

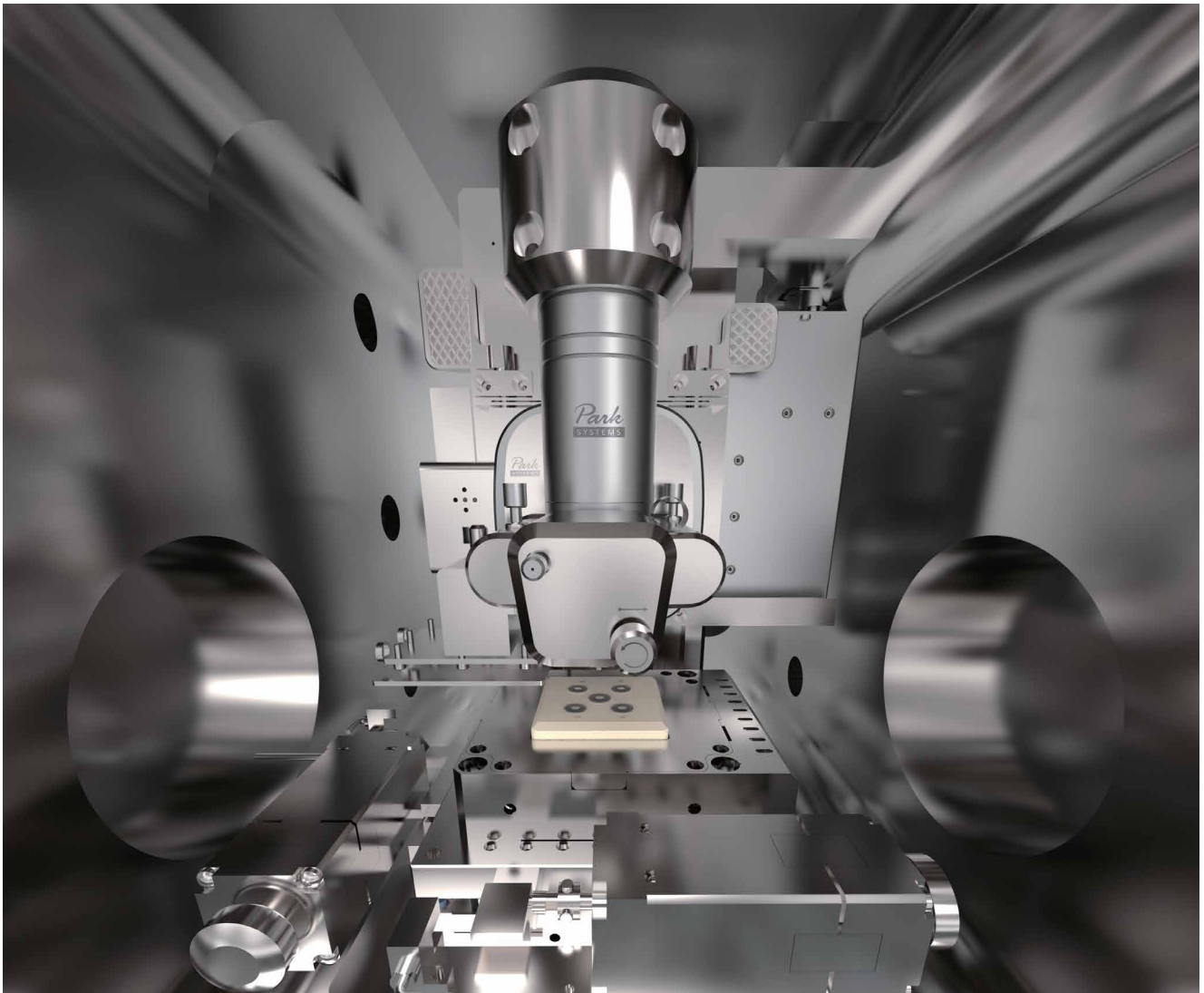
Enabling Nanoscale Advances



# Park NX-Hivac

Ideal for failure analysis  
and sensitive materials research





# Park NX-Hivac

High vacuum Atomic Force Microscope for failure analysis and atmosphere-sensitive materials research

Park NX-Hivac allows failure analysis engineers to improve the sensitivity and repeatability of their AFM measurements in a high vacuum environment. Because high vacuum measurement offers greater accuracy, better repeatability, and less tip and sample damage than ambient or dry N<sub>2</sub> conditions, users can measure a wider range of signal response in various failure analysis applications, such as dopant concentration of Scanning Spreading Resistance Microscopy (SSRM).

