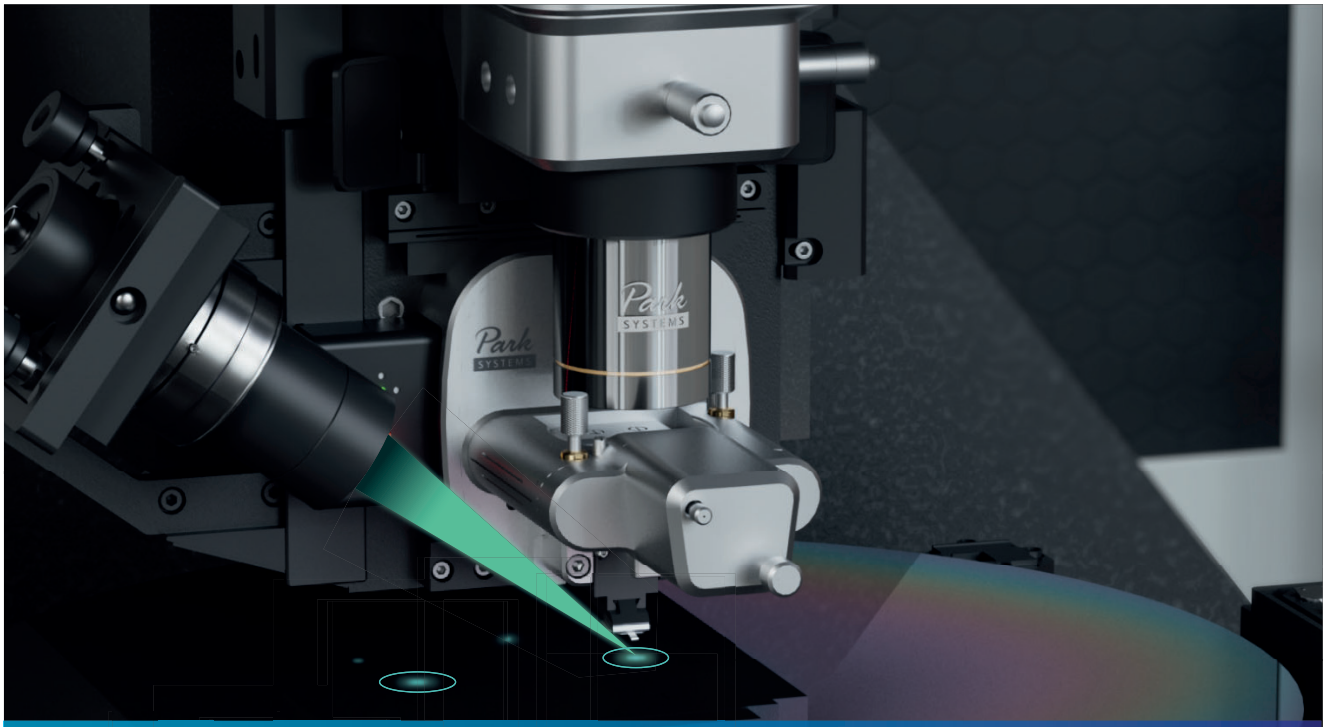
Enabling Nanosacle Advances

Park SYSTEMS

Park NX-Wafer

The industry's leading automated AFM system for in-line metrology solutions



Park NX-Wafer

The only wafer fab AFM with automatic defect review

High-Throughput Wafer-Fab Inspection and Analysis

- Automatic data acquisition and analysis of trench width, depth, and angle measurements
- Equipment Front End Module (EFEM) for automatic wafer handling
- Cleanroom compatibility and remote control interface

Accurate Sub-Angstrom Surface Roughness Control

- Industry's lowest noise floor of less than 1 Å rms throughout the entire wafer area
- Immunity from parameter-dependent results with True Non-Contact™ mode
- Preserving the sharpness of the tip end for surface roughness accuracy
- 10x - 20x longer tip lifetime than any other AFM

Full Automation of High Throughput Defect Imaging

- Direct linkage to defect mapping inspection tools without stage calibration
- Automatic coordinate translation and alignment of defect maps through enhanced vision
- Automated zoom-in AFM scan of specified defects
- Automated analysis of imaged defect types

