more time and better data, you can focus on doing more innovative research. And the Park NX10's wide range of measurement modes and customizable design means it can be easily tailored to the most unique projects.

Park NX10

Innovative features for innovative work

Accurate XY Scan by Crosstalk Elimination

- Two independent, closed-loop XY and Z flexure scanners for sample and probe tip
- Flat and orthogonal XY scan with low residual bow
- Out-of-plane motion of less than 1 nm over an entire scan range
- Z scanner linearity deviation of less than 0.015% over an entire scan range
- Accurate height measurements without any need for software processing

Accurate AFM Topography with Low Noise Z Detector

- Sample topography measured by industry leading low noise Z detector
- True Sample Topography™ without edge overshoot or piezo creep error
- Accurate surface height recording, even during high-speed scanning
- Reduced XY scanner ringing by forward sine-scan algorithm
- Industry leading forward and backward scan gap of less than 0.15%

Best Tip Life, Resolution and Sample Preservation by True Non-Contact™ Mode

- Industry leading Z-scanner bandwidth of more than 9 kHz
- Fastest Z-servo speed of more than 62 mm/sec tip velocity
- Minimum tip wear for prolonged high-quality and high-resolution imaging
- Minimized sample damage or modification
- Immune from parameter-dependent results common in tapping imaging

User Experience-Driven Software and Hardware Features

- Open side access for easy sample or tip exchange
- Easy, intuitive laser alignment with pre-aligned tip mount
- Easy head removal by dovetail-lock mount
- Direct on-axis optics for high resolution optical viewing
- Fast automatic tip approach to sample surface within 10 seconds
- **Park SmartScan™** - AFM operating software versatile enough to empower both novices and power users alike toward great nanoscale research.
  - Auto mode: Automated image acquisition in three easy steps to determine probe setup, scan position, and scan area.
  - Manual mode: Opens various up scan parameters and macro/scripting support to advanced users for fine-tuned scan control.

The Most Comprehensive and Extensible AFM Solution

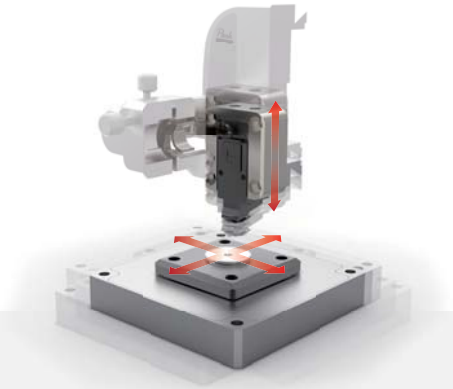
- The most extensive range of SPM modes
- The largest number of sample measurement options
- The best option compatibility and upgradeability in the industry
- 24 bit digital electronics with three internal lock-ins, Q-control, and spring constant calibration
- Active temperature control of acoustic enclosure


Park
SYSTEMS

Park NX10
AFM Technology

Flat Orthogonal XY Scanning Without Scanner Bow

Park's Crosstalk Elimination removes scanner bow, allowing flat orthogonal XY scanning regardless of scan location, scan rate, and scan size. It shows no background curvature even on 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.



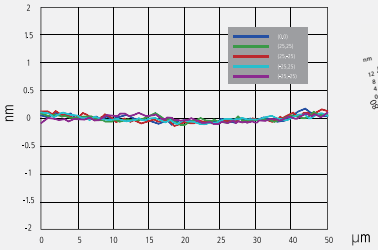
Decoupled XY and Z Scanners

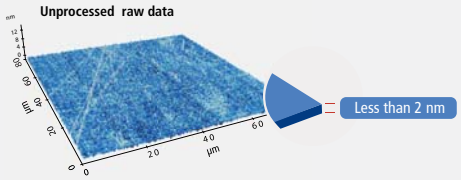
The fundamental difference between Park and its closest competitor is in the scanner architecture. Park's unique flexure based independent XY scanner and Z scanner design allows unmatched data accuracy in nano resolution in the industry.

Accurate Surface Measurement

"Flat" sample surface as it is!