Park NX-Hivac enables materials scientific research that requires high accuracy and high resolution measurements in a vacuum environment free from oxygen and other agents.

# Park Hivac Manager

## NX-Hivac auto vacuum control

High vacuum is controlled by Hivac Manager, pumping for the optimized vacuum condition and venting processes are logically and visually controlled by one-button clicking. Each process is visually monitored by color and schematic changes, you do not need to worry about the sequence of vacuum operation after clicking on a button. Faster and easier vacuum control software brings you ease of use AFM operation and better productivity.

The screenshot displays the Park Hivac Manager software interface. On the left, a schematic diagram shows a 'CHAMBER' connected to a 'GAS' cylinder via a 'NEEDLE VALVE' and 'VENTING VALVE'. The chamber is also connected to a 'ROUGHING VALVE' and a 'DRY PUMP' (nXDS / Running, Speed 100%, 352.0 W). A 'GATE VALVE' connects the chamber to a 'TURBO PUMP' (EXT750X / Running, Speed 82%, 80.5 W). A 'FORELINE VALVE' connects the turbo pump to the dry pump. Two gauges are shown: a 'HIGH VACUUM GAUGE' (mTorr, 0-70) and a 'LOW VACUUM GAUGE' (Torr, 0-900). The current pressure is  $1.28 \times 10^{-4}$  Torr. The interface includes a 'Status' bar (Connected), 'Controls' (Auto, Manual), and 'Pumping'/'Venting' buttons. An 'Event Log' table is visible on the right.

when	description
12:02:06	Turn On Dry Pump Fan
12:02:06	Turn On Turbo Pump Fan
12:02:06	Open Roughing Valve
12:02:07	Open Foreline Valve
12:02:09	Start Dry Pump
12:02:10	Waiting for pressure dropped below 0.150...
12:04:23	Start Turbo Pump
12:04:25	Waiting for turbo pump started
12:05:40	Close Roughing Valve
12:05:43	Open Gate Valve

### Automatic vacuum pumping and venting

The NX-Hivac lets users set up automatic controls for vacuum pumping and venting, further streamlining the scanning process and reducing required human input. The average pumping speed is to about  $10^{-5}$  torr in < 5 min using Turbo and Dry Pump.



VALVE OPEN



VALVE CLOSE



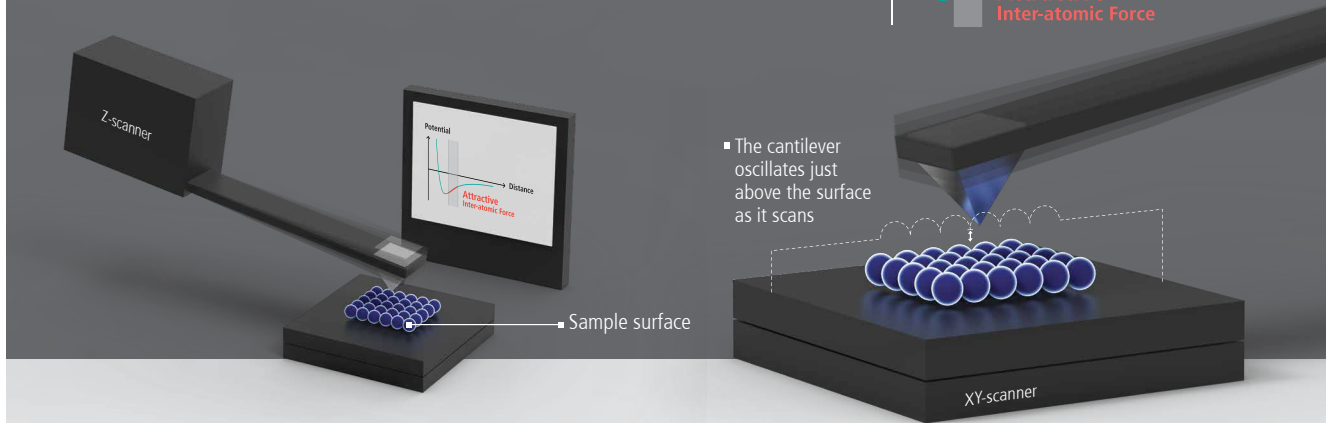
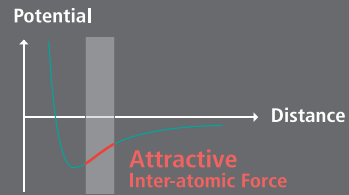
GAUGE SENSOR