Low Noise, High Throughput Atomic Force Profiler

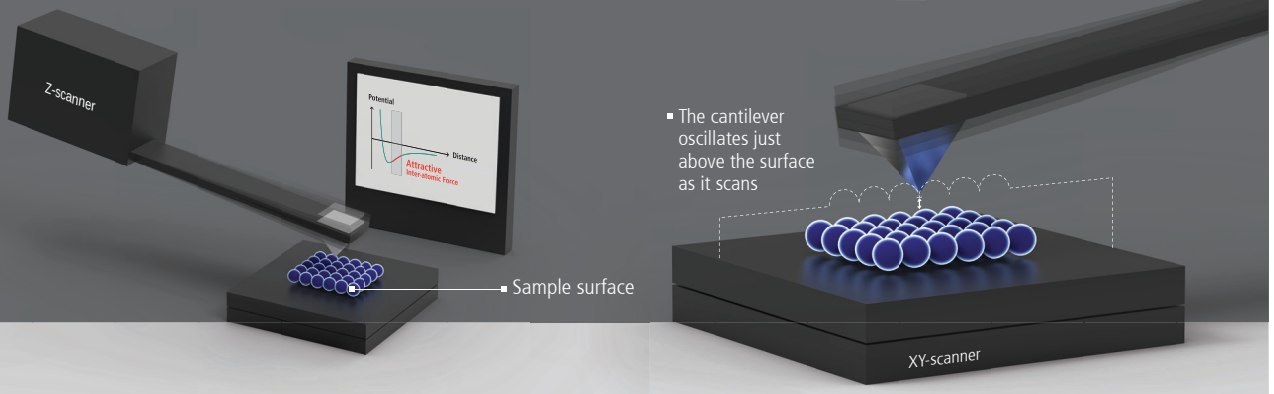
- CMP profiling up to 50 mm with long range traveling stage
- Industry leading sample topography repeatability measured by low noise Z detector
- Accurate surface height recording, even during high-speed profiling
- Superior tool-to-tool matching

True Non-Contact™ Mode

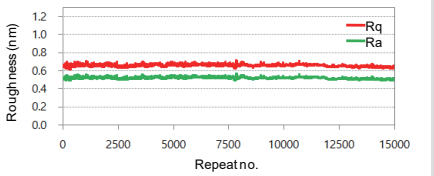
True Non-Contact™ Mode is a scan mode unique to Park AFM systems that produces high resolution and accurate data by preventing destructive tip-sample interaction during a scan.

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

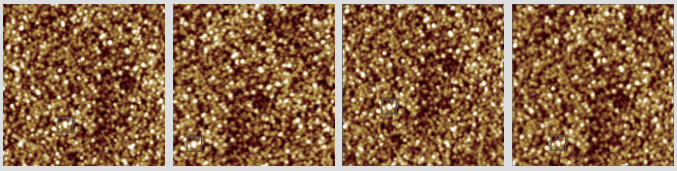
- Less tip wear → Prolonged high-resolution scan
- Non-destructive tip-sample interaction → Minimized sample modification
- Maintains non-contact scan over a wide range of samples and conditions



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.



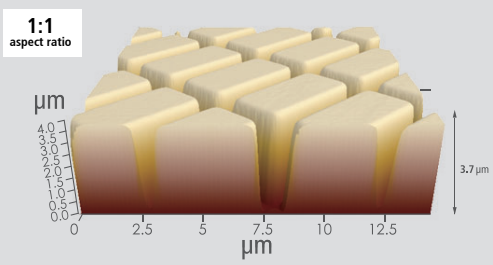
Repeat	1st	...	5000th	...	10000th	...	15000th	Total Avg.	1σ (%)
Rq(nm)	0.669		0.674		0.665		0.642	0.662	0.011 (1.720%)
Ra(nm)	0.527		0.535		0.525		0.508	0.524	0.010 (1.835%)



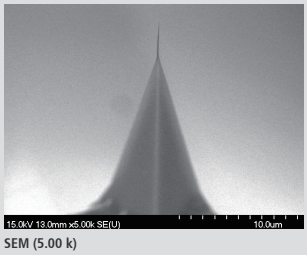
1st image | 5,000th | 10,000th | 15,000th

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.

