



NANOSCIENCE AFM  
**NANO WIZARD® V**

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Automated quantitative nanomechanical imaging  
Fastest scanning of rough surfaces

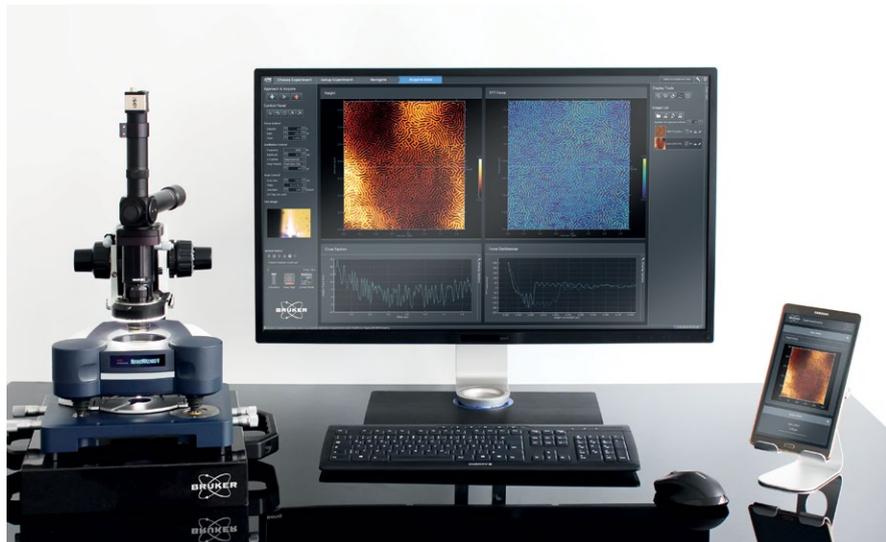
# NanoWizard V

## Exceptional Versatility

Bruker's new **NanoWizard® V** combines high spatio-temporal resolution with a large scan area, flexible experiment design, and outstanding integration with advanced optical microscope systems. Its automated setup, alignment, and re-adjustment of system parameters opens new possibilities for long-term, self-regulating experiments series.

The **NanoWizard V** NanoScience features novel scanner and sensor technologies, significantly extending the capabilities of atomic force microscopy. The newly developed PeakForce-QI™ mode enables the fast and flexible quantitative nanomechanical characterization of a broad range of samples. The enhanced, workflow-based design with intuitive user guidance empowers beginners and experts alike to achieve highest quality, reproducible data.

“ The performance of NanoWizard AFMs is exceptional. In the NanoWizard V, Bruker have built on this with automated alignment and fast imaging even at large scan sizes, solving real user problems. This instrument will expand the range of experiments possible and make what were once difficult experiments routine. ”



### Discover the 5<sup>th</sup> generation NanoWizard NanoScience AFM

The Nanowizard® V sets a new benchmark in automation while providing a host of new technical capabilities and a degree of comfort second to none.

- Latest generation packed with novel innovations
- Proven legacy of success through an install base of nearly 1000 JPK/Bruker NanoWizard AFMs across the globe
- Supported by dedicated cantilever development for high-resolution imaging, fast scanning, and customized applications
- Intuitive V8 software environment
- Unmatched ease-of-use
- Ideal for multi-user imaging facilities

#### Dr. Nic Mullin

Senior Experimental Officer for the Biophysical Imaging Centre  
Department of Physics and Astronomy, Sheffield, UK

#### Image top

NanoWizard V NanoScience setup with TopViewOptics™, intuitive user interface and ExperimentControl™.