# 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.

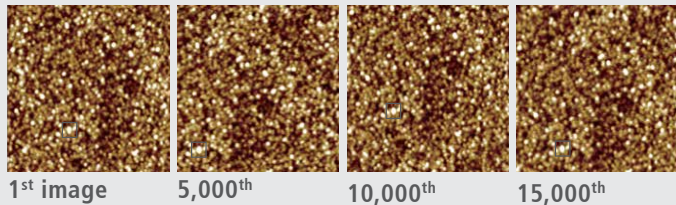
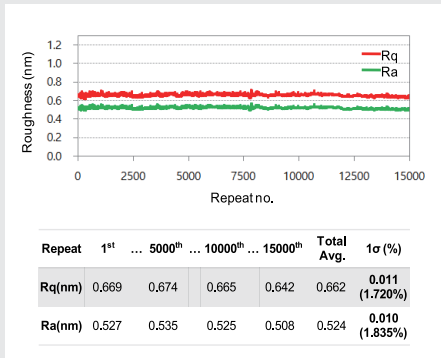
## Accurate Feedback by Faster Z-servo enables True Non-Contact AFM

- 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

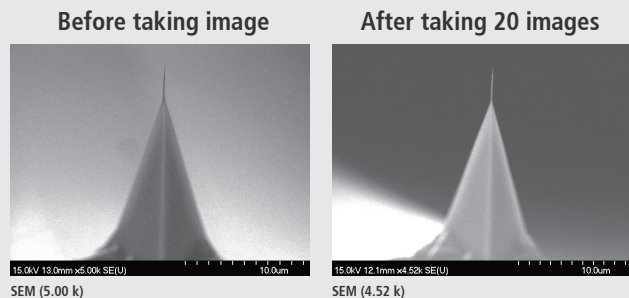
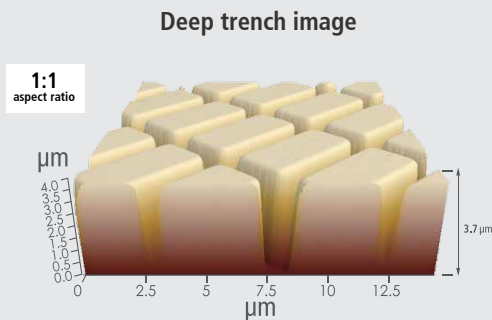


