Park NX20

The leading nano metrology tool for failure analysis and large sample research

www.parksystems.com

Park SYSTEMS

The Most Accurate Atomic Force Microscope

Park NX20

The premier choice for failure analysis

As an FA engineer, you're expected to deliver results. There's no room for error in the data provided by your instruments. Park NX20, with its reputation as the world's most accurate large sample AFM, is rated so highly in the semiconductor and hard disk industry for its data accuracy.

More powerful failure analysis solutions

Park NX20 is equipped with unique features that make it easier to uncover the reasons behind device failure and develop more creative solutions. Its unparalleled precision provides high resolution data that lets you focus on your work, while its True Non-Contact™ mode scan keeps tips sharper and longer, so you won't have to waste as much time and money replacing them.

Easy to use, even for entry level engineers

Park NX20 has one of the most user friendly designs and automated interfaces in the industry, so you won't have to spend as much time and energy using the tool and supervising junior engineers with the system. This lets you focus your experience on solving bigger problems and providing insightful and timely failure analysis to your customers.

Park NX20

Innovative features for innovative work

Accurate AFM Solutions for FA and Research Laboratories

- Surface roughness measurements for media and substrates
- Defect review imaging and analysis
- High resolution electrical scan mode
- Sidewall measurements for 3D structure study

Accurate and Reproducible Measurements for Better Productivity

- Non-contact mode to preserve tip sharpness for surface roughness accuracy
- Fastest defect imaging in non-contact mode
- Decoupled XY scanning system for 3D structure measurements
- Minimized system drift and hysteresis using thermally matched components

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
- Industry leading forward and backward scan gap of less than 0.15%

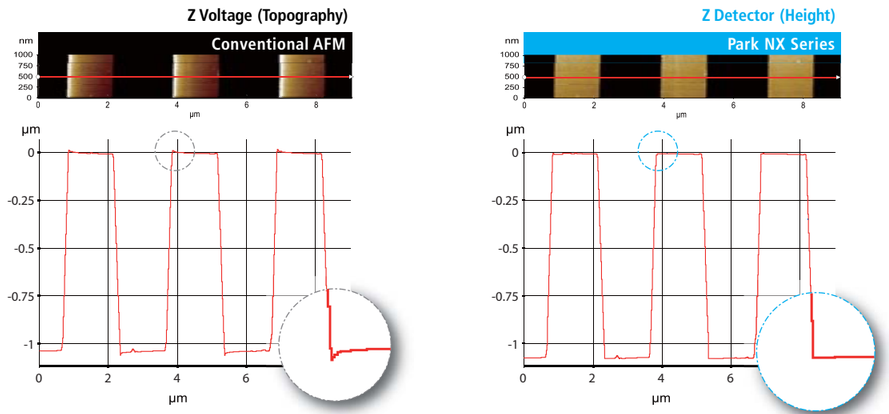
Cost Savings with True Non-Contact™ Mode

- 10 times or longer tip life during general purpose and defect imaging
- Less tip wear from prolonged high-quality scans
- Minimized sample damage or modification

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 .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 NX20 saves your time and gives you better data.

Accurate Sample Topography Measured by Low Noise Z Detector



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

Piezoelectric creep effect

No creep effect

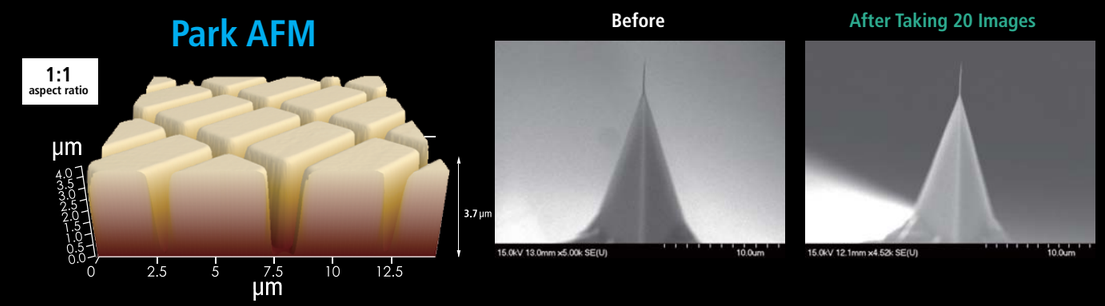
No artifact by AFM scanner in low noise closed-loop topography

- 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

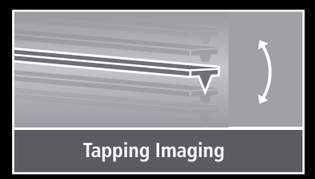
True Non-Contact™ Mode Preserves Sharp Tip

AFM tips are so brittle that touching a sample will instantly reduce the resolution and quality of the image they produce. For soft and delicate samples, the tip will also damage the sample and result in inaccurate sample height measurements, something that can cost you valuable time and money.