Deep trench image

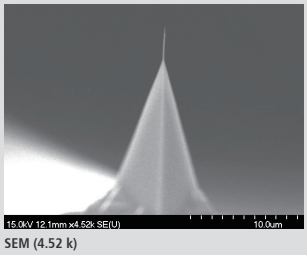


Before taking image



SEM (5.00 k)

After taking 20 images

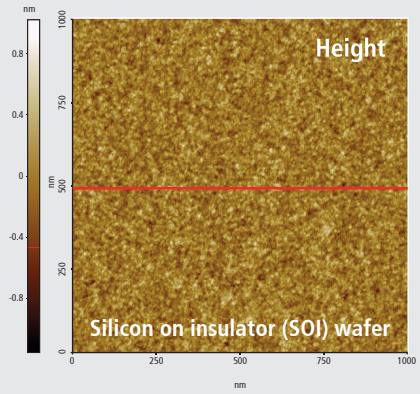


SEM (4.52 k)

Park NX-Wafer

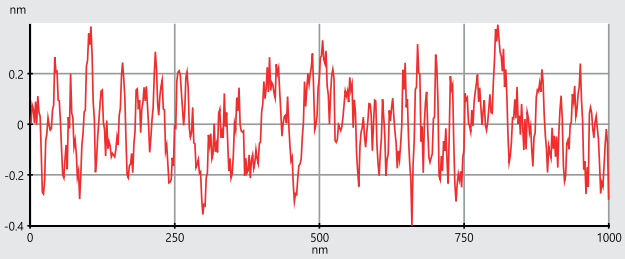
Productivity meets Accuracy

Sub-Angstrom Surface Roughness Control



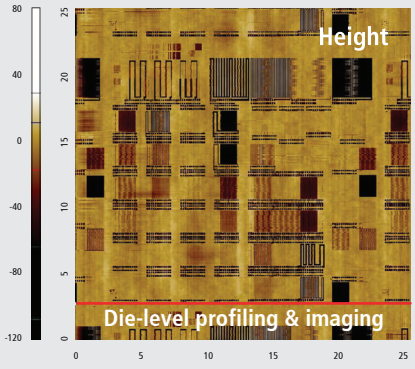
Extremely flat surface roughness of silicon on insulator (SOI) wafer.

Line Profile

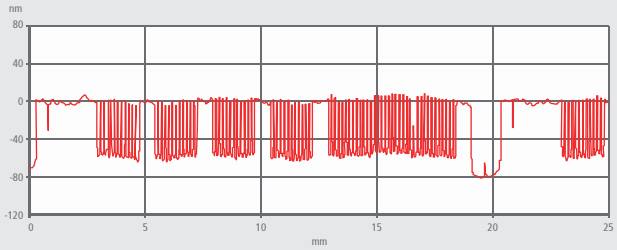


Semiconductor suppliers are developing ultra-flat wafers to address the ever-increasing need for shrinking device dimensions. However, there has never been a metrology tool capable of providing accurate and reliable measurements for the sub-Angstrom roughness of these substrate surfaces. By delivering the industry's lowest noise floor of less than 1 Å throughout the wafer area, and combining it with True Non-Contact™ mode, the Park NX-Wafer can make accurate, repeatable, and reproducible sub-Angstrom roughness measurements for the flattest substrates and wafers with minimized tip-to-tip variation. Very accurate and repeatable surface measurements can be obtained even for the long-range waviness measurement of scan sizes up to 100 µm x 100 µm.

Long Range Profiling for CMP Characterization



Line Profile



Planarization is the most important step in the back-end processes where metals and dielectric materials are used. Both local and global uniformity after chemical mechanical polishing (CMP) affect the yield of chip manufacturing significantly.
Accurate CMP profiling is a critical metrology necessary to optimize process conditions for best planarity and improve production yield.

