BRUKER

ATOMIC FORCE MICROSCOPY

Dimension Nexus

Intersection of High Performance
and Unbeatable Value

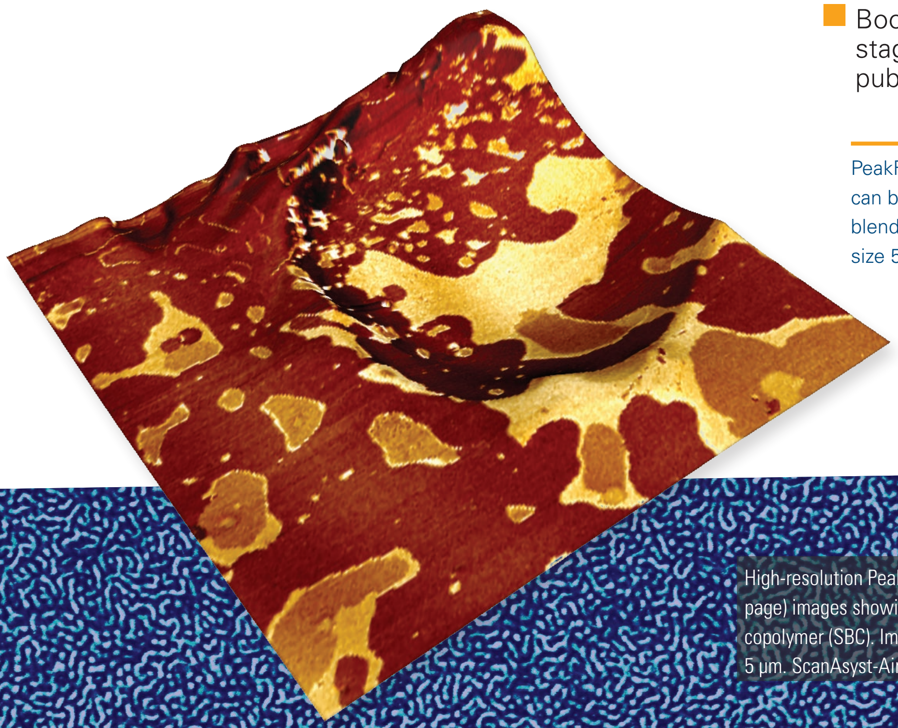
Dimension Nexus

Redefining the Quintessential Value AFM

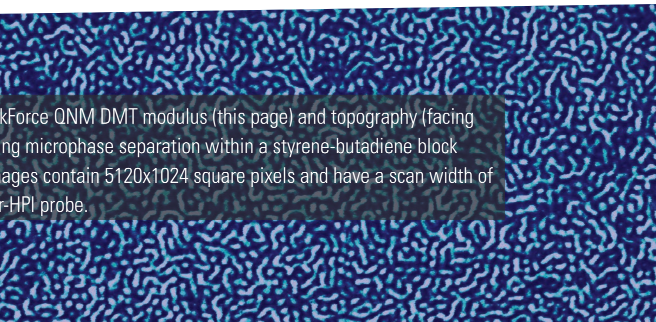
As the latest addition to Bruker’s industry-leading Dimension® atomic force microscope (AFM) product line, Dimension Nexus™ delivers an ideal combination of data quality, experiment flexibility, and ease of use in a small-footprint system. It incorporates the milestone innovations of Bruker's NanoScope® 6 controller and PeakForce Tapping® technology to deliver more functionality than competing systems in its class. Whether in a multi-user facility, academic research group, R&D laboratory, or industry setting, Nexus will become the core of your research activities.

Only Dimension Nexus:

- Provides ultimate versatility and value with an expansive suite of available AFM modes and scripting capabilities.
- Enables accurate, repeatable metrology and class-leading performance for atomic- to molecular-resolution imaging.
- Boosts productivity with a programmable, motorized stage on a compact system for high-throughput and publication-ready results every time.



PeakForce quantitative nanomechanics (PeakForce QNM®) can be used to map distribution of components in polymer blends. PS-PMMA-PVC sample courtesy of U. Mons. Scan size 5x5 µm, RTESPA-150 probe.



High-resolution PeakForce QNM DMT modulus (this page) and topography (facing page) images showing microphase separation within a styrene-butadiene block copolymer (SBC). Images contain 5120x1024 square pixels and have a scan width of 5 µm. ScanAsyst-Air-HPI probe.