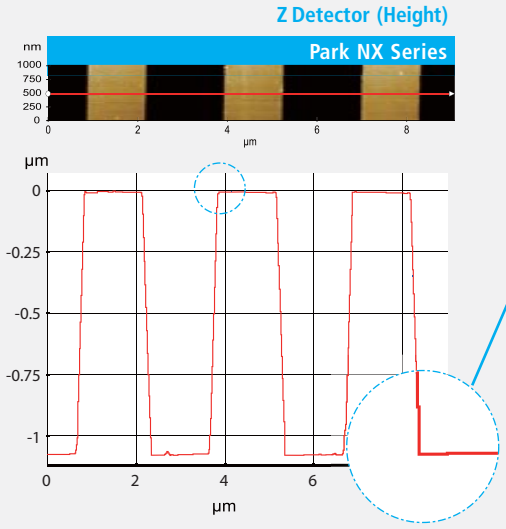
- Low residual bow
- No need for software processing (raw data)
- Accurate results independent of scan location





Industry Leading Low Noise Z Detector

Our AFMs are equipped with the most effective low noise Z detectors in the field, with a noise of 0.02 nm over large bandwidth. This produces highly accurate sample topography, no edge overshoot and no need for calibration. Just one of the many ways Park NX10 saves you time and gives you better data.



No creep effect

Accurate Sample Topography Measured by Low Noise Z Detector

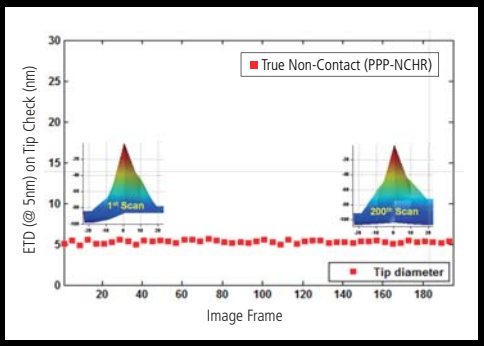
- Uses low noise Z detector signal for topography
- Has low Z detector noise of 0.02 nm over large bandwidth
- Has no edge overshoot at the leading and trailing edges
- Needs calibration done only once at the factory

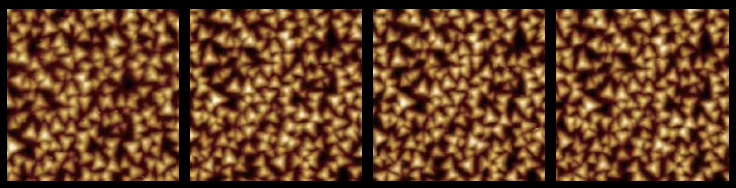
Sample: 1.2 µm Nominal Step Height
(9 µm x 1 µm, 2048 pixels x 128 lines)

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.

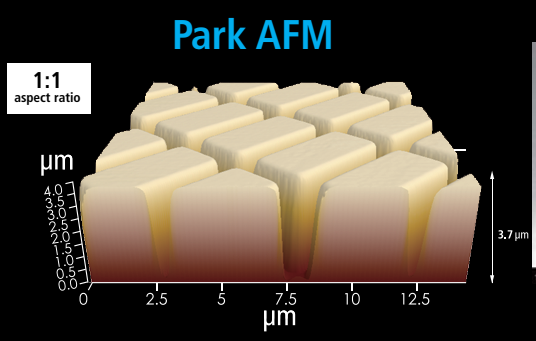
Unlike in contact mode, where the tip touches the sample continuously during a scan, or in tapping mode, where the tip touches the sample periodically, a tip used in non-contact mode does not touch the sample. Because of this, use of non-contact mode has several key advantages. Scanning at the highest 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. Money is also saved as turnover on costly tips is reduced.

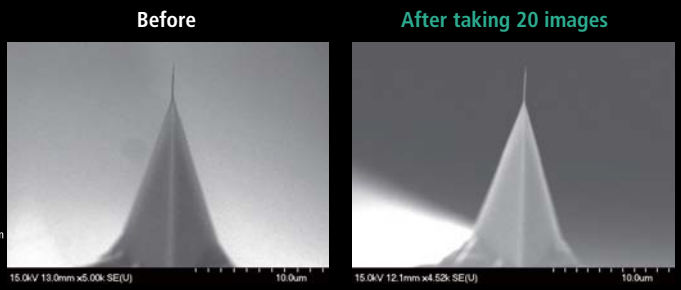




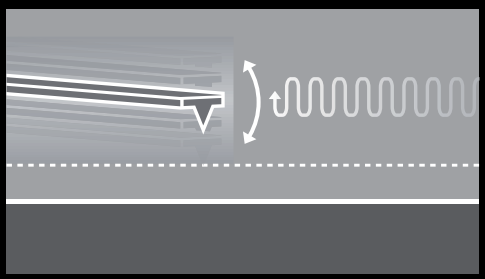
1st Scan | 30th Scan | 70th Scan | 100th Scan

Furthermore, non-contact mode senses tip-to-sample force 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.





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



True Non-Contact™ Mode

- 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.

Park NX10

Equipped with the most innovative AFM technology

1 2D Flexure-Guided Scanner with 50 µm x 50 µm Scan Range

The XY scanner consists of symmetrical 2-dimensional flexure and high-force piezoelectric stacks. It provides high orthogonal movement with minimal out-of-plane motion and high responsiveness that is essential for precise sample scanning in the nanometer scale. The compact and rigid structure of Park NX10 enables low noise, high-speed servo response.