Combining Park NX-Wafer with a sliding stage provides a long range profiling capability for CMP metrology. Due to the unique stage design of Park's automated AFM, the combined system provides very flat profiling and there is no need for complex background subtraction or past processing after each measurement in general. The Park NX-Wafer enables unprecedented CMP metrology of both local and global planarity measurements including dishing, erosion, and edge-over-erosion (EOE).

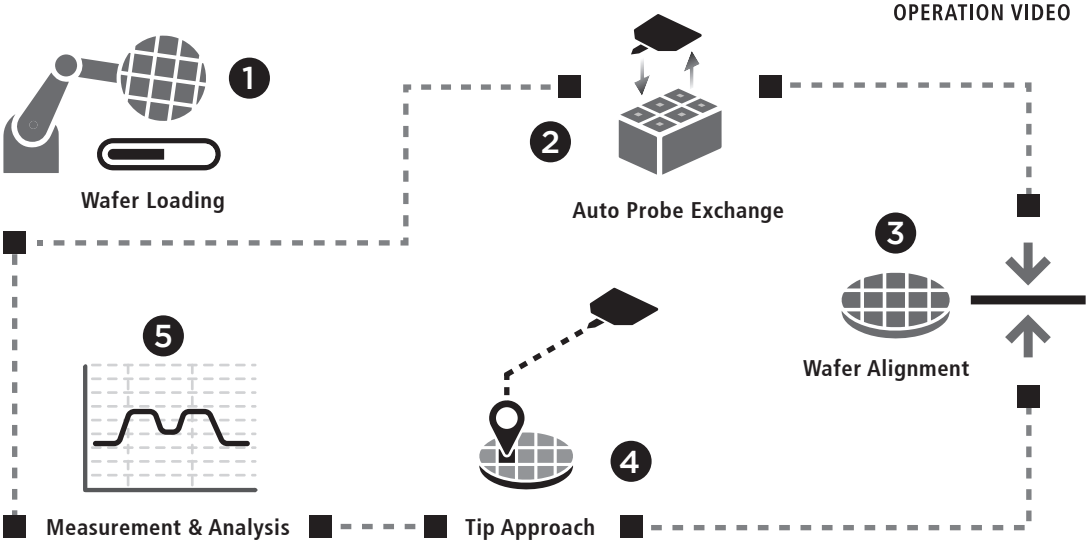
Automatic Defect Review for Bare Wafers and Substrates

The new 300 mm bare wafer ADR provides a fully automated defect review process from transfer and alignment of defect maps to the survey and zoom-in scan imaging of defects that uses a unique remapping process that does not require any reference marker on a sample wafer. Unlike SEM which leaves square-shaped destructive irradiation marks on defect sites after its run, the new Park ADR AFM enables advanced coordinate translation with enhanced vision that uses the wafer edge and notch to automatically enable linkage between a defect inspection tool and the AFM. Since it is fully automated, it does not require any separate steps to calibrate the stage of the targeted defect inspection system, increasing throughput by up to 1,000%.