Latest-Generation Controller Enables the Most Powerful AFM Modes

Central to the best-in-class performance of Dimension Nexus is NanoScope 6. As the driving power behind many of Bruker's proprietary AFM innovations, including PeakForce Tapping technology, this controller platform delivers an unrivaled range of unique capabilities and ease-of-use features.

NanoScope 6 Controller

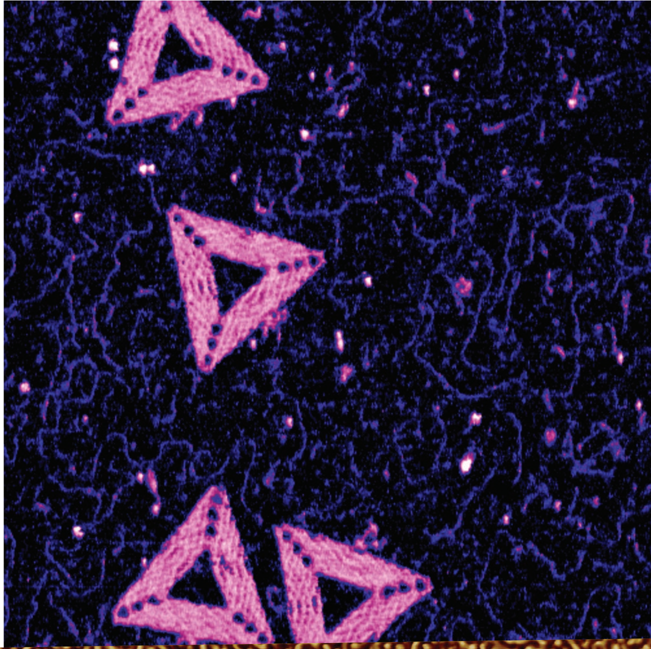
Featuring the highest speeds, lowest noise, and utmost AFM mode versatility, Bruker's NanoScope 6 AFM controller provides unprecedented efficiency and customizability for investigating material properties. Its open-architecture design allows users to quickly tailor and optimize scanning parameters to suit even the most demanding applications. Dimension Nexus uses this controller technology to deliver ultimate ease of use without compromising function or flexibility.

PeakForce magnetic force microscopy (PeakForce MFM) can easily resolve magnetic domains (bits) on a 20 TB hard disk drive. Scan size 2.5x2.5 µm, PFMFM-LM probe.

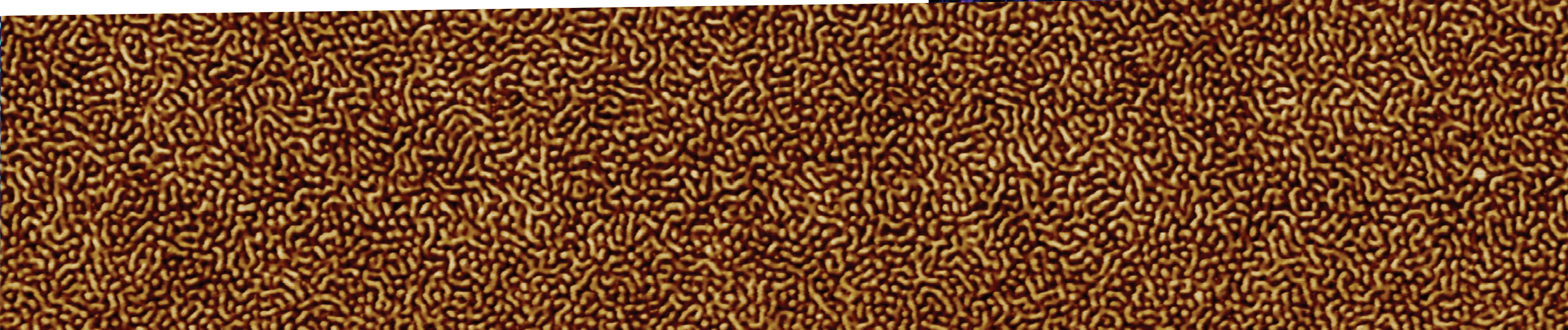
PeakForce Tapping Technology

PeakForce Tapping is a non-resonant AFM mode that uses a real feedback loop to precisely control probe-sample interactions. This superior force control enables the lowest-available imaging forces to provide the most consistent, highest-resolution AFM imaging for the widest range of sample types, from the most delicate bio-related samples and polymers to hard materials. PeakForce Tapping piconewton-level force sensitivity also enables the simultaneous acquisition of correlated and quantitative mechanical, electrical, and chemical property mapping for a more complete understanding of materials at the nanoscale. ScanAsyst® self-optimizing imaging further maximizes ease of use, empowering researchers of all experience levels to make new discoveries.