2 High Speed Z Scanner with 15 µm Scan Range

Driven by a high-force piezoelectric stack and guided by a flexure structure, the standard Z scanner has a high resonant frequency of more than 9 kHz (typically 10.5 kHz) and an ultra fast Z-servo speed of more than 48 mm/sec tip velocity. The maximum Z scan range can be extended from 15 µm to 30 µm with the optional long range Z scanner.

3 Low Noise XYZ Position Sensors

The industry leading low noise Z detector replaces the applied Z voltage as the topography signal while the low noise XY closed loop scan minimizes the forward and backward scan gap to less than 0.15% of the scan range.

4 Motorized XY Sample Stage

XY Sample Stage is motorized to make it easy for navigating and positioning the sample to the region of interest. This motorized stage has a resolution of 0.6um (using micro-stepping) on both axis.

5 Step-and-Scan Automation

Using the motorized sample stage, Step-and-Scan enables programmable multiple region imaging. Here's how it works:

1. Scan an image
2. Lift cantilever
3. Move motorized stage to a user defined coordinate
4. Approach
5. Repeat scan

This automated feature greatly increases productivity by reducing the need for your interaction during the scan process.

6 Accessible Sample Holder

The Park NX10's unique head design handles up to 50 mm x 50 mm x 20 mm (width x length x height) sample size, and it allows easy side access to the sample and tip.

7 Expansion Slot for Advanced SPM Modes and Options

Advanced SPM modes are enabled by simply plugging an option module to the expansion slot. The modular design of the NX-series AFM allows option compatibility throughout its product line.

8 Direct On-Axis High Powered Optics with Integrated LED Illumination

The Park NX10's custom designed objective lens with an ultra long working distance (50 mm, WD 0.21 NA, 1.0 µm resolution) provides direct on-axis optical view with unprecedented clarity. This allows users to navigate the sample surface easily, and find the target area quickly. With the EL20x objective lens of long travel head, the enlarged sensor size of the CCD provides a resolution of 0.7 µm without losing visual quality.

9 Auto Engage by Slide-to-Connect SLD Head

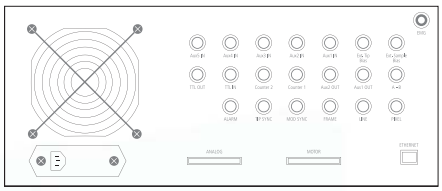
The AFM head is easily inserted or removed by sliding it along a dovetail rail. This automatically locks the head into its pre-aligned position and connects it to the control electronics with a positioning repeatability of a few microns. The low coherency of the Super Luminescence Diode (SLD) enables accurate imaging of highly reflective surfaces and precise measurements for pico-Newton Force-distance spectroscopy. The SLD wavelength eliminates interference issues for users interested in combining the AFM with experiments in the visible spectrum.

10 Vertically Aligned Motorized Z Stage and Focus Stage

The motorized Z stage and the motorized focus stage both make it possible of engaging the cantilever to the sample surface while constantly maintaining a clear vision for the user. And because the focus stage is motorized and software controlled, it has the precision necessary for transparent samples and liquid cell applications.

High Speed 24-bit Digital Electronics

All the NX-series AFMs are controlled and processed by the same NX electronics controller. The controller is an all digital, 24-bit high speed electronics which successfully realizes the True Non-Contact™ mode for accuracy and speed. With its low noise design and high speed processing unit, the controller is also ideal for precise voltage and current measurement as well as nanoscale imaging. The embedded digital signal processing capability adds to the functionality and the economics of our AFM solutions for advanced researchers.



Park NX AFM Controller

24-bit signal resolution for XY and Z detectors

- 0.003 nm resolution in XY (50 µm XY)
- 0.001 nm resolution in Z (15 µm Z)

Embedded digital signal processing capability

- 3 channels of flexible digital lock-ins
- Spring constant calibration (thermal method)
- Digital Q control included