True Non-Contact™ mode, a scan mode unique to Park AFMs, consistently produces high resolution and accurate data while maintaining the integrity of the sample.

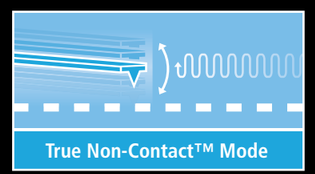


Accurate Feedback by Faster Z-servo enables True Non-Contact AFM



Tapping Imaging

- Quick tip wear = Blurred low-resolution scan
- Destructive tip-sample interaction = Sample damage and modification
- Highly parameter-dependent



True Non-Contact™ Mode

- Less tip wear = Prolonged high-resolution scan
- Non-destructive tip-sample interaction = Minimized sample modification
- Immunity from parameter dependent results

Park NX20

Equipped with the most innovative AFM technology

❶ 2D Flexure-Guided Scanner with 100 µm x 100 µm Scan Range

The XY scanner consists of symmetrical 2-dimensional flexure and high-force piezoelectric stacks provides high orthogonal movement with minimal out-of-plane motion as well as high responsiveness essential for precise sample scanning in the nanometer scale.

❷ 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 Z-servo speed of more than 48 mm/sec tip velocity which enables accurate feedback. The maximum Z scan range can be extended from 15µm to 30µm with the optional long scan range Z scanner.

❸ Low Noise XYZ Position Sensors

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

❹ Motorized XY Sample Stage with Optional Encoders

The encoders, used on all motorized stages, enable higher positioning repeatability for accurate sample positioning. The encoded XY stage travels in 1 µm resolution with 2 µm repeatability, and the encoded Z stage, in 0.1 µm resolution with 1 µm repeatability.