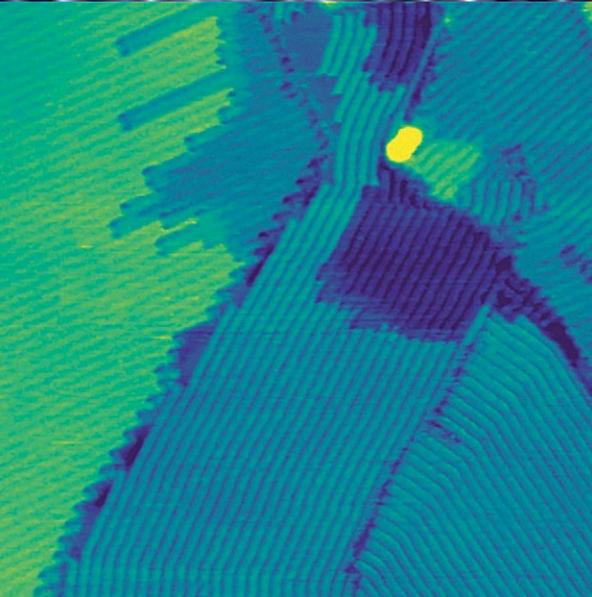
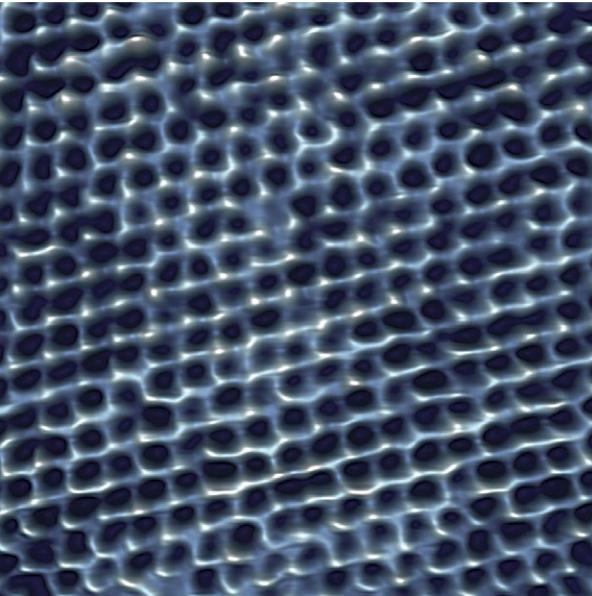
TopViewOptics is the ideal solution for opaque samples, providing easy positioning and focus adjustment.

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# Perfected Performance and Increased Productivity

The latest developments in automated setup and experiment control, increased throughput and standardized analysis features establish a new benchmark in AFM capabilities.

The NanoWizard V is an outstanding tool for the nanosciences, uniquely combining technical innovation with performance and user comfort.



## Paving the way for new scientific discoveries

- Lowest noise scanner and detection system ensure high-resolution data and unrivalled performance
- High-speed scanning rates of up to 400 lines/sec
- Ideal for real-time investigation of dynamics
- Automation for improved productivity and maximized throughput
- High-resolution nanomechanical imaging with PeakForce-QI™, PeakForce Tapping®, PeakForce QNM, and QI
- DirectOverlay for AFM in conjunction with advanced optical microscopy
- Features the latest ExperimentPlanner and ExperimentControl options
- Widest range of accessories for environment control, electrical measurements and more

## Superior Performance

- Versatile imaging from atomic lattices to large scale samples
- Largest range of add-ons
- Extended optical viewing field for AFM with tiling feature
- Optimized storage of parameters and favorite settings
- Intuitive user operation
- Standardized batch analysis routines for the generation of statistically relevant datasets
- Fully automated cantilever and detector alignment
- Capture fast dynamic processes in harsh environments
- Follow reactions across multiple time scales, from milliseconds, to seconds and minutes

### Image top

Topography image of atomic lattice of mica in liquid. Image taken in closed-loop TappingMode operation on an inverted microscope.

Scan size: 10 nm × 10 nm  
Height range: 220 pm

### Image bottom

Topography image of hexacontane (C<sub>60</sub>H<sub>122</sub>) deposited on highly oriented pyrolytic graphite (HOPG). The image was taken in TappingMode under ambient conditions. Several monomolecular layers of hexacontane are observed. The hexacontane molecules form visible lamellar stripes within each layer.

Scan size: 400 nm × 400 nm  
Height range: 1.04 nm

# Comprehensive Nanomechanical Characterization

Bruker continuously strives to improve the nanomechanical characterization capabilities of its AFMs and to provide easy technology solutions for complex scientific endeavors.

The **NanoWizard V** is the ideal solution for quantifying nanomechanical properties and understanding the crucial role they play in structure, morphology, and molecular interactions.

The **NanoWizard V** pushes the boundaries of science, opening the AFM technology to a wider range of applications and making nanomechanical characterization faster, easier, and more accessible for users of all fields of science.