Intergrated signal access ports

- Dedicated and programmable signal input/output ports
- 7 inputs and 3 outputs

Park SmartScan™

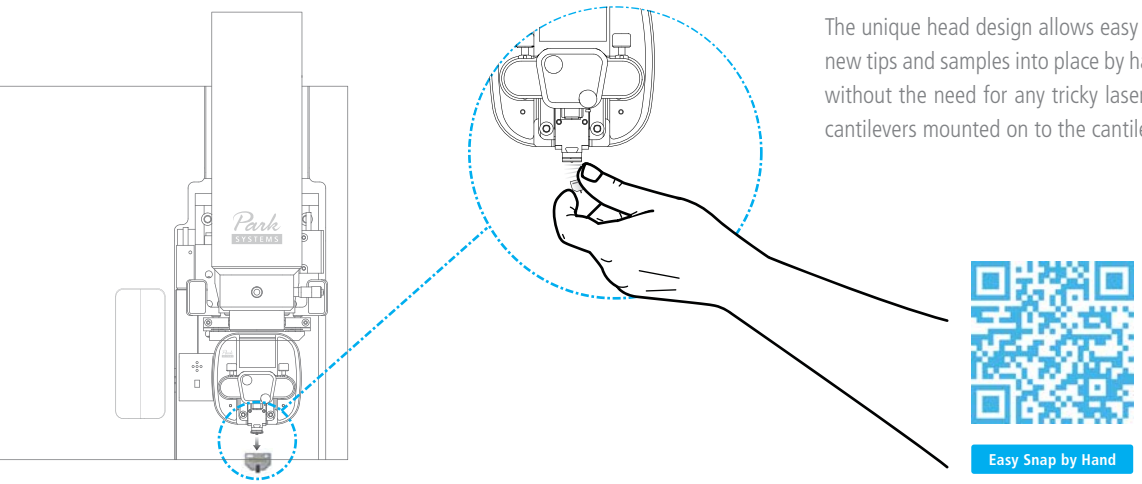
Revolutionary operating software for Park AFMs combining versatility, ease-of-use, and top-flight quality performance for the best AFM experience available. Featuring an Auto mode to assist inexperienced users to quickly acquire quality nanoscale images with minimal effort, Park SmartScan also has a full Manual mode to enable AFM power users in crafting a totally customized sample scan with access to various parameters, settings, and advanced features such as macros and scripting.

Park NX10

Why the world's most accurate small sample AFM is also the easiest to use

Easy Tip and Sample Exchange

The unique head design allows easy side access allowing you to easily snap new tips and samples into place by hand. The cantilever is ready for scanning without the need for any tricky laser beam alignment by using pre-aligned cantilevers mounted on to the cantilever tip holder.



Easy Snap by Hand

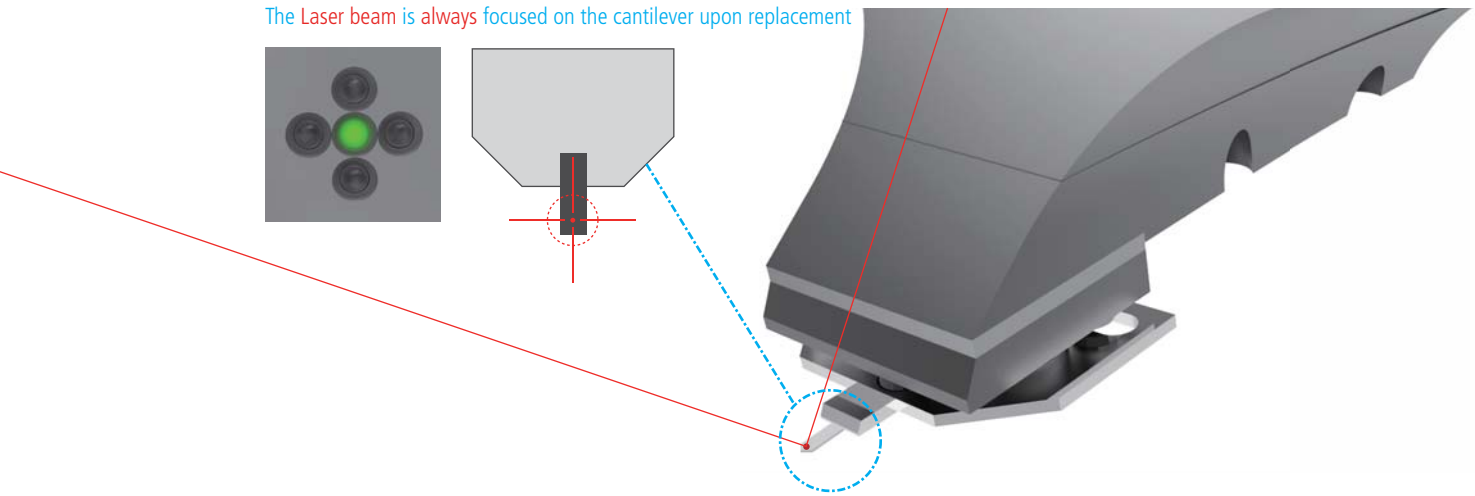
Lightning Fast Automatic Tip Approach

Our automatic tip to sample approach requires no user intervention and engages in just 10 seconds after loading the cantilever. By monitoring the cantilever response to the approaching surface, Park NX10 can initiate an automatic fast tip to sample approach within 10 seconds of cantilever loading. Fast feedback by the high-speed Z scanner and low noise signal processing by the NX electronics controller enable quick engagement to the sample surface without any user intervention. It just works, minimal user involvement required.