❺ Step-and-Scan Automation

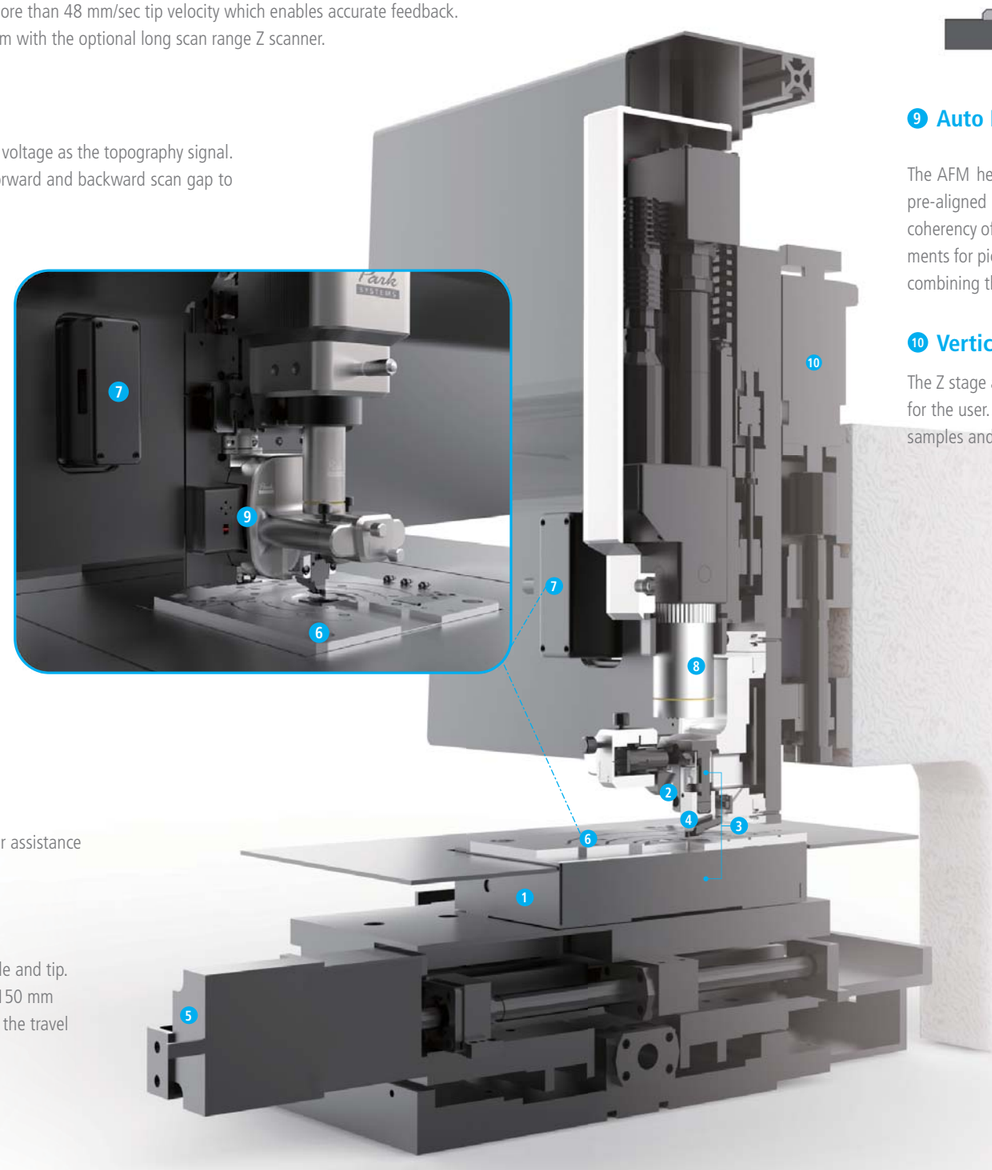
Using the motorized sample stage, Step-and-Scan enables user-programmable multiple region imaging.
The Step-and-Scan process consists of:

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

This automated feature increases productivity by minimizing user assistance during repetitive imaging processes.

❻ Accessible Sample Holder

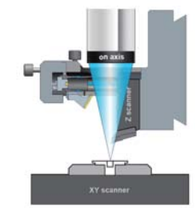
The unique head design allows for an open side access to sample and tip. The maximum sample size one can place on the stage is either 150 mm diameter x 20 mm or 200 mm diameter x 20 mm depending on the travel range option chosen for the XY sample stage.



❼ 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.

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



Custom designed objective lens with ultra long working distance (51 mm, 0.21 NA, 1.0 µm resolution) provides direction on-axis optical view with unprecedented clarity. The intuitive direct on-axis sample view from the top allows users to navigate the sample surface easily to find the target area. For a higher vision resolution the EL20x objective lens of Long Travel Head is used, which has 20 mm working distance, 0.42 NA, and 0.7 µm resolution. The enlarged sensor size of the CCD provides wide field of view of the sample without compromising the optics resolution. The software-controlled LED light source provides ample illumination onto the sample surface for clear sample observation.

❾ Auto Engage by Slide-to-Connect SLD Head

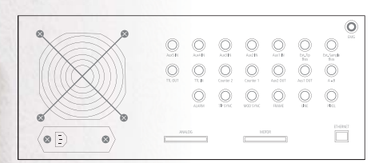
The AFM head is easily inserted or removed by sliding it along a dovetail rail. This automatically locks the head into its pre-aligned position and connects it to the control electronics with a positioning repeatability of a few microns. The low coherency of the Super Luminescence Diode (SLD) enables 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.

❿ Vertically Aligned Motorized Z Stage and Focus Stage

The Z stage and focus stage engage the cantilever with the sample surface while constantly maintaining a clear field of 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 NX-series AFMs are controlled and processed by the same NX electronics controller. The controller is an all digital, 24-bit high speed electronics unit, which insures the speed and accuracy of Park's True Non-Contact ModeTM for accuracy and speed. With its low noise design and high speed processing unit, the controller is ideal for nanoscale imaging and precise voltage and current measurements. The embedded digital signal processing capability adds to the functionality and economics of our AFM solutions for advanced researchers.