▪ The cantilever oscillates just above the surface as it scans

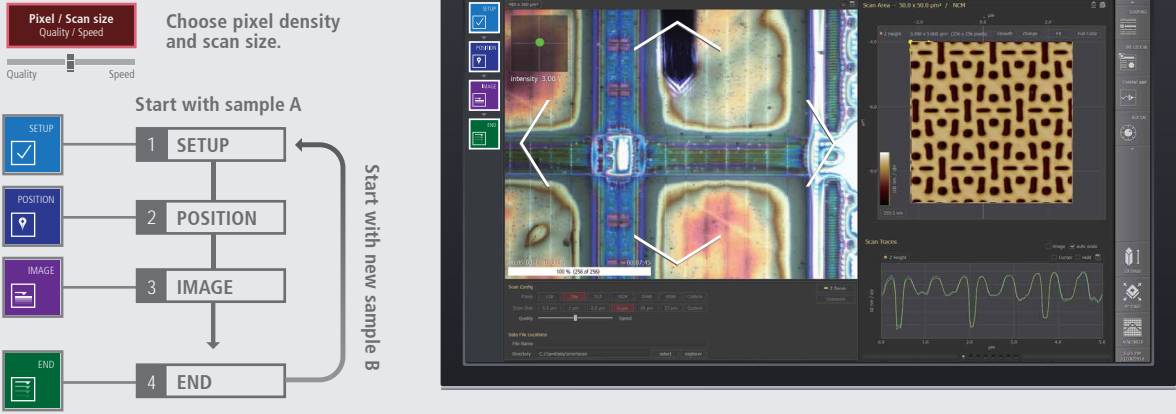
Unlike in contact mode, where the tip contacts the sample continuously during a scan, or in tapping mode, where the tip touches the sample periodically, a tip used in non-contact mode does not touch the sample. Because of this, use of non-contact mode has several key advantages. Scanning at the highest 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.



Furthermore, non-contact mode senses tip-sample 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.



# Park SmartScan™



Pixel / Scan size  
Quality / Speed

Choose pixel density and scan size.

Start with sample A

1 SETUP

2 POSITION

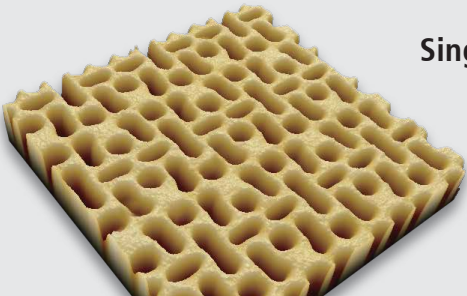
3 IMAGE

4 END

Start with new sample B

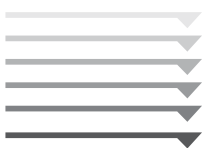
### Single-click Imaging with SmartScan™ Auto Mode

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 operation software 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 FastApproach™ safely takes the cantilever down to the sample surface at full speed without the user's intervention and engages in just 10 seconds after loading the cantilever.