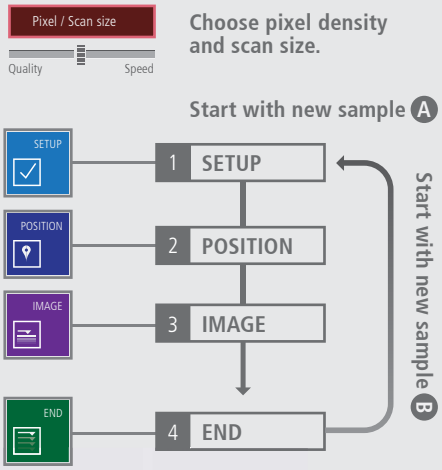
Easy, Intuitive Laser Beam Alignment

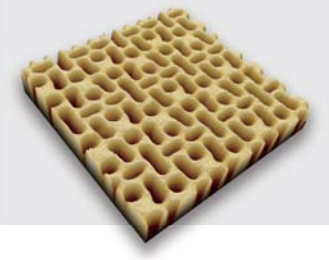
With our advanced pre-aligned cantilever holder, the laser beam is focused on the cantilever upon placement. Furthermore, the natural on-axis top-down view, the only one in the industry, allows you to easily find the laser spot. Since the laser beam falls vertically on the cantilever, you can intuitively move the laser spot along the X- and Y-axis by rotating its two positioning knobs. As a result, you can easily find the laser and position it on PSPD using our beam alignment user interface. From there, all you will need is a minor adjustment to maximize the signal to start acquiring the data.

The Laser beam is always focused on the cantilever upon replacement



Park SmartScan™





Single-Click Imaging with SmartScan™ Auto Mode

All you need to specify for AFM imaging are quality-speed preference, pixel density and scan size. Outside of those factors, you can leave all sophisticated AFM parameters up to the Auto mode of SmartScan™. The system will start a measurement with optimized conditions for imaging automatically at the click of a button.

An AFM OS for everyone, from amateurs to experts

Whether your AFM needs are focused on academic research, industrial metrology or failure analysis, SmartScan's Auto mode offers a streamlined system to generate publishable high quality AFM data. Moreover, SmartScan™ promises productive sessions with an AFM even for beginners to obtain quality data as good as an expert's, in much shorter time.

FastApproach™

Click the Position button, and the Z scanner approaches the sample automatically and at a much higher speed than the typical manual approach. Park's patented FastApproach™ safely takes the probe down to the sample surface at full speed without the user's intervention and engages in just 10 seconds after loading the cantilever.

Easy to Find an Area of Interest

After probe-to-surface engagement, the optical camera will automatically focus on the sample to find your area of interest (AOI). The UX of SmartScan™ easily enables intuitive navigation of the sample by controlling the motorized stages in the integrated optical window. You can move theAOI of the sample directly by clicking the desired position in the optical window.

Speeds Up Imaging with AdaptiveScan™

Park's innovative AdaptiveScan™ controls the scan speed automatically based on the peaks and valleys of the sample surface. AdaptiveScan™ adjusts the optimum scan speed dynamically to acquire a quality image of an unknown morphology at a higher speed. This effectually shortens the imaging time while retaining top image quality comparable to that obtained by a well-trained expert manually. When moving to neighboring locations or zooming-in to a target, AdaptiveScan automatically applies a new optimal condition.

Park NX10

Adaptable to any project

The wide range of scanning modes and modular design of the NX series allows it to be easily tailored to the needs of any scanning probe microscopy project.

Standard Imaging

- True Non-Contact AFM
- Basic Contact AFM
- Lateral Force Microscopy (LFM)
- Phase Imaging
- Intermittent (tapping) AFM

Electrical Properties

- Conductive AFM
- I-V Spectroscopy
- Scanning Kelvin Probe Microscopy (SKPM/KPM)
- SKPM with High Voltage
- Scanning Capacitance Microscopy (SCM)
- Scanning Spreading-Resistance Microscopy (SSRM)
- Scanning Tunneling Microscopy (STM)
- Scanning Tunneling Spectroscopy (STS)
- Time-Resolved Photo Current Mapping (Tr-PCM)

Magnetic Properties

- Magnetic Force Microscopy (MFM)
- Tunable MFM

Chemical Properties

- Chemical Force Microscopy with Functionalized Tip
- Electrochemical Microscopy (EC-STM and EC-AFM)