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

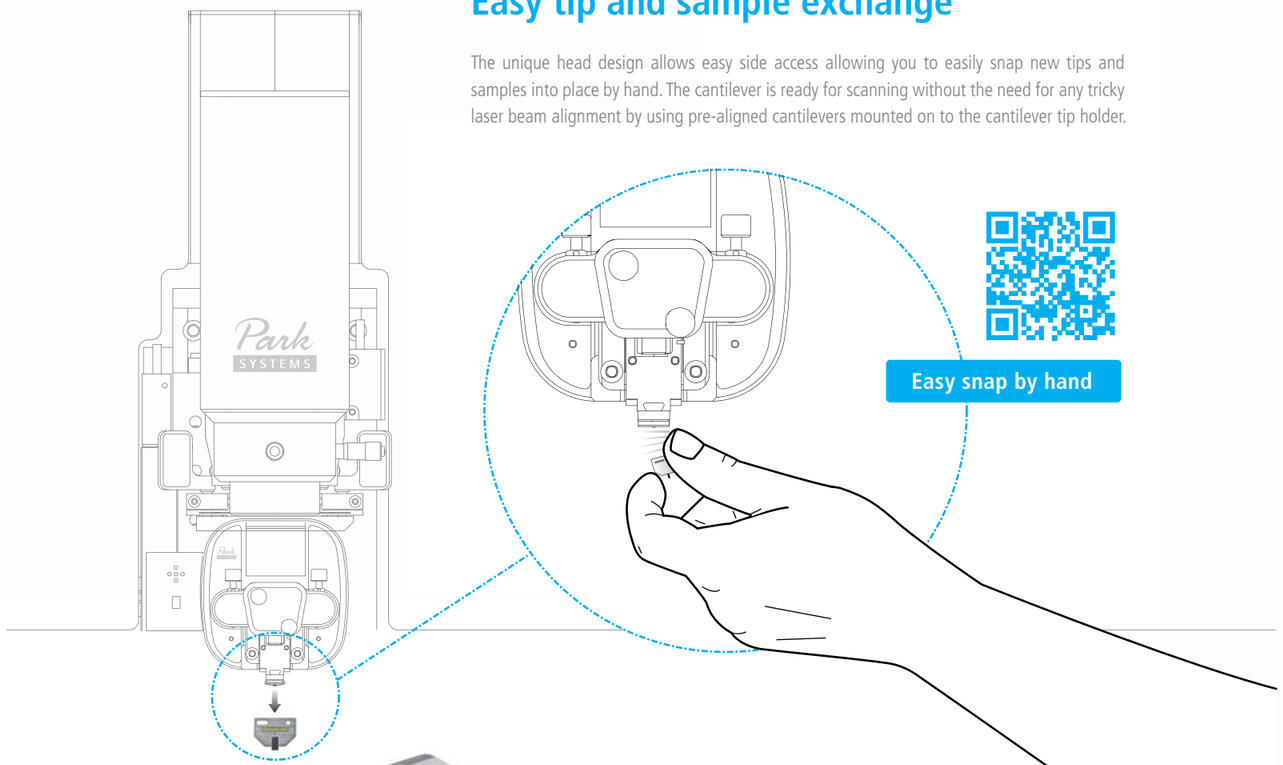
- Dedicated and programmable signal input/output ports
- 7 inputs and 3 outputs

Park NX20

Why the world's most accurate large 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.



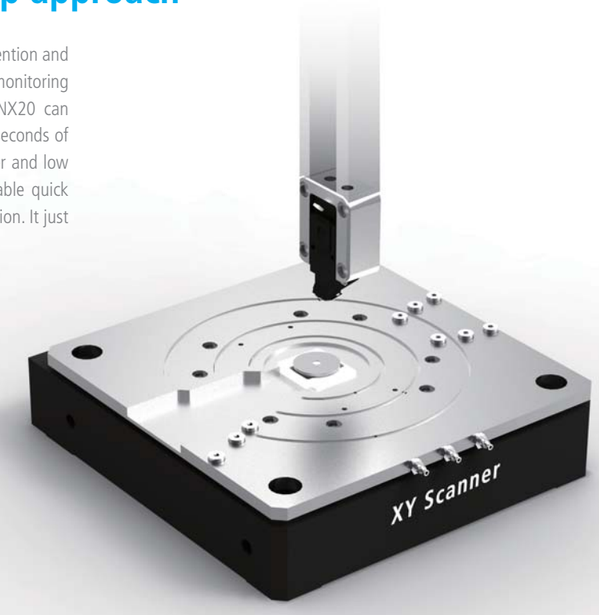
Closed-loop XY scan with dual servo system for increased accuracy

The low noise position sensors on each axis of the XY scanner are doubled to attain high scan orthogonality for the largest scan ranges and sample sizes. The secondary sensor corrects and compensates for the non-linear and non-planar positional errors that would occur with a single sensor alone.