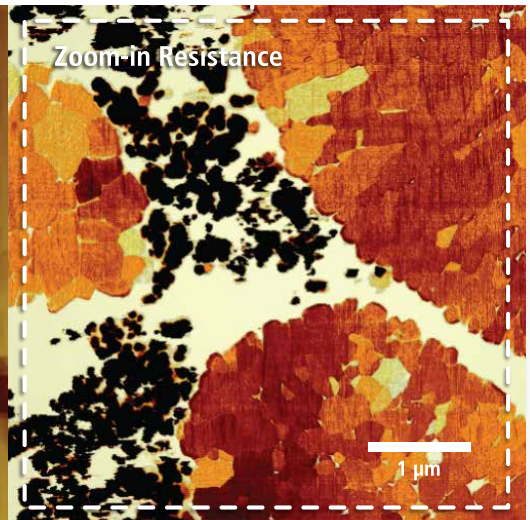
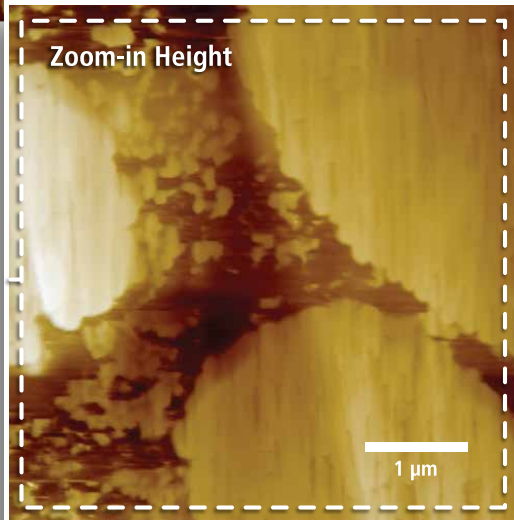
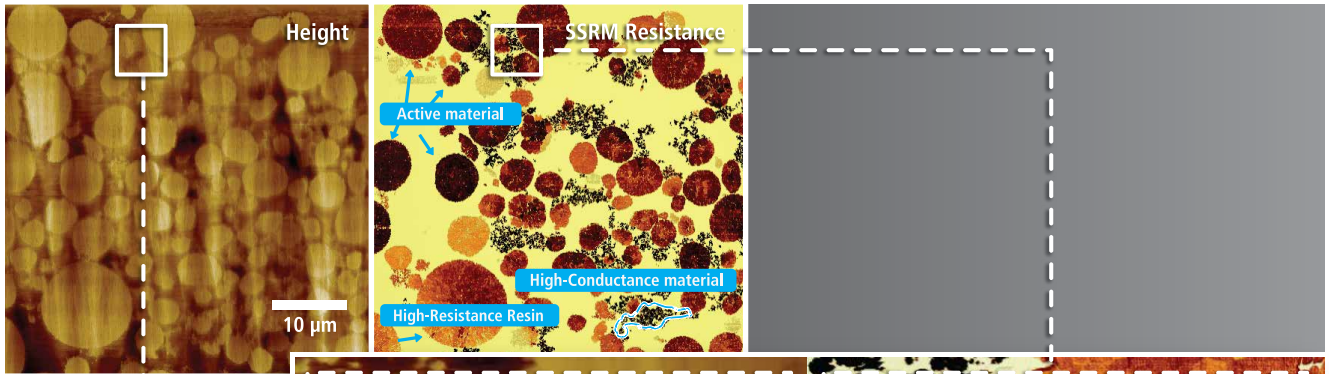


### Easy to find an area of interest

After tip-to-sample 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 the AOI of the sample directly by clicking the desired position in the optical window.

## Speeds up imaging with AdaptiveScan™

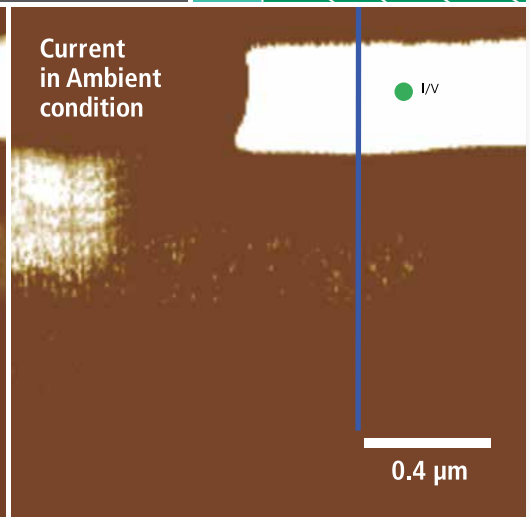
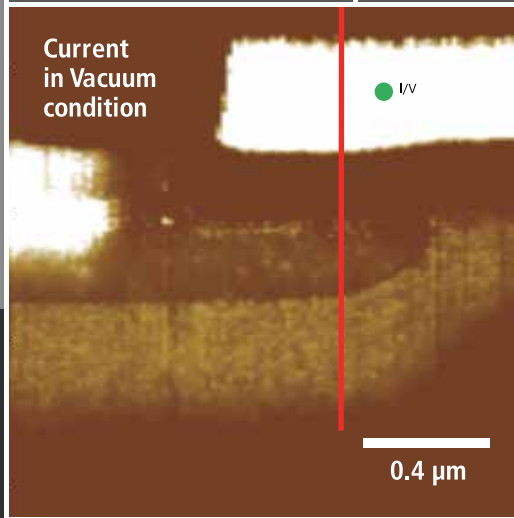
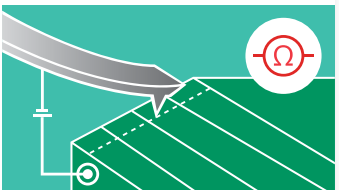
Park's innovative AdaptiveScan™ controls the scan speed automatically based on the peaks and valleys of the sample surface. AdaptiveScan™ adjusts the optimum scan speed dynamically to acquire a quality image of an unknown morphology at a higher speed. This effectually shortens the imaging time while 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.