The adoption rate of PeakForce Tapping remains unprecedented, with close to 10,000 publications in the fifteen years since its release. This includes over 4500 publications using PeakForce QNM and more than 1000 using PeakForce electrical modes. That's about two publications every day for the past fifteen years!



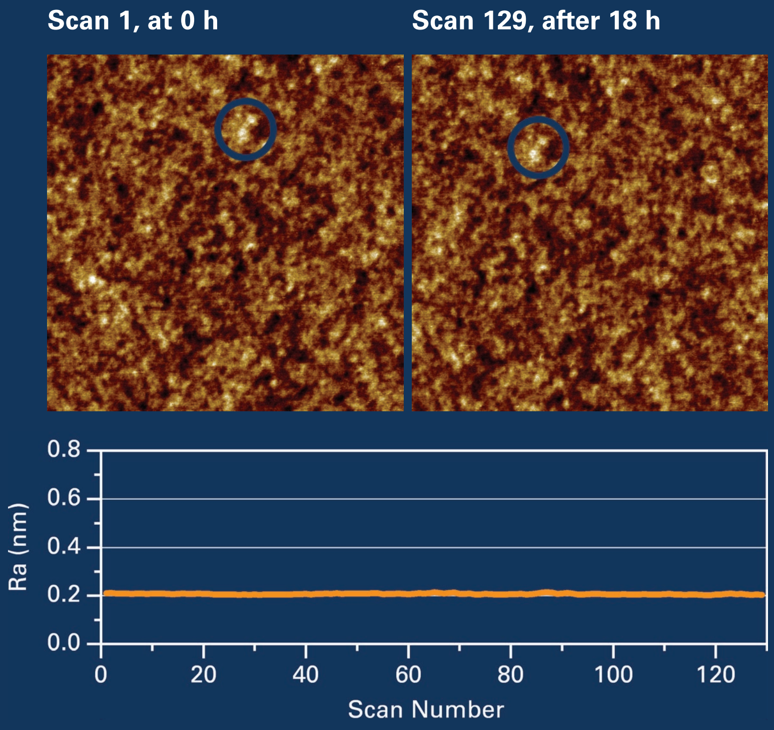
ScanAsyst images of triangular DNA origami in fluid. The individual strands that make up these nanostructures are clearly observed, as are single-stranded DNA molecules on the substrate background. Scan size 500x500 nm, ScanAsyst-Fluid+ probe.



Core Performance and Value in Every Scan

Through a combination of cutting-edge hardware, software, and dedicated AFM probes, Nexus delivers the highest performance in its class for a wide range of sample types in research and industry.

Dimension Nexus can achieve sub-molecular to atomic lattice resolution and perform highly accurate and repeatable metrology measurements. The closed-loop XYZ scanner incorporates temperature-compensating position sensors and is driven by the low-noise electronics of NanoScope 6. The scanner is mounted to a sturdy, drift-compensated bridge structure with an integrated granite base and a tabletop acoustic enclosure. Repeatability is maximized when using PeakForce Tapping modes, where the ultra-low forces used preserve tip quality and minimize sample degradation.


Scan 1, at 0 h

Scan 129, after 18 h

Topography images and measured surface roughness (plot) of SiO_2 wafer acquired continuously over 18 h in PeakForce Tapping mode. No tip wear or sample degradation is observed with minimal drift (note circled feature).