Dual servo sensor

Lightning fast automatic tip approach

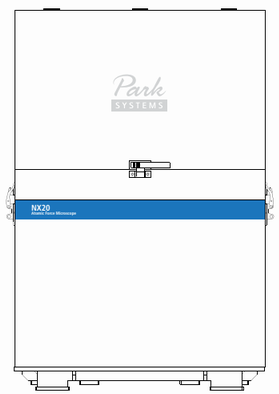
Our automatic tip to sample approach requires no user intervention and engages in just 10 seconds after loading the cantilever. By monitoring the cantilever response to the approaching surface, Park NX20 can initiate an automatic fast tip to sample approach within 10 seconds of cantilever loading. Fast 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.

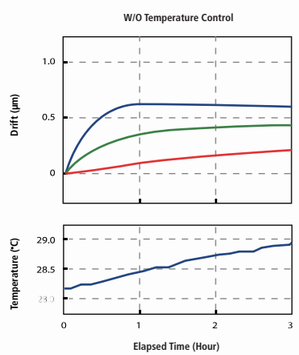


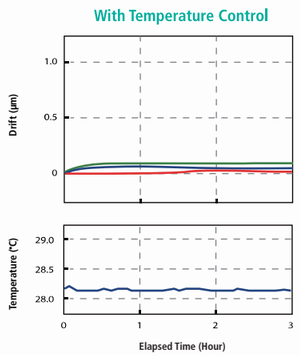
Active temperature controlled acoustic enclosure

Designed exclusively for Park NX20, the Acoustic Enclosure is actively temperature-controlled for a perfectly stable thermal environment. The Park NX20 also features active vibration isolation and is completely isolated from external acoustic and light noise so that nothing can interfere with its accuracy.

- **Easy to use controls** - Innovative control design allows Park NX20 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 NX20

Power for any project

With a wide range of scanning modes and modular design, the Park NX20 has the power and flexibility you need for any project.

Surface Roughness Measurement
- True Non-Contact Mode
- Dynamic Force Mode

Electrical Characterization
- Conductive AFM (ULCA and VECA)
- Electricstatic Force Microscopy (EFM)
- Piezoelectric Force Microscopy (PFM)
- Scanning Capacitance Microscopy (SCM)
- Kelvin Probe Force Microscopy (KPFM)
- Scanning Spreading Resistance Microscopy (SSRM)
- Scanning Tunneling Microscopy (STM)
- Time-Resolved Photo Current Mapping (Tr-PCM)

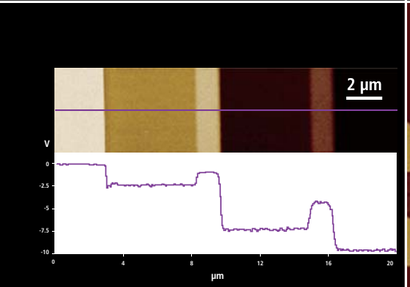
Mechanical Characterization
- Force Modulation Microscopy (FMM)
- Force-Distance (F-d) Spectroscopy
- Force Volume Imaging
- Lateral Force Microscopy (LFM)
- Nanoindentation
- Nanolithography
- Phase Imaging

Thermal Characterization
- Scanning Thermal Microscopy (SThM)

Magnetic Characterization
- Magnetic Force Microscopy (MFM)

Material Property Characterization

QuickStep™ SCM
The Fastest Scanning Capacitance Microscopy

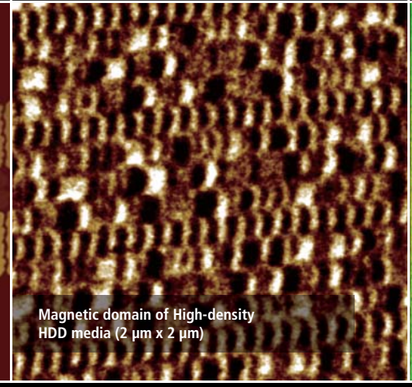


SCM profiles of n-doped semiconductor (Doping ratio variation: 1×10^{17} cm^{-3} to 4×10^{19} cm^{-3})