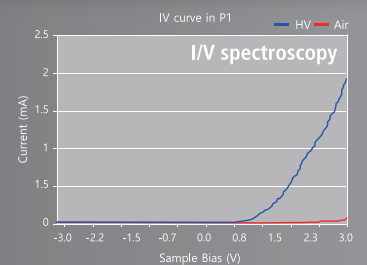
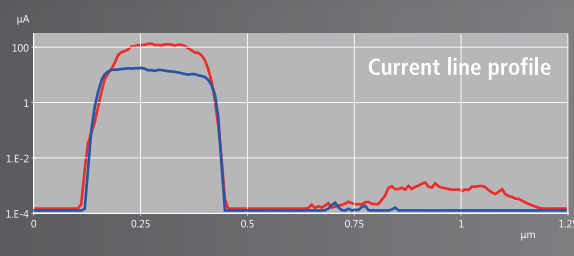
**Li ion Battery Electrode**      **SiC MOSFET**

**Scanning conditions**  
 Scan Mode: SSRM  
 Cantilever: CDT-NCHR  
 (k=80 N/m, f=400 kHz)

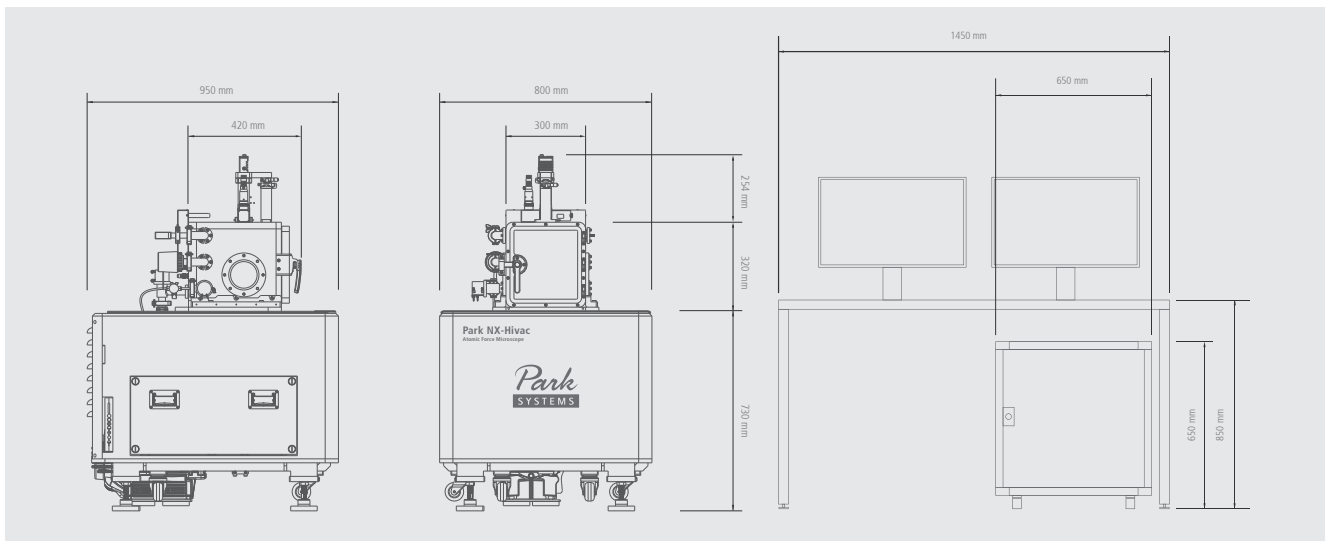
**Scanning conditions**  
 Scan Mode: SSRM  
 Cantilever: Full diamond  
 (k=27 N/m)



