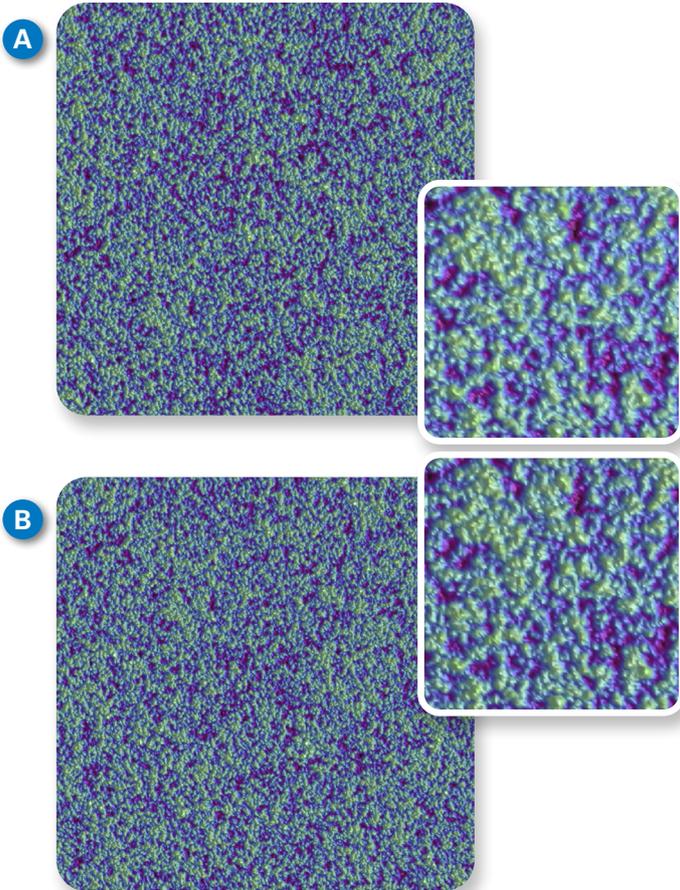


## Dimension FastScan Pro AFM

- Automated Nanometrology and Characterization

# ● Fast and Cost-Effective Precision Metrology for QA/QC/FA

The Dimension FastScan Pro™ with PeakForce Tapping® delivers the highest metrology-level speed and performance of any industrial atomic force microscope (AFM) available today. Designed specifically for high-volume, production environments, FastScan Pro enables automated or semi-automated measurements while ensuring the utmost ease of use and the lowest cost per measurement for quality control, quality assurance, and failure analysis.



An alkali-aluminosilicate sheet glass main property is characterized by its strength and scratch resistance, making it challenging to measure its nanometer topography consistently and reliably. Using FastScan AFM and a single Bruker HPI probe, a first image (A) rendered roughness  $R_q=0.99$  nm,  $R_a=0.79$ . Image no. 615 (B) rendered the same roughness;  $R_q=0.99$  nm,  $R_a=0.79$ . Insets are digitally zoomed images of scan no. 1 and no. 615 revealing insignificant topographical changes.

## Highest Resolution Imaging and Most, Precise Measurement Performance

PeakForce Tapping enables users to precisely control probe-to-sample interaction, enabling the lowest available imaging forces. This superior force control delivers the most consistent, highest resolution AFM imaging for the widest range of sample types, from soft polymers, thin films and electrical samples to very hard materials.

## Unique, Quantitative Results, Whatever You Measure

PeakForce Tapping's piconewton force sensitivity simultaneously and uniquely combines the highest resolution AFM topography with quantitative, nanoscale electrical and mechanical property mapping, enabling users of all experience levels to achieve precise, accurate measurements.