PinPoint™ CP-AFM
The Frictionless Conductive Probe AFM

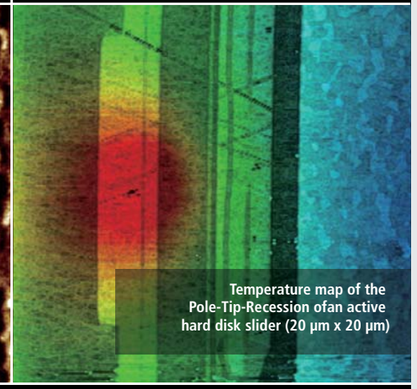
Failure analysis of contact plugs (3 µm x 3 µm)

Magnetic Force Microscopy (MFM)
Accurately view your sample's magnetic structure



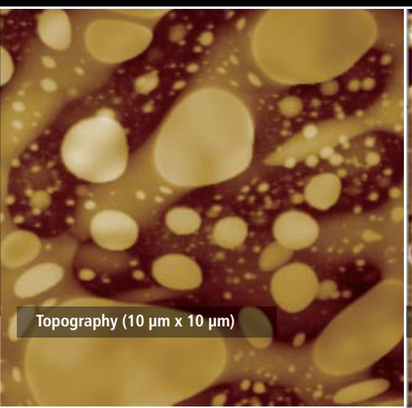
Magnetic domain of High-density HDD media (2 µm x 2 µm)

Scanning Thermal Microscopy (SThM)
Easily examine your sample's thermal conductivity

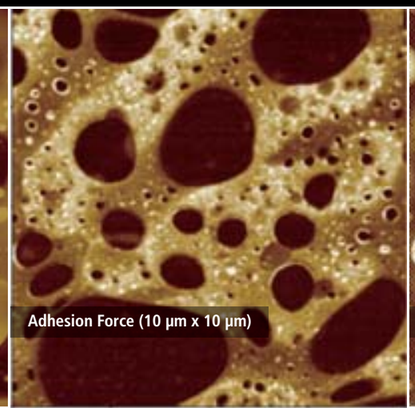


Temperature map of the Pole-Tip-Recession ofan active hard disk slider (20 µm x 20 µm)

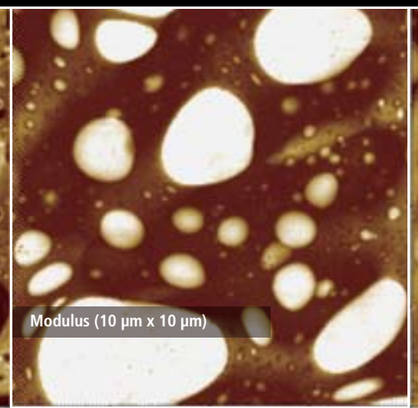
PinPoint™ Nanomechanical Mode, Nanomechanical Property Characterization
Topography, Adhesion force, Elastic modulus , Stiffness of Polystyrene-Polybutene Composites are acquired simultaneously in real-time.



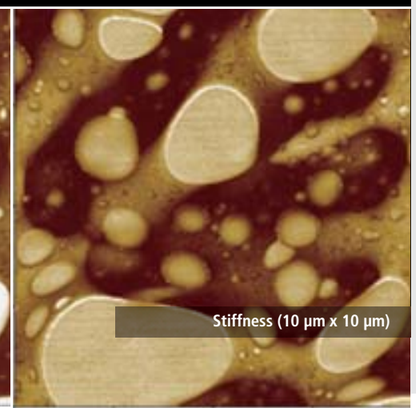
Topography (10 µm x 10 µm)



Adhesion Force (10 µm x 10 µm)



Modulus (10 µm x 10 µm)

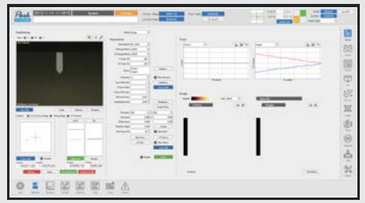


Stiffness (10 µm x 10 µm)