\* Current in vacuum condition showed stronger than ambient by better tip-sample contact



Scanner	Vision	Sample Stage	High Vacuum		
<b>XY scanner:</b> 50 $\mu\text{m}$ $\times$ 50 $\mu\text{m}$ (100 $\mu\text{m}$ $\times$ 100 $\mu\text{m}$ optional) <b>Z scanner:</b> 15 $\mu\text{m}$	Direct on-axis vision of sample surface and cantilever  <b>Field-of-view:</b> 840 $\mu\text{m}$ $\times$ 630 $\mu\text{m}$ (with 10 $\times$ objective lens) <b>CCD:</b> 5 M pixel	<b>Sample size:</b> Open space up to 100 mm $\times$ 100 mm using single sample and 10 mm $\times$ 10 mm using multi samples, thickness up to 20 mm <b>XY stage travel range:</b> 22 mm $\times$ 22 mm <b>Z stage travel range:</b> 24 mm <b>Focus stage travel range:</b> 11 mm	<b>Vacuum level:</b> Typically less than $1 \times 10^{-5}$ torr <b>Pumping speed:</b> Reach to $10^{-5}$ torr in about 5 min using Turbo & Dry pump		
Electronics	Software	Electronics	Software		
Integrated functions  4 channels of flexible digital lock-in amplifier Spring constant calibration (Thermal method) Digital Q control	<b>Park SmartScan™</b>  • 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	<b>Hivac Manager</b>  • Auto vacuum control software		
Options/Modes	Topography Imaging	Magnetic Properties	Dielectric/Piezoelectric Properties	Electrical Properties	Mechanical Properties
	• Non-Contact • Contact • Tapping	• Magnetic Force Microscopy (MFM)	• Piezoresponse Force Microscopy (PFM) • PFM with High Voltage • Piezoresponse Spectroscopy	• Conductive AFM (C-AFM) • UV Spectroscopy • Kelvin Probe Force Microscopy (KPFM) • KPFM with High Voltage • Scanning Capacitance Microscopy (SCM) • Scanning Spreading-Resistance Microscopy (SSRM) • Scanning Tunneling Microscopy (STM) • Electrostatic Force Microscopy (EFM)	• PinPoint Nanomechanical • Force Modulation Microscopy (FMM) • Nanoindentation • Nanolithography • Nanolithography with High Voltage • Nanomanipulation • Lateral Force Microscopy (LFM) • Force Distance (F/d) Spectroscopy • Force Volume Imaging
	Thermal Properties	Chemical Properties			
	• Scanning Thermal Microscopy (SThM)	• Chemical Force Microscopy with Functionalized Tip			
Accessories	• Temperature Controlled Stage    • Tilting Sample Chuck    • Snap-in Sample Chuck				



## Committed to contributing to impactful science and technology

Park Systems Corporation is a leading manufacturer of nanoscale microscopy and metrology solutions that encompasses the atomic force microscopy, white light interferometry, infrared spectroscopy and ellipsometry systems. Its products are widely used for scientific research, nanoscale engineering, and semiconductor fabrication and quality assurance. Park Systems provides a full range of AFM products from desktop to fully automated systems with integrated robotic arms. Furthermore, its product line includes WLI AFM, Photo-induced Force Microscopy spectroscopy and ellipsometry systems for those in the chemistry, materials, physics, life sciences, and semiconductor industries. In 2022, Park Systems acquired and merged Accrion GmbH, a leader in high-end ellipsometry and active vibration isolation, to form Park Systems GmbH, Accrion Division.

Park Systems is a publicly traded corporation on the Korea Stock Exchange (KOSDAQ) with corporate headquarters in Suwon, Korea, and regional headquarters in Santa Clara, California, Mannheim, Germany, Paris, France, Beijing, China, Tokyo, Japan, Singapore, India, and Mexico. To learn more, please visit [www.parksystems.com](http://www.parksystems.com).

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