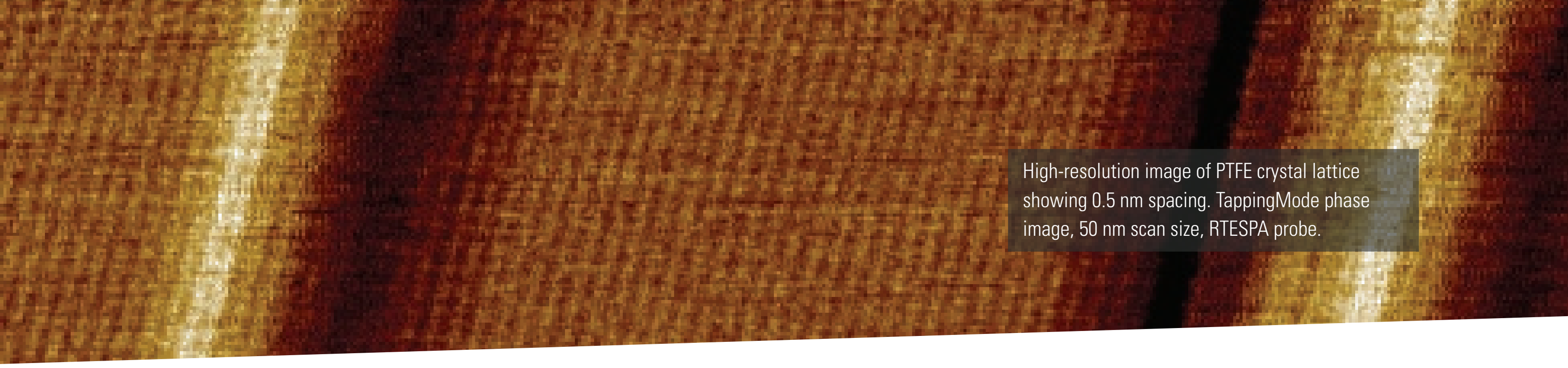
With Nexus, high throughput is just as important as quality results. NanoScope 6 enables high-speed data capture and high-pixel-density images (5120x5120) in eight channels simultaneously. Simplified setup, intuitive software workflow, scripting for automated measurements, and dedicated modes like Fast Tapping all streamline your AFM studies to accelerate time to results.

An Array of Applications

Nexus is a valuable addition to any lab or multi-user research facility. It offers a truly incredible 50+ modes and accessories that come either standard or as options to be added at any time. With Nexus, your priorities can be addressed:

- Mapping nanomechanical properties of polymers and composite materials
- Characterizing graphene, moiré superlattices, and other 2D materials at the nanoscale
- Correlating structural and ferroelectric properties of perovskites in photovoltaics
- Conducting in-situ and operando studies of the local electrochemical activity of lithium-ion batteries
- Quantifying nanoscale surface roughness of semiconductor thin films and substrates
- Manipulating and characterizing the electrical properties of DNA nanowires for nanoelectronic devices

NanoScope 6 Controller and Dimension Nexus



High-resolution image of PTFE crystal lattice showing 0.5 nm spacing. TappingMode phase image, 50 nm scan size, RTESPA probe.

More Unique Modes for More New Insights

Dimension Nexus is a cost-effective, high-performance AFM with extensive upgradability that empowers researchers with any application or budget to begin and expand their AFM studies.

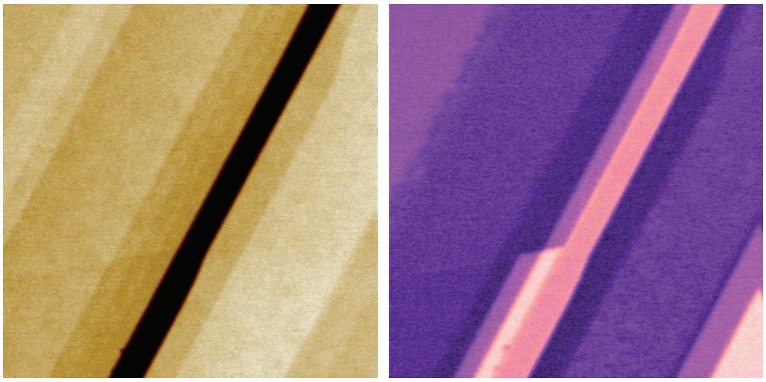
Nexus grows with your research needs. With an expansive and continually growing suite of Bruker AFM modes, Nexus is easily customizable and expandable for the most demanding research environments.

Capabilities Far Beyond Topographical Imaging

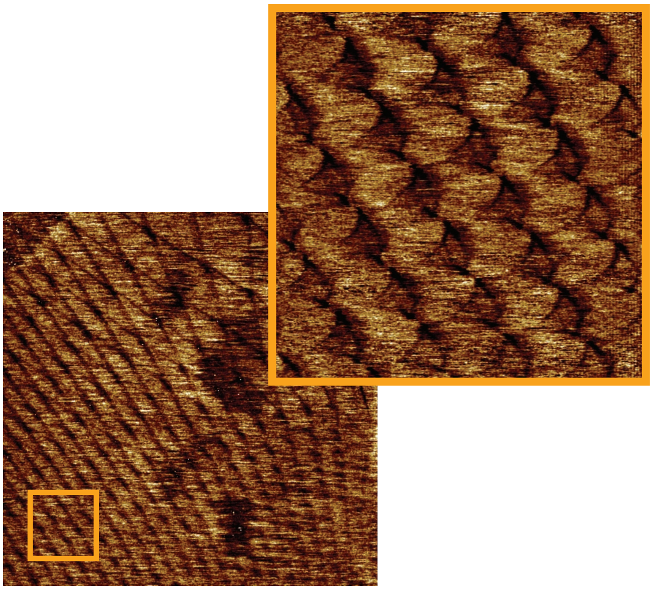
AFM has become much more than a topographical imaging tool. Built on a legacy of innovation, Bruker has an unrivaled modes portfolio of over 50 imaging modes and variants, the majority of which are compatible with Nexus. These unique measurement modes include:

- **AFM-nDMA**—First and only AFM-based viscoelastic measurements tied directly to bulk DMA
- **PeakForce QNM**—High-resolution quantitative mapping of mechanical properties
- **PeakForce TUNA™**—Highest-resolution current mapping on the most fragile samples
- **TR-DFM**—Increased sensitivity to lateral (frictional) forces for highest-resolution imaging of 2D materials
- **DataCube modes**—Hyperspectral imaging and management for rich, 3D datasets

See the specifications page for full list of available modes on Dimension Nexus.



Hexagonal boron nitride (hBN) imaged with Kelvin probe force microscopy (KPFM). Topography image (left) and corresponding surface potential map (right) are 6x6 µm, and were acquired using an SCM-PIT-V2 probe.



High-resolution topography images of a van der Waals heterostructure showing a moiré superlattice. Images collected in torsional resonance dynamic force microscopy (TR-DFM) with a FESPA probe. Scan sizes 1x1 µm and 200x200 nm (orange box).

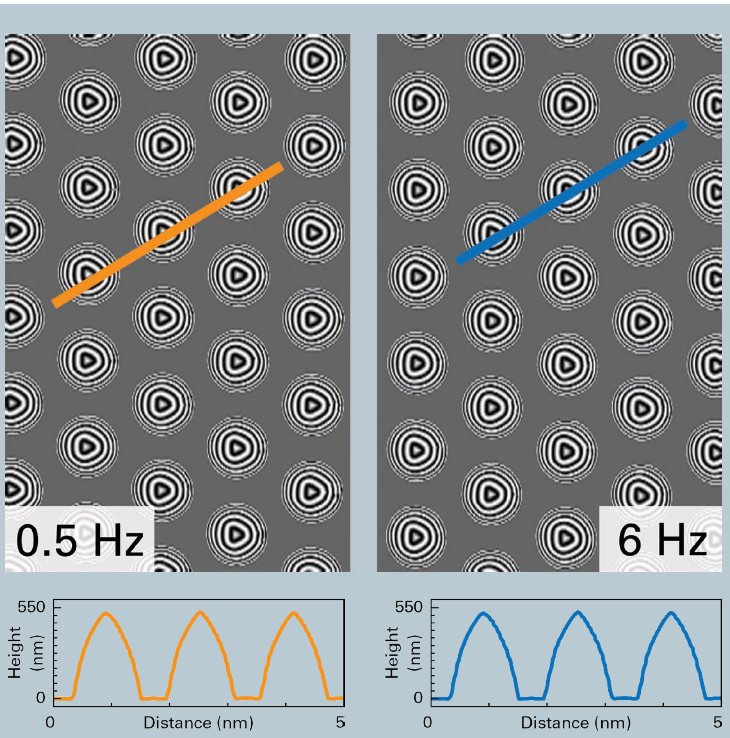
Fast to Data, Fast to Publication

Dimension Nexus boosts productivity from experiment setup to publication-ready results with a combination of ease-of-use features, fast data collection, and comprehensive analysis tools.

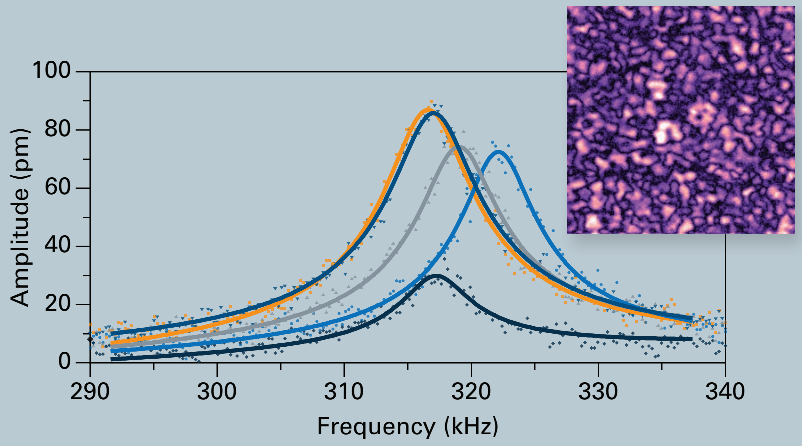
ScanAsyst auto-optimization of imaging parameters makes data acquisition easy, even for the most challenging samples. A fully motorized and programmable stage facilitates efficient multi-site and multi-sample measurements with minimal preparation time.