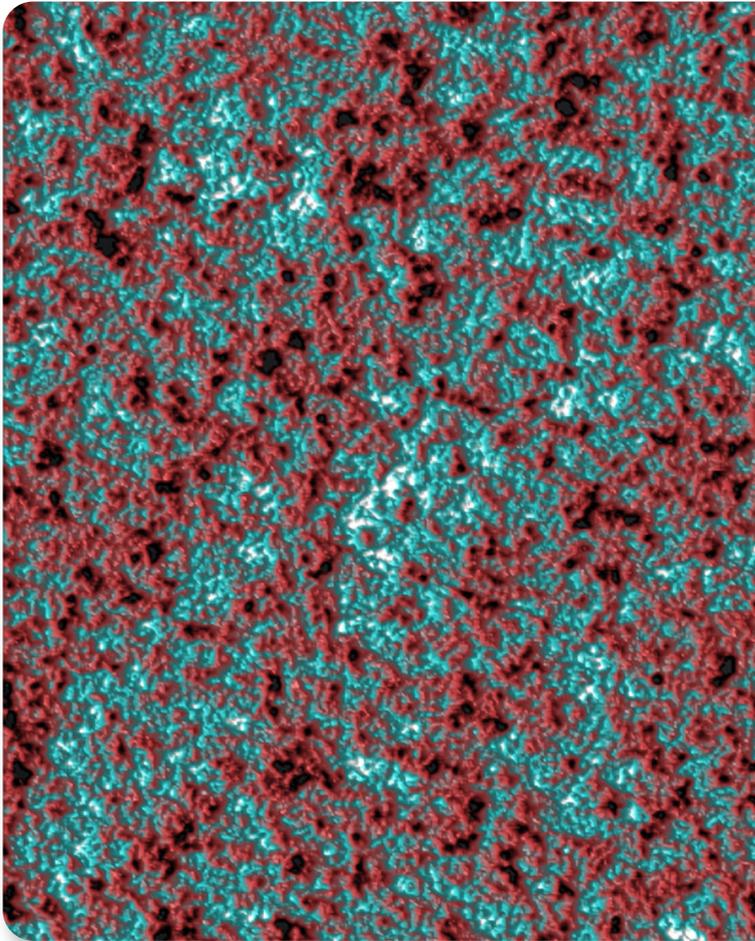
## Easy to Use, Making Every User an AFM Expert

AutoMET™ recipe software and ScanAsyst® ensure unmatched AFM ease of use by eliminating operation complexity. The result is consistently better data and faster metrology results regardless of the operator's AFM experience level.

## Most Reliable Platform and Unrivalled Support

Bruker has the largest service and applications support network of any AFM supplier, with regional customer support and programs for extended support. Major industrial companies and leading data storage and semiconductor manufacturers throughout the world have chosen Bruker systems for their reputation as the most reliable precision metrology platforms.

# ● Industry-Leading Bruker AFM Technology for Production



PeakForce Tapping provides an exceptional surface characterization capability on low-roughness samples, with precise control of probe-to-sample interaction, enabling the lowest available imaging forces and long tip life over hundreds of data scans. This superior force control results in the most consistent, highest resolution AFM imaging for very hard materials. Sample shown is an extremely flat glass substrate with low roughness values of  $R_q=0.194$  nm,  $R_a=0.153$  nm.

## Revolutionary PeakForce Tapping Enables Exceptional Surface Characterization

Bruker's proprietary PeakForce Tapping is one of the most significant breakthroughs in AFM technology. By precisely controlling the peak normal force at every pixel, it minimizes the lateral force on the probe.

- Samples protected from contact damage
- Extended probe lifetimes
- Consistent measurement performance

## Unique FastScan Technology Delivers Highest Throughput

FastScan technology sets new standards of AFM performance, enabling  $>10x$  scan rate increases without loss of data quality for the highest AFM throughput in the most challenging metrology applications.

- Highest AFM throughput with proven FastScan high-bandwidth technology
- No loss of accuracy at high scan rates for immediate efficiency improvements
- Automated scanner for seamless workflow in automated measurements

## Proprietary FastScan AFM Probes Provide Lowest Cost per Measurement

Bruker's FastScan probes make the most of PeakForce Tapping's precise control of probe-to-sample forces to ensure the highest performance and repeatability.

- Routine high-speed, high-resolution topography measurements
- Repeatable high-speed, electrical and magnetic measurements
- Minimizes tip to tip measurement variations

# ● A Proven AFM Performance Leader

The Dimension platform has the largest installed base of any AFM in the semiconductor, data storage, high-brightness LED and polymer industries. Its open-access platform, large- or multiple-sample holders, and numerous ease-of-use features open up the power of atomic force microscopy to manufacturers, delivering the best solution for nanoscale metrology in QA/QC/FA—cost effectively and reliably.