## Unrivalled Capabilities

- Fast scanning and ease-of-use combined with topographic and nanomechanical imaging
- Characterization of viscoelastic properties using microrheological measurements
- Contact resonance for mechanical characterization of stiff samples (>10 GPa)
- Intuitive and powerful RampDesigner software
- Highly sensitive force control and tip-saving features
- True, real-time force curve monitoring
- Mechanical mapping combined with electrical sample characterization in a single run

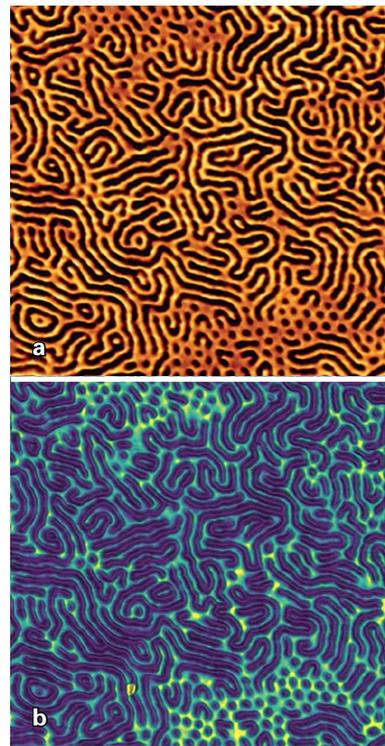
## PeakForce-QI

### New Chapter in Quantitative Imaging

PeakForce-QI, the symbiosis of PeakForce Tapping and QI mode, delivers unique quantitative nanomechanical imaging capabilities. It combines highest acquisition rates with advanced force control to deliver highest resolution, multi-parametric images. The automated setup, operation, and calibration make it simple to configure and run an experiment, and obtain top-quality images and data quickly and easily, even for non-experts.

## Powerful Data Analysis

- Easy, reliable batch processing
- Flexible creation of topography images at different forces
- Zero force (contact point) imaging
- Image stack output of any channel from batch processing routines



### Images top

PeakForce-QNM image of a thin film of styrene-ethylene-butylene-styrene triblock copolymer (Kraton G1652) prepared on a silicon wafer. The topography is shown at the top and the corresponding Young's modulus is shown below.

Scan size:  $1 \mu\text{m} \times 1 \mu\text{m}$   
a) Height range: 22 nm  
b) Modulus range: 280 MPa

### Images left top row

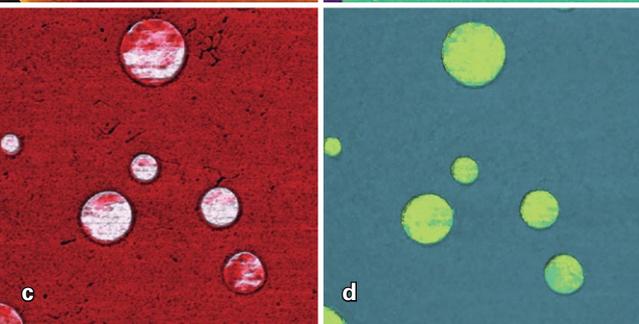
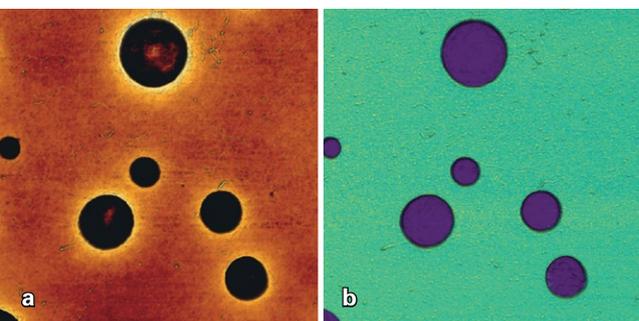
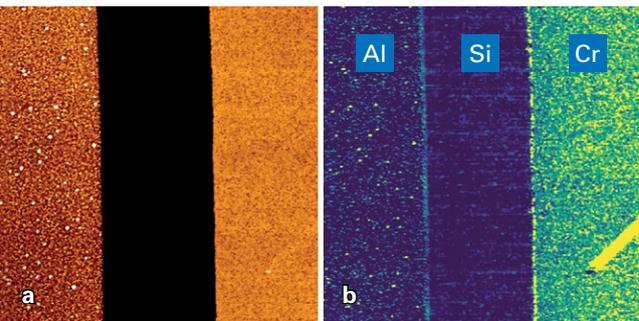
Contact resonance measurement on a layered sample consisting of aluminum, silicon and chromium.