The NanoScope 6 controller provides better, more rapid data collection with 5k x 5k–pixel images, 8 data channels, and a 50 MHz sampling rate. It also enables the use of Bruker's more advanced modes, such as DataCube modes.

With DataCube modes, individual spectra are collected at each XY-position on the sample surface using a force-volume method. The resulting multidimensional cube of data provides high-density datasets of correlated, nanoelectrical and nanomechanical properties that were previously unattainable in a single measurement. This hyperspectral approach enables more efficient materials characterization by delivering the key information needed to answer your research questions with less experimentation.



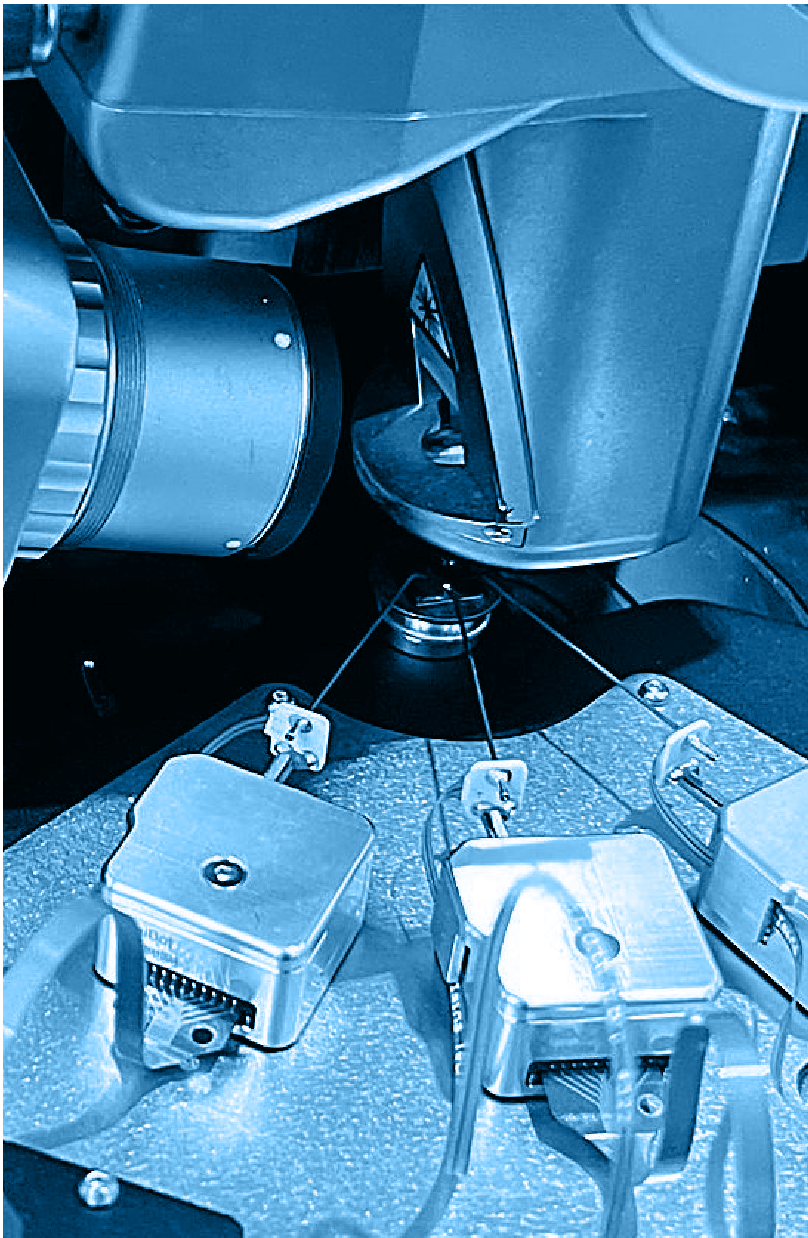
Pattern sapphire substrate (PSS) sample for LED applications, imaged at 10 min/frame (left) and 53 sec/frame (right). Full 10 µm scan durations were 10 min/image (0.5 Hz) and 53 s/image (6 Hz). Images show minimal differences, with consistent feature size measurements at both scan rates.