- Automated, highest accuracy metrology
- Automated measurements for semi, data storage, and HB-LED (multiple small-format wafers to single 300 mm wafer capability; 300 mm requires optional sample chuck)
- Reliable platform designed for use in industrial environments

## NanoScope Provides Fast, Intuitive Sample Navigation

The FastScan Pro's NanoScope® navigation interface provides fast and intuitive sample navigation to quickly and easily find your area of interest. Pan and zoom features for fast setup and scan speeds up to 100 times the standard AFM scan rates significantly reduce measurement time.

- Easy step-by-step navigation makes measurement sessions simple
- Pan and zoom efficiently locate the region of interest
- Preconfigured software settings easily integrate the system into manufacturing workflow

## ScanAsyst Eliminates the Complexity of AFM Operation

ScanAsyst is a PeakForce Tapping-based image-optimization mode that enables users of all experience levels to obtain the highest measurement performance. The user simply selects a sample scan area and scan size, and ScanAsyst takes over, creating a turnkey solution for AFM imaging. ScanAsyst eliminates the need to navigate complicated AFM interfaces and parameter settings. Intelligent algorithms automatically and continuously monitor the image quality and make needed parameter adjustments.



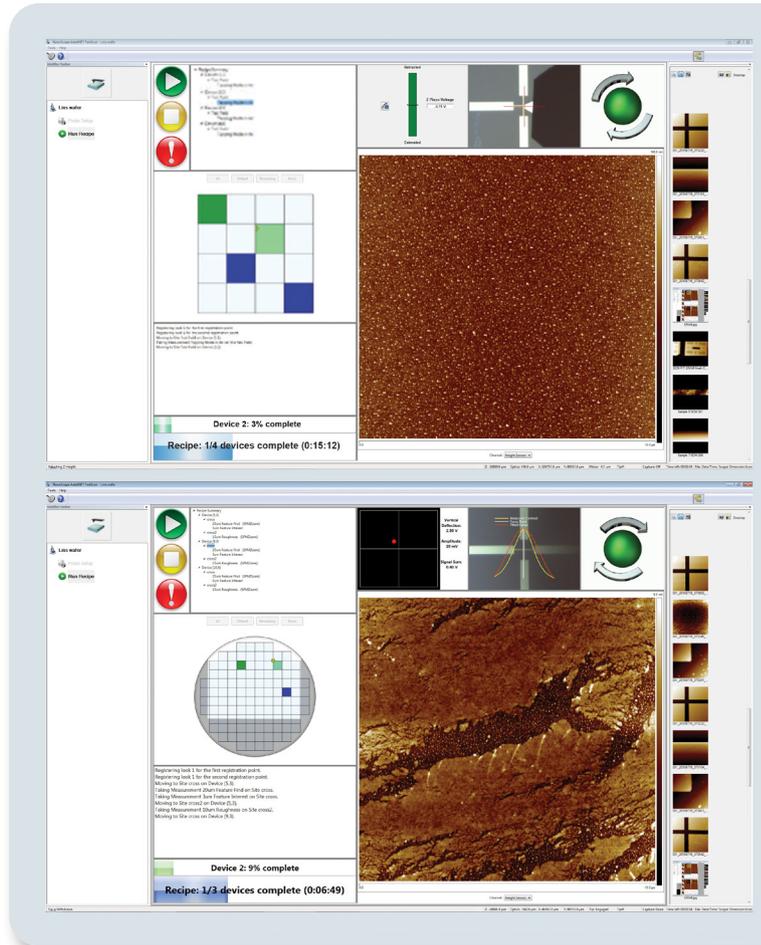
## Automation Software Ensures Exceptional Ease of Use

New AutoMET full-recipe software delivers fast, automated metrology, simple operation, and AFM adaptability for easy capture of critical-to-quality measurements needed in production.