Park NX-Wafer

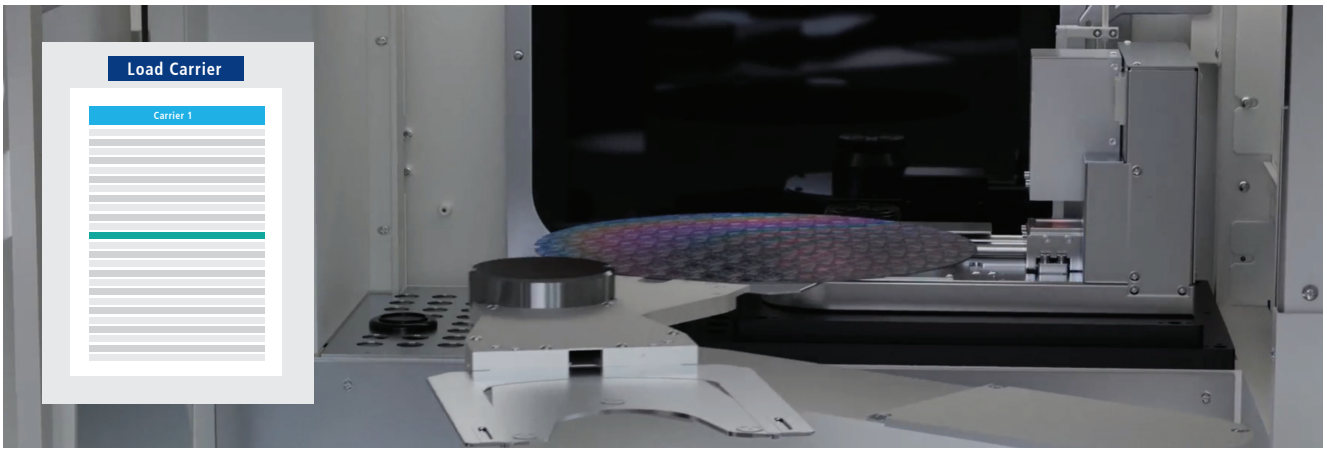
Auto Measurement Procedure

OPERATION VIDEO



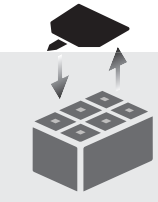
Wafer Loading

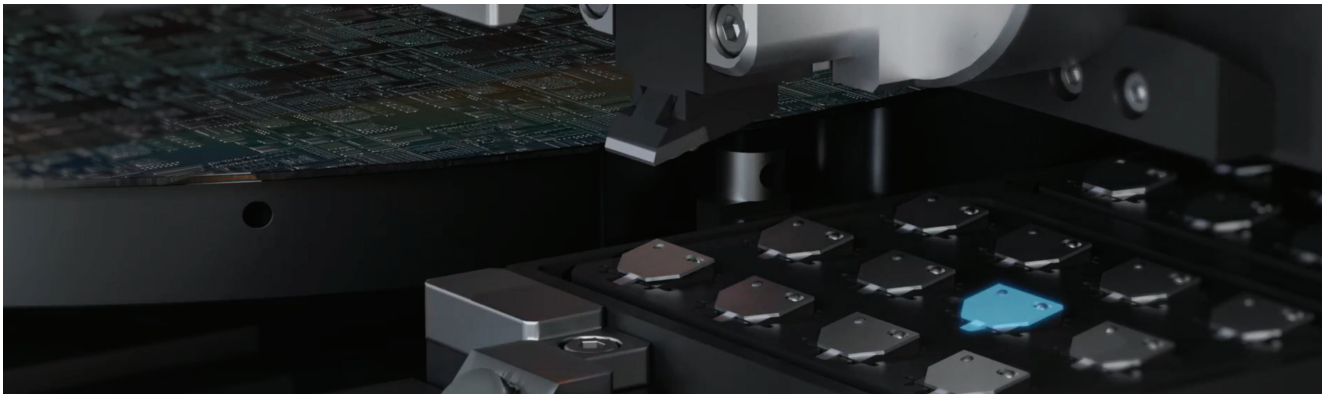
Wafer transfer to AFM stage by automatic wafer handler. It uses robotic mechanisms, sensors, and algorithms to ensure precise alignment and secure gripping of the wafer.



Auto Probe Exchange

Automatic replacement with a suitable probe for measurement and checking the tip position. This innovative technology greatly enhances efficiency and accuracy in various industries that rely on precise measurements and inspections.