DataCube CR PFM on BFO piezoelectric thin film. Plot of PFM amplitude as a function of applied voltage over range of frequencies acquired at 5 sample locations. 3 µm PFM amplitude image (inset), SCM-PIT-V2 probe.

Below: An array of 360 trenches (spanning onto the facing page) imaged in a single 90x2 µm scan (16384x16 px) in PeakForce Tapping with an SAA-HPI probe. Critical dimension analysis shows no scanner artifacts or tip degradation over the full range.

Your Experiments, Your Way



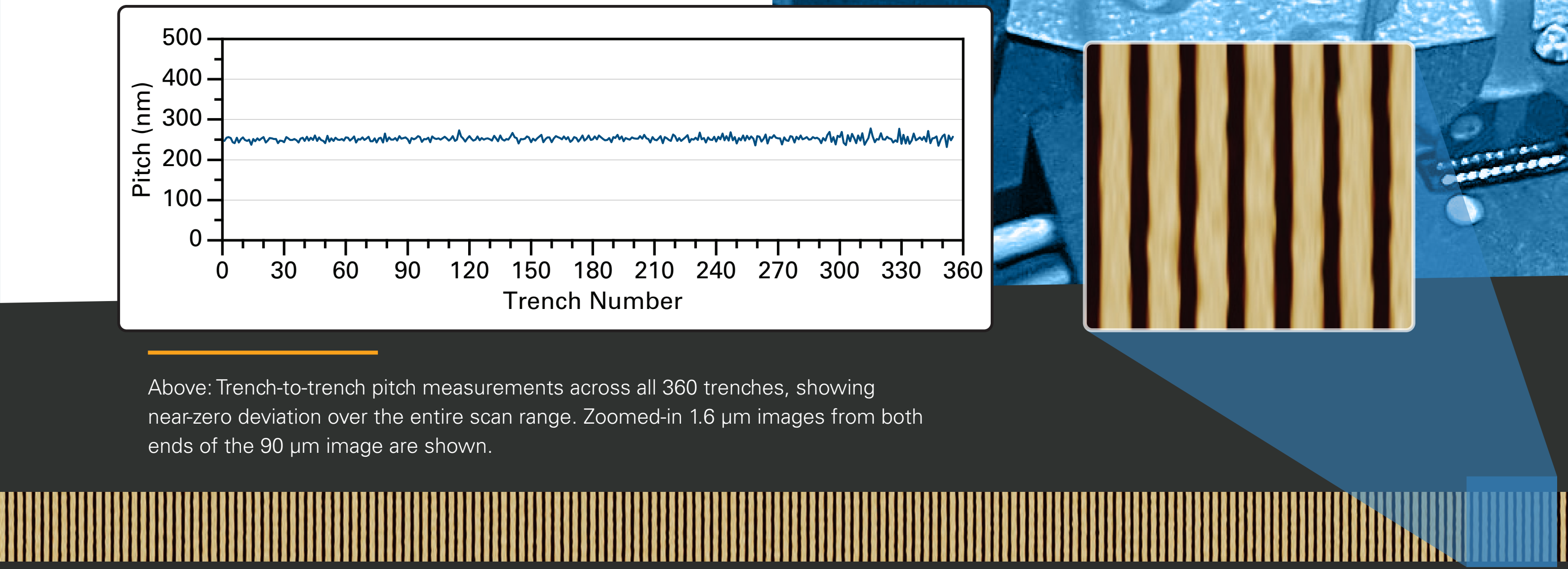
Dimension Nexus prioritizes your individual testing needs, from the straightforward to the complex. A base configuration of Nexus easily addresses standard applications, with best-in-class performance and all of our most-published AFM modes. Its 150 mm programmable stage is ideal for large- or multi-sample testing and accommodates geometrically challenging device structures.

Nexus also has extensive upgrade options—unique operating modes, reliable environmental control, and powerful software integrations—to ensure the system can grow with your research. The platform has physically open access to the probe-sample junction, accommodating electrical connection attachments and other custom experiment accessories. Bruker also supports both routine and specialized measurements by offering a wide range of highest-quality probes.