Dielectric/Piezoelectric Properties

- Electric Force Microscopy (EFM)
- Dynamic Contact EFM (DC-EFM)
- Piezoelectric Force Microscopy (PFM)
- PFM with High Voltage

Thermal Properties

- Scanning Thermal Microscopy (SThM)

Optical Properties

- Tip-Enhanced Raman Spectroscopy (TERS)
- Time-Resolved Photo Current Mapping (Tr-PCM)

Mechanical Properties

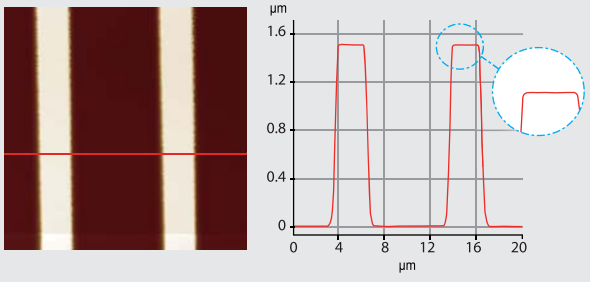
- Force Modulation Microscopy (FMM)
- Nanoindentation
- Nanolithography
- Nanolithography with High Voltage
- Nanomanipulation
- Piezoelectric Force Microscopy (PFM)

Force Measurement

- Force Distance (F-D) Spectroscopy
- Force Volume Imaging
- Spring Constant Calibration by Thermal Method

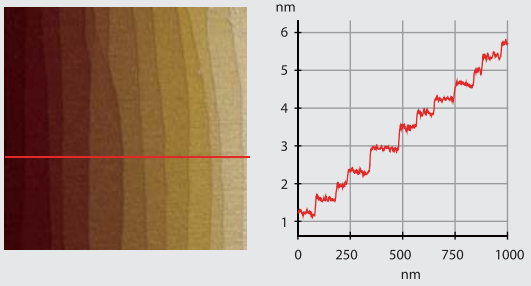
1 **Tall Sample** 1.5 µm step height

Scan Mode: Non-contact mode, Topography from Z position sensor



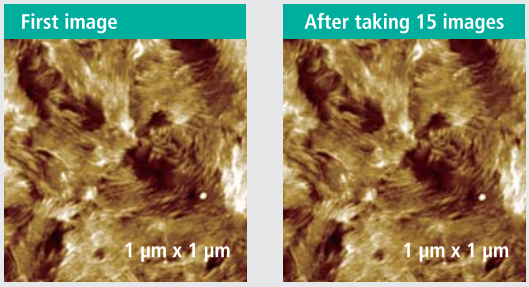
2 **Flat Sample** Atomic steps of sapphire wafer

0.3 nm step height, Scan Mode: Non-contact mode, Topography from Z position sensor



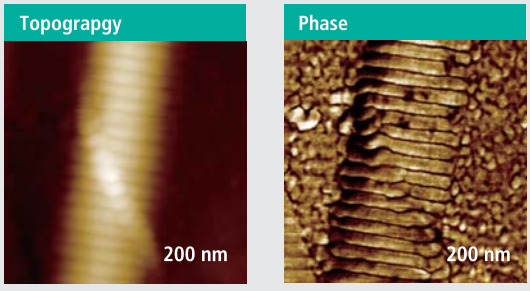
3 **Hard Sample** Tungsten film

Scan Mode: Non-contact mode, Topography from Z position sensor

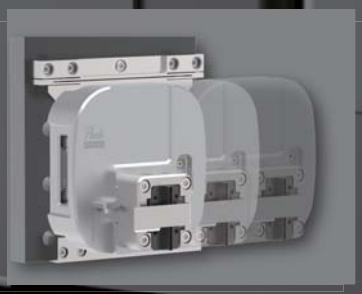


4 **Soft Sample** Collagen fibril

Scan Mode: Non-contact mode, Topography from Z position sensor



Park NX10
Options



Park NX10 SICM permits truly non-invasive in-liquid imaging by combining the usage of nanopipettes with a no force, non-contact technique under aqueous conditions. This approach is powered by our dedicated Approach-Retract-Scan (ARS) software that enables both steamlined scanning automation through nanoscale probe-sample distance control.

Park NX10 SICM is now available for a wide range of applications ranging from cell biology, analytical chemistry, electrophysiology, and neuroscience

Park NX10 SICM Module

- A new hardware module for the Park NX10 to enable Scanning Ion Conductance Microscopy (SICM) functionality.