Scan size:  $12 \mu\text{m} \times 12 \mu\text{m}$   
a) Height range: 121 nm  
b) Modulus range: 107 GPa

### Four images left

PeakForce QNM image of a blend of polystyrene (PS) and ethylene-octene copolymer. The softer ethylene-octene copolymer (~0.1 GPa) is embedded in a stiff matrix of PS (~2 GPa).

Scan size:  $4 \mu\text{m} \times 4 \mu\text{m}$   
a) Height range: 80 nm  
b) Adhesion range: 10 nN  
c) Deformation range: 50 nm  
d) Modulus range: 3 GPa



# Automation and Intuitive Operation at Its Best

The NanoWizard V was designed to meet the specific needs of scientists in research and industry today. Innovative hardware and software solutions have led to increased throughput, automated measurement procedures, and batch processing routines that allow scientists to focus on what's important – their research.

## Highest Level of Automation

- Automated alignment of laser detection system
- Automated cantilever calibration
- Automated multi-region imaging using HybridStage or motorized stage
- Intuitive scripting of automated experiments with ExperimentPlanner
- ExperimentControl for remote monitoring of experiments

## Intuitive Operation

- Workflow-based software with fundamental ease-of-use features
- User management, ideal for multi-user facilities
- Integrated software assistance
- Single-click optical image calibration
- Integrated camera for alignment of laser detection system
- Comprehensive data processing routines
- Convenient saving of parameters and favorite settings

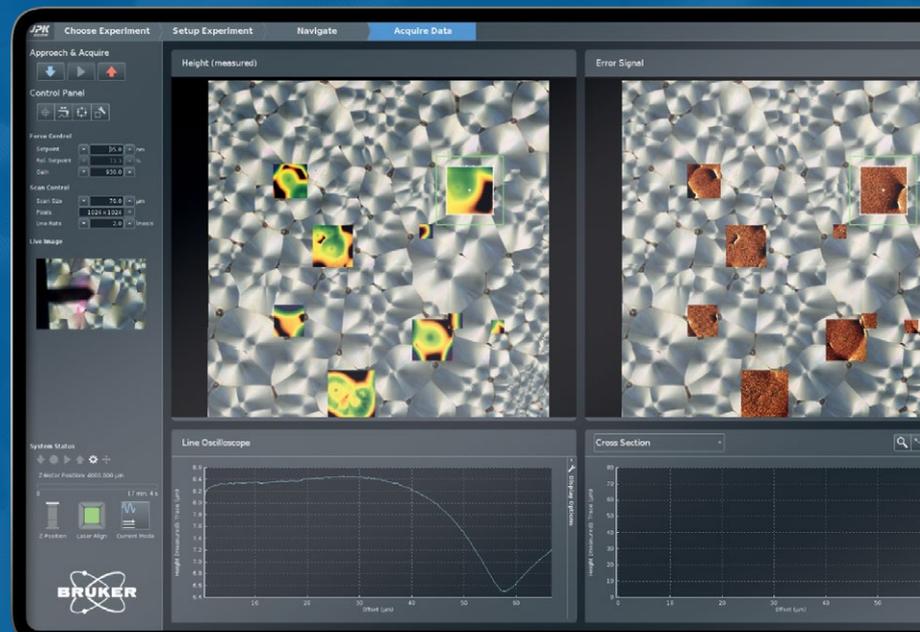
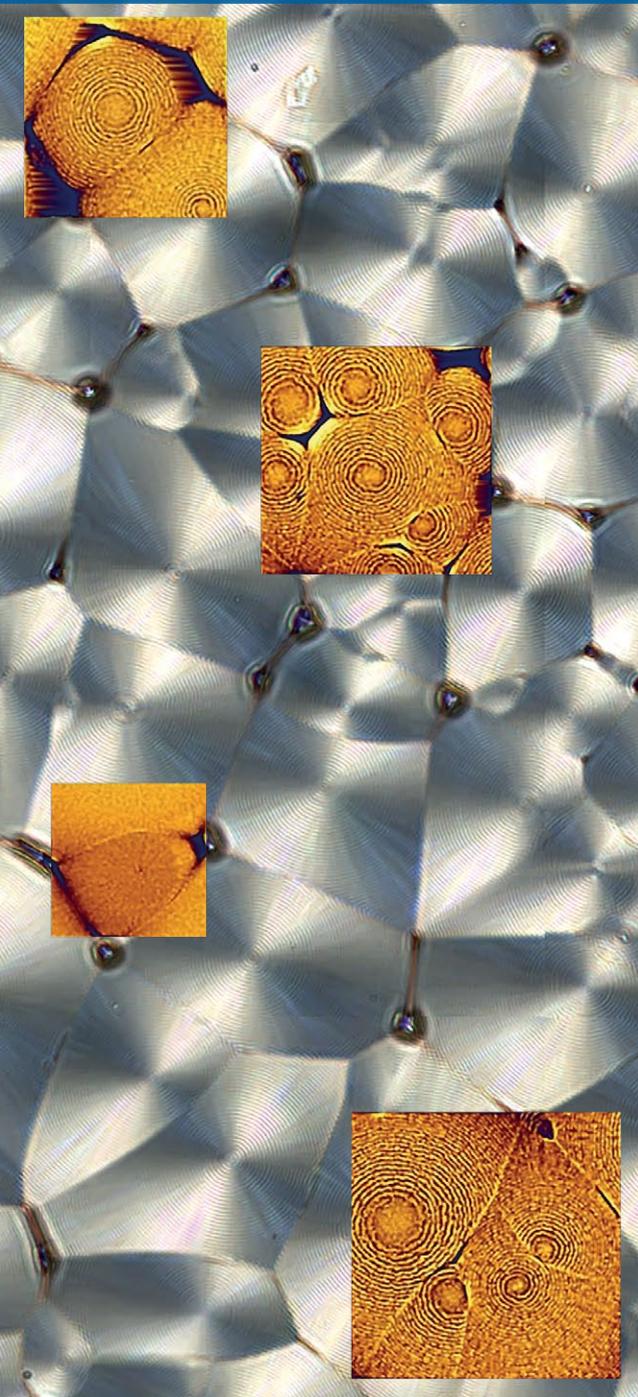
## Images