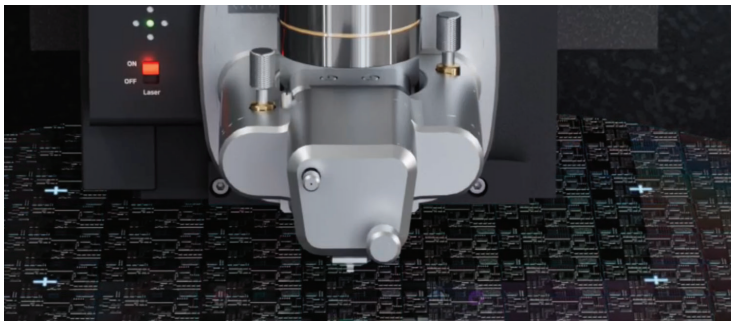


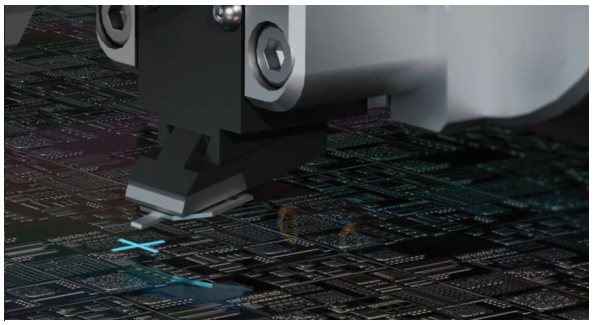
Wafer Alignment

Wafer alignment is a critical process in the semiconductor industry that involves mapping the coordinates of a wafer to the coordinates of the Atomic Force Microscope (AFM) stage.

Tip Approach

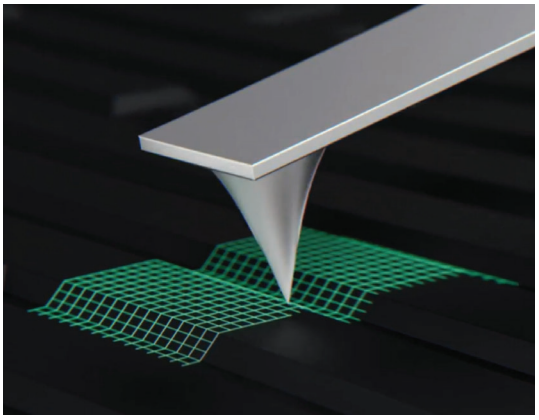
Fast tip landing on target surface. This multidimensional approach improves productivity, reduces production time, and enhances product quality.

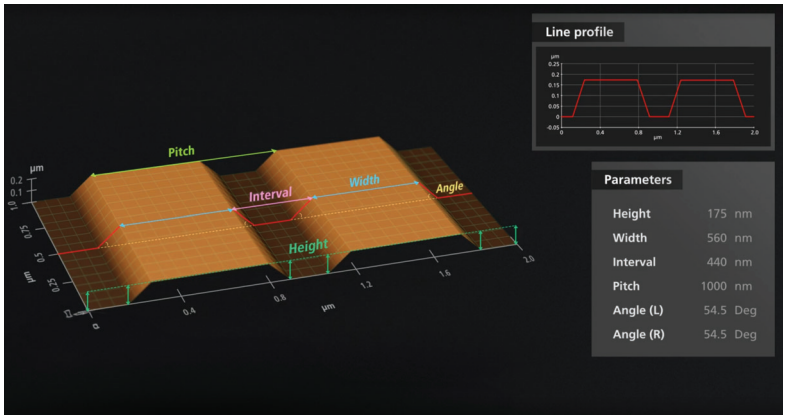




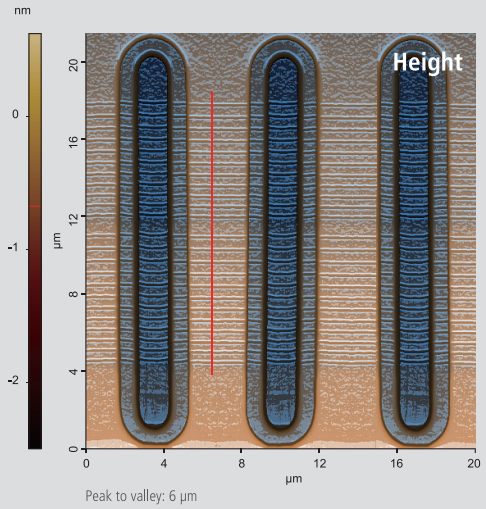
Measurement & Analysis

Automatic measurement and analysis based on preset recipe.