XY Scanners

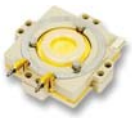
- 10 µm x 10 µm XY Scanner
- 50 µm x 50 µm XY Scanner
- 100 µm x 100 µm XY Scanner

Z Scanner Heads

- 15 µm Z Scanner Head
- 30 µm Z Scanner Head
- Wide optical access from the side

Temperature Control

- Heating & Cooling Stage (0~180 °C)
- 250 °C Heating Stage
- 600 °C Heating Stage



Liquid Cells

- Universal Liquid Cell
- Electrochemistry Cell
- Open Liquid Cell

Liquid Probehand

- Designed for imaging in general liquid environment
- Resistant to most buffer solutions including acid
- Contact and Non-contact AFM imaging in liquid

Clip-type Chip Carrier

- Can be used with unmounted cantilever
- Tip bias function available for Conductive AFM and EFM
- Tip bias range: -10 V ~ 10 V

Magnetic Field Generator

- Applies external magnetic field parallel to sample surface
- Tunable magnetic field
- Range: -300 ~ 300 gauss
- Composed of pure iron core & two solenoid coils

Active Temperature Controlled Acoustic Enclosure

- **Easy to use controls** - Innovative control design allows Park NX10 to quickly reach temperature equilibrium
- **Get scanning faster** - Temperature stability of less than 0.05 °C within 10 minutes of closing the Acoustic Enclosure door

Park NX10
Specification

Scanner

Z scanner

AFM Head
Guided high-force flexure scanner
Scan range: 15 µm (optional 30 µm)
Resolution: 0.015 nm
Position detector noise: 0.03 nm (bandwidth: 1 kHz)
Resonant frequency: > 9 kHz (typically 10.5 kHz)

SICM Head
Flexure-guided structure driven by multiply-stacked piezoelectric stacks
Z scan range: 25 µm
Position detector noise: 0.03 nm (bandwidth: 1 kHz)

XY scanner

Single module flexure XY-scanner with closed-loop control
Scan range: 50 µm × 50 µm (optional 10 µm × 10 µm or 100 µm × 100 µm)
Resolution: 0.05 nm
Position detector noise: < 0.25 nm (bandwidth: 1 kHz)
Out-of-plane motion: < 2 nm (over 40 µm scan)

Stage

Sample size: Open space up to 100 mm x 100 mm, thickness up to 20 mm
Sample weight: up to 500 g
XY stage travel range: 20 mm x 20 mm
Z stage travel range: 25 mm
Focus stage travel range: 15 mm

Vision

Direct on-axis vision of sample surface and cantilever
Field-of-view: 480 µm × 360 µm (with 10× objective lens)
CCD: 1 Mpixel (pixel resolution: 0.4 µm)
5 Mpixel (pixel resolution: 0.2 µm)

Objective lens

10x (0.21NA) ultra-long working distance lens (1µm resolution)
20x (0.42 NA) high-resolution, long working distance lens (0.6 µm resolution)

Electronics

Signal processing

ADC: 18 channels
ADC channels (64 MSPS)
24-bit ADCs for X, Y, and Z scanner position sensor
DAC: 11 channels
DAC channels (64 MSPS)
20-bit DACs for X, Y, and Z scanner positioning
Maximum data size: 4096 x 4096 pixels

Integrated functions

3 channels of flexible digital lock-in amplifier
Spring constant calibration (Thermal method)
Digital Q control

External signal access

20 embedded signal input/output ports
5 TTL outputs: EOF, EOL, EOP, Modulation, and AC bias

Options/Modes

Standard Imaging

- True Non-Contact Mode
- Basic Contact Mode
- Lateral Force Microscopy (LFM)
- Phase Imaging Mode
- Tapping Mode

Chemical Properties

- Chemical Force Microscopy with Functionalized Tip
- Electrochemical Microscopy (EC-STM and EC-AFM)

Dielectric/Piezoelectric Properties

- Electric Force Microscopy (EFM)
- Dynamic Contact EFM (EFM-DC)
- Piezoelectric Force Microscopy (PFM)
- PFM with High Voltage

Force Measurement

- Force Distance (F-D) Spectroscopy
- Force Volume Imaging

Magnetic Properties

- Magnetic Force Microscopy (MFM)
- Tunable MFM

Thermal Properties

- Scanning Thermal Microscopy (SThM)

Electrical Properties

- Pinpoint Conductive AFM (CP-AFM)
- I-V Spectroscopy
- Scanning Kelvin Probe Microscopy (SKPM/KPM)
- SKPM with High Voltage
- QuickStep Scanning Capacitance Microscopy (SCM)
- Scanning Spreading-Resistance Microscopy (SSRM)
- Scanning Tunneling Microscopy (STM)
- Scanning Tunneling Spectroscopy (STS)
- Photo Current Mapping (PCM)
- Current-Distance Spectroscopy (with SICM)