- Automated measurements on multiple samples or a single large sample for nanoscale characterization across multiple locations
- Optical and AFM image pattern recognition, tip-centering, full wafer or grid mapping support, and image-placement accuracy within tens of nanometers
- Comprehensive yet simple recipe writing for the advanced user or engineer available for real-time and offline use
- Easy setup to align sample to probe and alignment corrections to AFM environment

## Data Analysis Flexibility for Varied Measurement Needs

NanoScope Analysis is a robust software package that supports remote data analysis of images via linked communication to FastScan Pro. This greatly expands the capability for analysis of data, either in real-time on the FastScan Pro or offline at your desk.



Top: Recipe window showing grid-based layout for user-defined measurement locations on rectangular or square scan areas. Lower: Recipe window showing wafer-based layout for precise, user-defined X-Y measurement locations within a wafer.

**1 Select Sample Site**

Site Name	X	Y	Enabled
Trench	1256.0	708.3	<input checked="" type="checkbox"/>
Via	1121.6	2638.7	<input checked="" type="checkbox"/>

**Site Assignments**

- Sites
  - Trench
    - 30um Overview
    - 7um Depth
    - 1um Detail
  - Via
    - Capture Video
    - 5um PFT
    - 750nm 4to1 HiRes PFT

**2 Create/Edit Measurements**

Measurement Name	Mode	Zoom	Advanced
30um Overview	Tapping		...
7um Depth	Tapping		...
1um Detail	Tapping		...
5um PFT	PeakFor		...
750nm 4to1 HiRes PFT	PeakFor		...

Easy measurement recipe creation, allows engineers to define location by name, assign any type, and number measurements at each location.

# ● Specifically Designed for Measurements in a Production Environment

## Highest Accuracy Roughness, Depth and Height Measurements

Dimension FastScan Pro provides highly repeatable and accurate roughness, height and depth measurements, from sub-nanometer steps to high-aspect ratio trenches using PeakForce Tapping or TappingMode.

## Most Comprehensive Defect Review Characterization

Nanoscale defects can be located and characterized on a variety of wafers, substrates and sliders. PeakForce QNM can uniquely provide combined 3D imaging and mechanical property information.

## Widest Range of Measurement Types

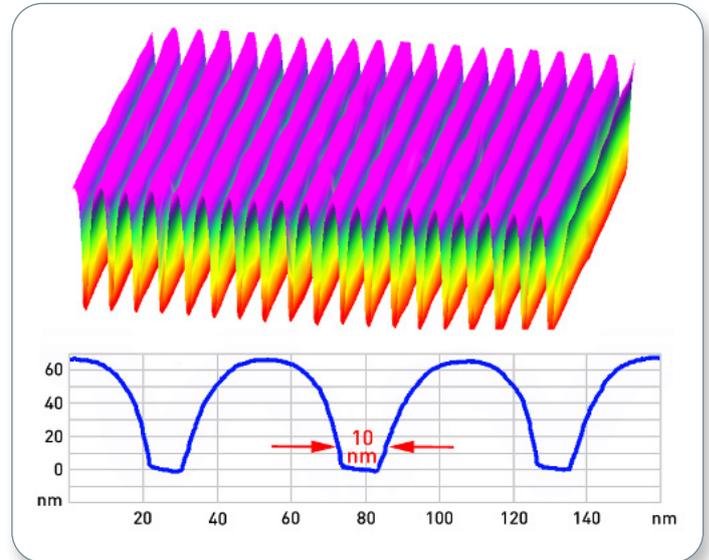
From our newest PeakForce Tapping modes to traditional AFM modes, FastScan Pro provides the greatest range and flexibility to meet your specific measurement and characterization needs on a wide range of samples.

## Unique Fast Nano-Electrical Measurements

FastScan technology with Conductive-AFM (CAFM) can perform nanoscale current measurements at high scan rates, significantly increasing the efficiency of failure analysis measurement. Using a small magnetic force microscopy (MFM) cantilever, FastScan Pro provides greater than 10x scan rate improvements for MFM applications with exceptional data quality using PeakForce Tapping. PeakForce KPFM™ provides the highest spatial resolution and most accurate measurements of surface potential. PeakForce TUNA™ provides the most sensitive conductivity measurements.

## Precise Nanoscale Mechanical Mapping

Bruker's unique PeakForce QNM® and FastForce Volume™ nanoscale mechanical mapping modes can precisely map mechanical properties—modulus, stiffness, adhesion, dissipation, and deformation—while simultaneously imaging sample topography and electrical properties. PeakForce QNM enables non-destructive measurements on polymers, thin films, and nanoscale defects not measurable by transmission electron or scanning electron microscopy techniques.