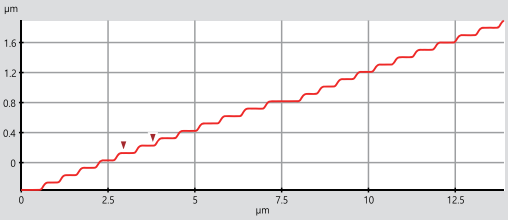


3D NAND flash



Peak to valley: 6 µm
RMS Roughness: 2 µm

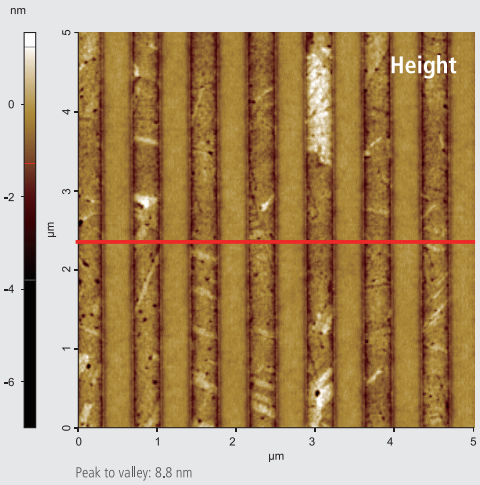
Line Profile



Cursor	ΔX (µm)	ΔY (µm)
Red	0.845	0.100

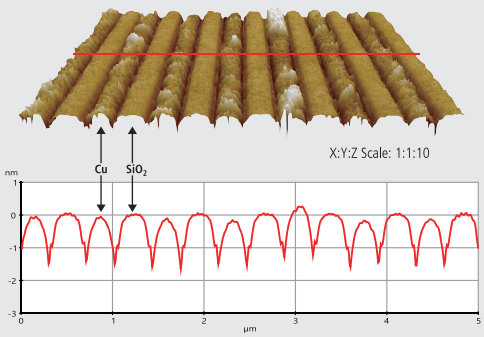
ΔY = Step height

Post CMP wafer



Peak to valley: 8.8 nm
RMS Roughness: 0.54 nm

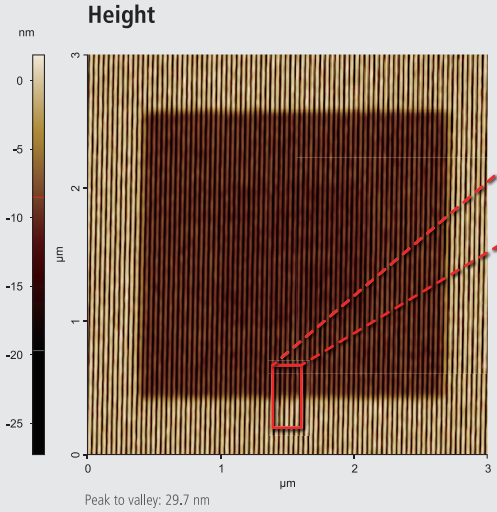
3D



Y: 1 nm/div

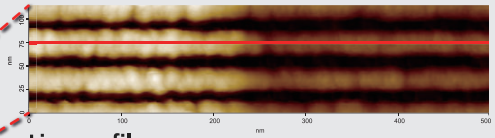
Damage of PR patterns

Height

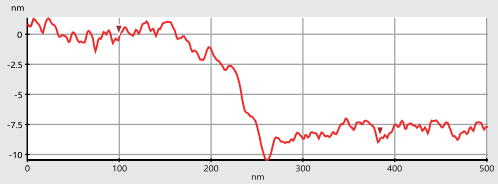


Peak to valley: 29.7 nm
RMS Roughness: 7.01 nm

Zoom-in height



Line profile



Cursor	ΔX (µm)	ΔY (µm)
Red	279.372	7.916

In Photo Resist (PR) patterns, approximately 8 nm height shrinkage was observed due to e-beam damage.