Mechanical Properties

- Pinpoint Mode
- Force Modulation Microscopy (FMM)
- Nanoindentation
- Nanolithography
- Nanolithography with High Voltage
- Nanomanipulation

Software

Park SmartScan™

- AFM system control and data acquisition software
- Auto mode for quick setup and easy imaging
- Manual mode for advanced use and finer scan control

XEI

- AFM data analysis software
- Stand-alone design—can install and analyze data away from AFM
- Capable of producing 3D renders of acquired data

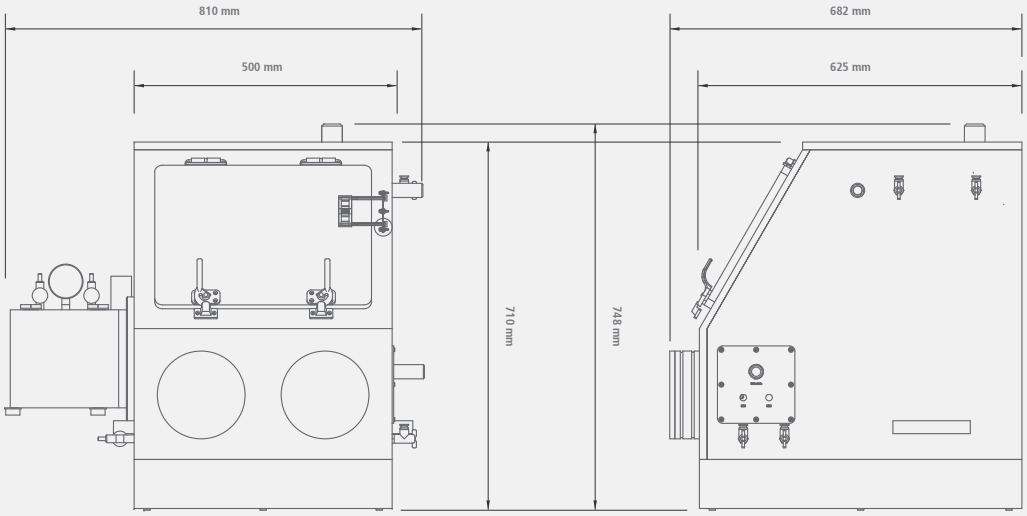
Accessories

Electrochemistry Cell
Universal Liquid Cell with Temperature Control
Sample Stages with Temperature Control
GloveBox
Magnetic Field Generator
Active Temperature Controlled Acoustic Enclosure

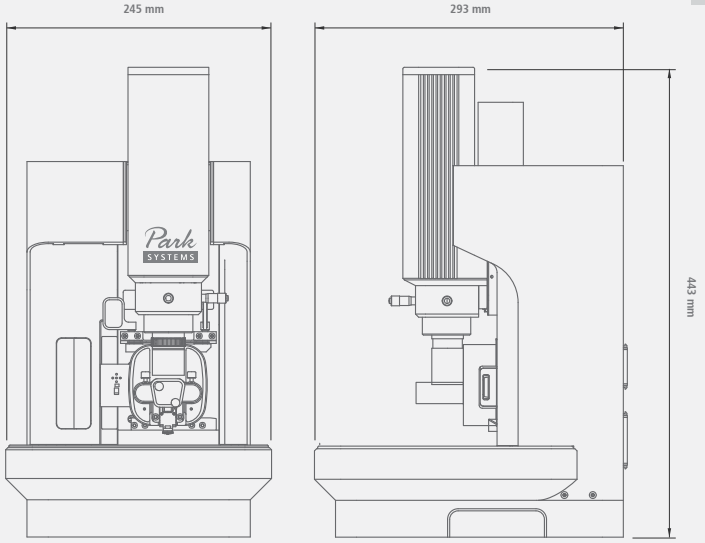
Dimensions in mm

GloveBox

* Optional

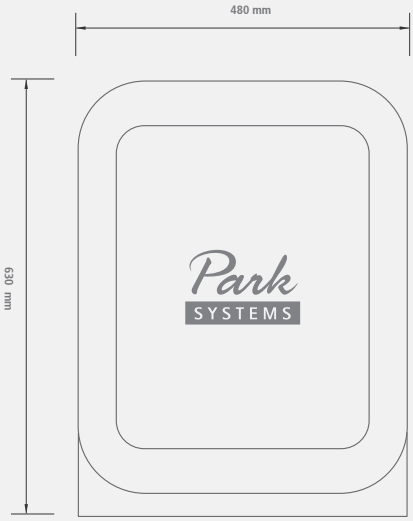


Park NX10



* Optional

Acoustic Enclosure 101



* Optional

Park NX10 Full System with Acoustic Enclosure 203