Trenches are difficult to image with typical imaging modes due to excessive damping of the probe oscillation. ScanAsyst easily reaches the bottom of trenches. In this example, trenches with a depth of ~65 nm and a width of ~50 nm are routinely measured with standard Bruker probes.

# ● Unlimited Applications

## Semiconductor

- Bare wafer roughness metrology and defect review characterization
- Nanometer-node electrical device characterization and fault isolation
- Accurate step height and depth metrology measurements

## Data Storage

- Most precise, highest resolution and high high-throughput, production-based slider metrology
- Media substrate roughness and defect review characterization with outstanding resolution
- Electrical and magnetic failure analysis characterization for wafer, media, and slider

## Polymers and Thin Films

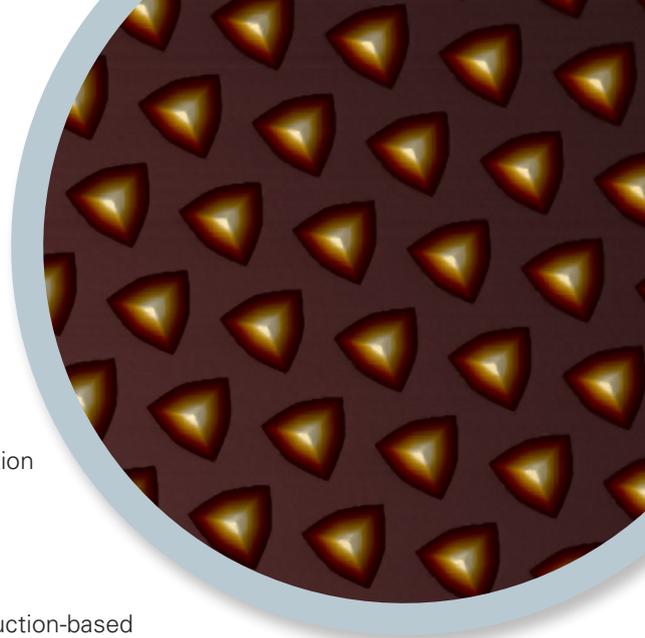
- high-throughput, topography measurements for quality control
- Simultaneous topography and mechanical property mapping
- Suitable for a wide range of block co-polymers

## High-Brightness LED and Solar Materials

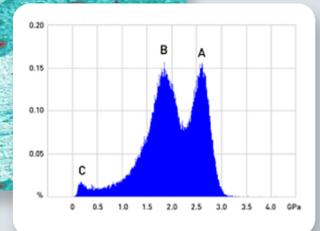
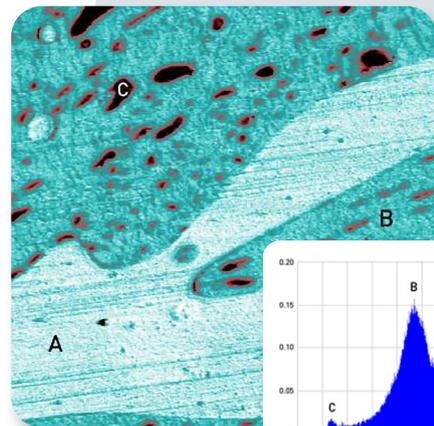
- Automated HB-LED pattern sapphire (PSS) depth and shape metrology
- Precise HB-LED substrate roughness
- Electrical characterization of HB-LED and solar materials