Options

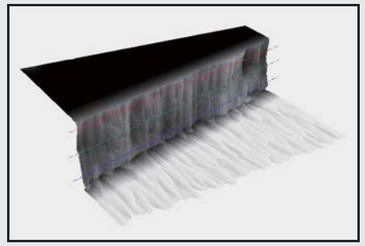
Customize your AFM to handle any project

Automatic data collection and analysis lets you save time



The NX20 features Park's automation control software that automatically carries out AFM measurements of a sample according to your preset procedure (recipe). It can accurately collect data, perform pattern recognition, and do analysis using its onboard Cognex board and optics module, and export with almost no user input so you have more time to do innovative research.

Sample Tilting Stage for Sidewall Imaging lets you see more



The NX20's innovative architecture lets you detect the sidewall and surface of the sample, and measure their angle. This gives the unit the versatility you need to do more innovative research and gain deeper insights.

- Tilting angle: 10, 15, and 20°
- Sample size: 20 x 20 mm
- Sample thickness: 2 mm

Our Active Temperature-controlled Acoustic Enclosure lets you take more accurate measurements

- Innovative control brings the system quickly to its temperature equilibrium
- Temperature stability of less than 0.05 °C within10 minutes of closing AE door
- Includes an active vibration isolation system

Encoders for Motorized Stage

- The encoded XY stage travels in 1 µm resolution with 2 µm repeatability
- The encoded Z stage travels in 0.1 µm resolution with 1 µm repeatability

Sample Plates

- Dedicated small sample holder for electrical measurements
- Vacuum grooves to hold wafers
- Sample dimension: Up to 200 mm (150 mm default)

Clip-type Chip Carrier

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

XY Scanners

- 20 µm x 20 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

Precise Temperature Control

- Heating & Cooling Stage (-25~180 °C)
- 250 °C Heating Stage
- 600 °C Heating Stage

Park NX20
Specification

Scanner

XY scanner

Single-module flexure XY scanner with closed-loop control
Scan range: 100 µm × 100 µm
50 µm × 50 µm
25 µm × 25 µm
20-bit position control and 24-bit position sensor

Z scanner

Guided high-force Z scanner
Scan range: 15 µm
30 µm
20-bit position control and 24-bit position sensor

Stage

XY travel range: 150 mm (200 mm optional)
Z travel range: 25 mm
Focus travel range: 15 mm
Precision encoder for all axes (optional)

Vision

Direct on-axis vision of sample surface and cantilever
Coupled with 10× objective lens (20× optional)
Field-of-view: 840 µm × 630 µm (420 µm x 315 µm optional)
CCD: 5 MP

Objective lens

10× (0.21 NA) objective lens with ultra-long working distance
20× (0.42 NA) objective lens with long working distance and high resolution

Sample Mount

Up to 150 mm (200 mm optional)
Vacuum grooves to hold wafer samples

Software

NXP

Dedicated system control and data acquisition software
Adjusting feedback parameters in real time
Script-level control through external programs (optional)

NXI

AFM data analysis software

Electronics

Signal processing

ADC: 18 channels
4 high-speed ADC channels (64 MSPS)
24-bit ADCs for X, Y, and Z scanner position sensor
DAC: 12 channels
2 high-speed 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 AFM
- Basic Contact AFM
- Lateral Force Microscopy (LFM)
- Phase Imaging
- PinPoint AFM
- Intermittent (tapping) AFM

Electrical Characterization

- Scanning Capacitance Microscopy (SCM)
- Conductive AFM
- Electric Force Microscopy (EFM)
- Piezoresponse Force Microscopy (PFM)
- Kelvin Probe Force Microscopy (KPFM)

General Characterization

- Magnetic Force Microscopy (MFM)
- Scanning Thermal Microscopy (SThM)
- F-D Spectroscopy
- Scanning Tunneling Microscopy (STM)
- Force Modulation Microscopy (FMM)
- Nanoindentation
- Nanolithography
- Nanomanipulation

Options

- Sample plates
- Temperature-controlled Acoustic Enclosure
- Liquid Probehand
- Liquid Cells
- Temperature-Controlled Stages
- External Bias Module
- Signal Access Module

Dimensions in mm