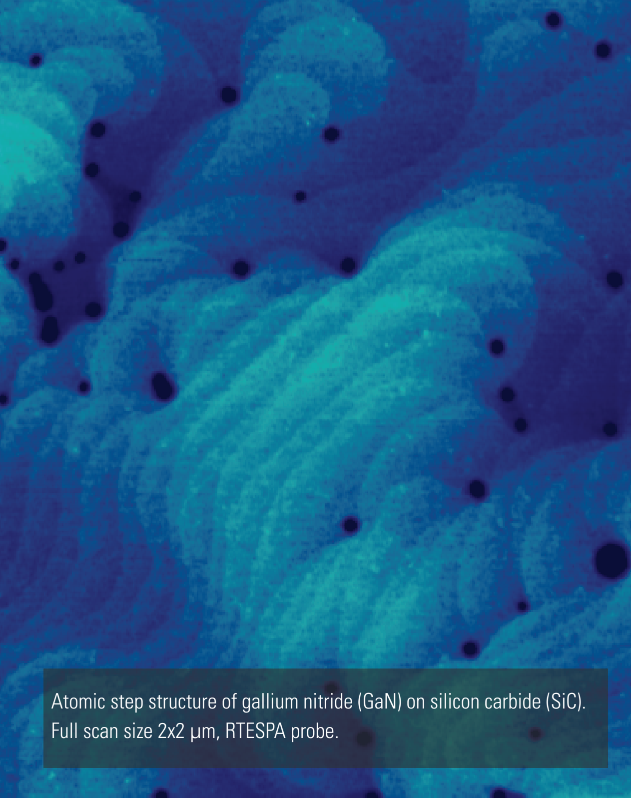
Customizable Features for Advanced Control

The NanoScope 6 controller provides an open hardware and software platform for implementation of custom experiments, including features such as:

- Front-panel BNC connectors for easy access to most input and output signals
- An optional signal-access module to expand access to all signal and control lines
- Scripting software options with an expansive set of SPM control functions for custom measurements, lithography, and manipulation
- Easy import of NanoScope data into Python for analysis using the included Python Toolbox



Above: Trench-to-trench pitch measurements across all 360 trenches, showing near-zero deviation over the entire scan range. Zoomed-in 1.6 µm images from both ends of the 90 µm image are shown.



Atomic step structure of gallium nitride (GaN) on silicon carbide (SiC). Full scan size 2x2 µm, RTESPA probe.

AFM Modes and Capabilities Available

Standard	Optional
PeakForce Tapping	PeakForce QNM (PF-QNM)
ScanAsyst	PeakForce TUNA (PF-TUNA)
TappingMode	PeakForce KPFM™ (PF-KPFM)
Contact Mode	PeakForce EFM (PF-EFM)
Lateral Force Microscopy (LFM™)	DataCube Modes
PhaseImaging™	Ramp & Hold
LiftMode™	Nanolithography
Force Spectroscopy	Dark Lift Mode
Force Volume	Conductive AFM (C-AFM™)
Surface Potential (KPFM)	Tunneling AFM (TUNA)
Piezoresponse Microscopy (PFM)	Fast Tapping
Electrostatic Microscopy (EFM)	Torsional Resonance Mode (TR-Mode™)
	Torsional Resonance Dynamic Friction Microscopy (TR-DFM)
	Fluid Imaging (PeakForce Tapping, TappingMode, Contact Mode)

Inquire for additional modes and capabilities

Dimension Nexus Specifications

X-Y Scan Range	90 µm x 90 µm typical, 85 µm minimum
Z Range	10 µm typical in imaging and force curve modes, 9.5 µm minimum
Vertical Noise Floor	≤40 pm RMS in appropriate environment typical imaging bandwidth (up to 625 Hz)
XY Position Sensor Noise Level (Closed Loop)	≤0.15 nm RMS typical imaging bandwidth (up to 625 Hz)
Z Sensor Noise Level	35 pm RMS typical imaging bandwidth (up to 625 Hz)
Integral Nonlinearity (XY)	<0.5% typical
Sample Size/Holder	150 mm vacuum chuck for samples, ≤150 mm diameter, ≤15 mm thick
Motorized Positioning (XY Stage)	150 mm x 150 mm inspectable area; 6 µm repeatability, bidirectional; programmable for multi-site measurements
Microscope Optics	5 MP digital camera; 180 µm to 1465 µm viewing area; digital zoom and motorized focus
Controller	NanoScope 6
Acoustic isolation	Operational in environments with up to 75 dBC continuous acoustic noise
Laser Classification	Class 2M
Certification	CE

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