## MEMS Manufacturing

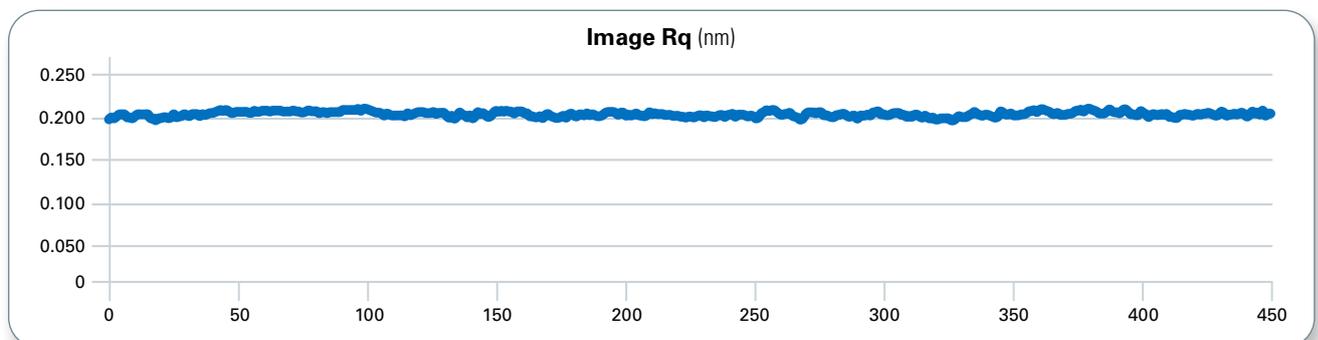
- Automated measurement of roughness, height, and shape
- Mechanical property characterization (displacement, strain) of actuators
- Electrical characterization of MEMS devices



Semi-automated 24/7 operations using a Dimension AFM to characterize 3D geometry for process control.



Modulus map of a multi-component polymer blend imaged using PeakForce QNM. There are three different components clearly present, the light blue component (A), the darker blue component (B), and the red/black component (C). (7  $\mu\text{m}$  scan).



Bruker's AFMs and high-performance industrial probes provide consistent and reliable measurements for the most demanding critical-to-quality nanoscale measurements.

	Icon Scan Head	FastScan Scan Head
X-Y scan range	90 $\mu\text{m}$ x 90 $\mu\text{m}$ typical, 85 $\mu\text{m}$ minimum	35 $\mu\text{m}$ x 35 $\mu\text{m}$ typical, 30 $\mu\text{m}$ minimum
Z range	10 $\mu\text{m}$ typical in imaging and force curve modes, 9.5 $\mu\text{m}$ minimum	$\geq 3$ $\mu\text{m}$
Vertical noise floor*	<35 pm RMS, height sensor in appropriate environment, typical imaging BW (up to 625 Hz)	<55 pm RMS, height sensor in appropriate environment (up to 625 Hz)
X-Y position noise	$\leq 0.15$ nm RMS typical imaging BW (up to 625 Hz)	$\leq 0.20$ nm RMS typical imaging BW (up to 2.5 kHz in adaptive mode)
X-Y flatness (30 $\mu\text{m}$ range)	NA	$\leq 3$ nm
Integral nonlinearity (X-Y-Z)	$< 0.50\%$	
Scanner laser alignment	Manual	Automated laser and detector alignment
Sample size/holder	200 mm vacuum chuck for samples $\leq 200$ mm in diameter, $\leq 15$ mm thick	
Optional sample size/holder	300 mm vacuum chuck for samples $\leq 300$ mm in diameter, $\leq 15$ mm thick	
Motorized position stage (X-Y)	Inspectable area; 200 mm x 200 mm, $\pm 6$ $\mu\text{m}$ repeatability	
	Bidirectional positional accuracy enabled by automated software recipes; 95%, $< \pm 2$ $\mu\text{m}$ with optical pattern recognition and $< 50$ nm through tip centering and SPM zoom features	
Microscope optics	5MP digital camera; 180 $\mu\text{m}$ to 1465 $\mu\text{m}$ viewing area, digital zoom and motorized focus	5MP digital camera; 130 $\mu\text{m}$ to 1040 $\mu\text{m}$ viewing area, digital zoom and motorized focus
Controller/Software	NanoScope V/NanoScope v9.1 and later	
AutoMET automation software	AutoMET software including global wafer registration using pattern recognition to compensate wafer skew and offset; Tip centering to compensate tip offset; Autofocus on tip and sample; Die selector by map graph	
Workstation	NanoScope V, stage controller, HV amplifiers, computer, ergonomic design with immediate physical and visual access	
Vibration and acoustic isolation	Integrated (refer to installation requirements for additional information)	
EH&S compliance	CE and UKCA certified	

\* Dependent on facility environmental noise emissions. Consult Bruker specialist to establish a plan for ultimate performance.

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