System Specification	200 mm Motorized XY stage	300 mm Motorized XY stage:	Motorized Z Stage	Motorized Focus Stage	Sample Thickness Allowance	COGNEX Pattern Recognition
	travels up to 275 mm × 200 mm, 0.5 µm resolution	travels up to 400 mm × 300 mm, 0.05 µm resolution	25 mm Z travel distance 0.08 µm resolution < 1 µm repeatability	8 mm Z travel distance for on-axis optics	Up to 20 mm (open space)	pattern align resolution of 1/4 pixel

Scanner Performances	XY Scanner	XY Scanner Resolution	Z Scanner Range	Z Scanner Resolution	Z Scanner Noise Floor
	Single-module flexure XY scanner with closed-loop control: 100 µm × 100 µm (large mode) 50 µm x 50 µm (medium mode) 10 µm × 10 µm (small mode)	0.15 nm (large mode)	15 µm (large mode) 2 µm (small mode)	0.016 nm (large mode) 0.002 nm (small mode)	< 0.05 nm

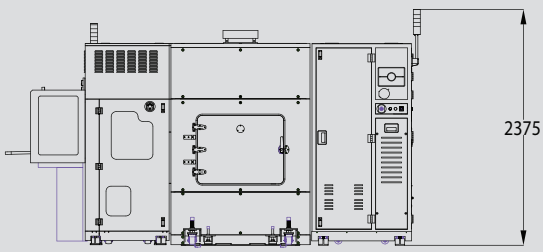
Dimension & Weight	200 mm System	300 mm System
	2732 mm (w) x 1100 mm (d) x 2400 mm (h) w/ EFEM, 2110 kg approx. (incl. Control Cabinet) Ceiling Height: 2000 mm or more Operator Working Space: 3300 mm (w) x 1950 mm (d), minimum	3890 mm (w) x 1770 mm (d) x 2375 mm (h) w/ EFEM, 3105 kg approx. (incl. Control Cabinet) Ceiling Height: 2500 mm or more Operator Working Space: 5090 mm (w) x 3370 mm (d)

Facility Requirements	Room Temperature (Stand By)	Room Temperature (Operating)	Humidity	Floor Vibration Level	Acoustic Noise
	10 °C ~ 40 °C	18 °C ~ 24 °C	30% to 60% (not condensing)	VC-D (6 µm/sec)	Below 65 dB

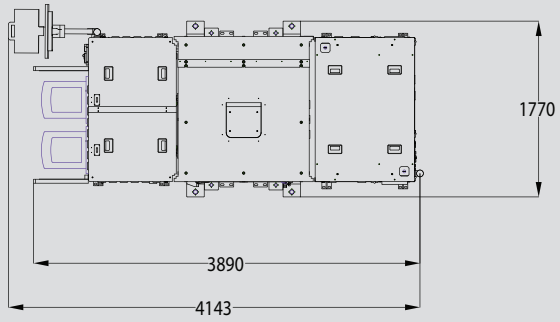
Pneumatics	Power Supply Rating	Total Power Consumption	Ground Resistance
Vacuum: -80 kPa CDA (or N2): 0.7 MPa	208 ~ 240 V, single phase, 15 A (max)	2 KW (typical)	Below 100 ohms

Systems with profiler specification may differ from standard system configurations. Please consult Park Systems for detailed information.

Park NX-Wafer 300 mm System (mm)



Park NX-Wafer 300 mm System (mm)



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 Accurion GmbH, a leader in high-end ellipsometry and active vibration isolation, to form Park Systems GmbH, Accurion 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.

Park Systems Americas
+1-408-986-1110 (USA)
+52-55-7100-2354 (Mexico)

Park Systems Europe
+49 (0)-621-490896-50 (Germany)
+33 (0)-6-07-10-87-36 (France)
+44 (0)-115-784-0046 (UK&Ireland)

Park Systems GmbH - Accurion
+49-551-999600 (Germany)

Park Systems Japan
+81-3-3219-1001 (Japan)

Park Systems Greater China
+86-10-6254-4360 (China)
+886-3-5601189 (Taiwan)

Park Systems SE Asia
+65-6634-7470 (Singapore)

Park Systems Korea
+82-31-546-6800 (Republic of Korea)

Park Systems India
+91-96869 51464 (India)

Park Systems Corporate Headquarters
To learn more about Park Systems, please visit www.parksystems.com or e-mail inquiry@parksystems.com

KANC 15F, Gwanggyo-ro 109, Suwon 16229, Korea Tel.+82-31-546-6800