Superposition of optical images from an inverted optical microscope with AFM scans on a thin film of crystallized Poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHB/V). The background optical image was created by tiling a series of smaller images (4 × 4 images) using a motorized stage. Crossed polarizers were used to visualize the spherulitic structure of the sample. AFM phase images were acquired in TappingMode under ambient conditions. The periodic, ring-like structures seen in the AFM scans result from the continuous twisting of the crystalline lamellae, forming so-called banded spherulites.

Scan size from top to bottom  
50 μm × 50 μm  
60 μm × 60 μm  
45 μm × 45 μm  
70 μm × 70 μm

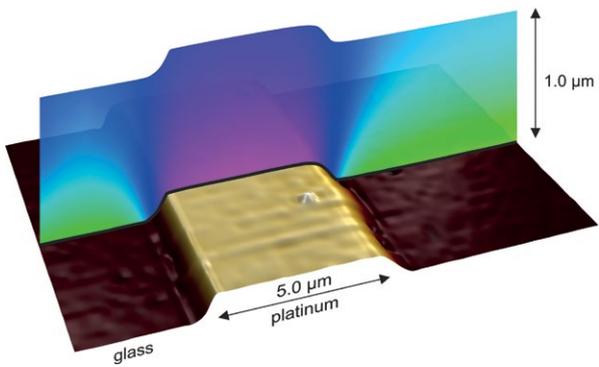
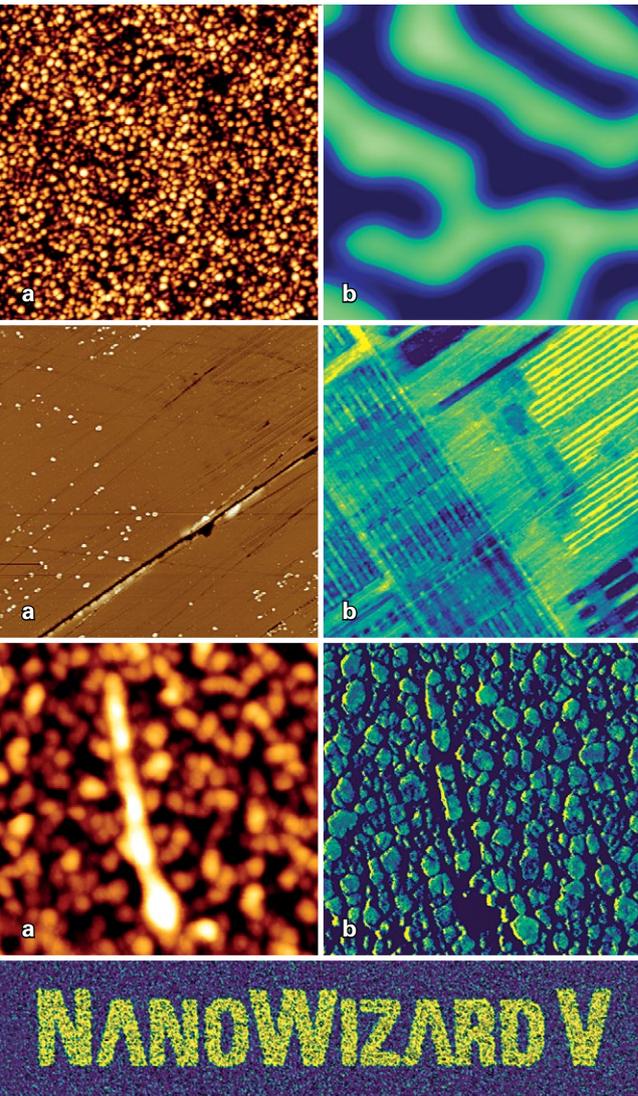
## Software setup

Latest workflow-based SPM Control Software V8 depicting DirectOverlay 2, DirectTiling and MultiScan features.



# Unrivalled Flexibility by Design

The renowned tip-scanner technology and modular design of the **NanoWizard V NanoScience AFM** can be seamlessly integrated with advanced optical techniques. A wide range of advanced modes and accessories make it the most flexible AFM available on the market today, enabling versatile experimental setups and environmental control.



## Comprehensive Range of Add-ons and Accessories

- Broad range of temperature control accessories (-120 °C up to +300 °C)
- Scanning Thermal Microscopy (SThM)
- Magnetic Force Microscopy (MFM)
- Nanomanipulation
- Friction Force Microscopy
- Multimodal imaging
- Stretching stages
- Various fluid cells
- see accessories brochure for more options

## High-Resolution Electrical Characterization

- Conductive AFM (CAFM)
- Kelvin Probe Force Microscopy (KPFM)
- Electrostatic Force Microscopy (EFM)
- Piezo Force Microscopy (PFM)
- Scanning Tunneling Microscopy (STM)
- Scanning Electrochemical Microscopy (SECM)

## For Complex Experiments, from Polymers to Solar Cells

- Optimized environmental control options
- Optical accessibility of the sample, e.g., for defined illumination
- 980 nm detection laser option
- Various modes for long-term, unattended experiments

### Two images top row

Magnetic force microscopy (MFM) on meander domains with perpendicular magnetization of a multilayer Co-Pt film on silicon. Sample courtesy Dr. V. Neu (Leibnitz IFW Dresden, Germany). Scan size: 1 μm × 1 μm  
a) Height range: 4 nm  
b) Phase range: 14.4 deg

### Two images second row

Kelvin Probe Force Microscopy (KPFM, dual-pass) on a DRAM (Core 2 Quad processor, Intel). Scan size: 85 μm × 85 μm  
a) Height range: 68 nm  
b) CPD range: 468 mV

### Two images third row

Conductive AFM (CAFM) of zinc oxide deposited on niobium-doped strontium titanate (bias voltage -4.0 V). Sample courtesy Prof. F. Bobba, University of Salerno, Italy. Scan size: 850 nm × 850 nm  
a) Height range: 16 nm  
b) Current range: 42 nA

### Image "NanoWizard V"

Piezoresponse Force Microscopy (PFM) of a ferroelectric polymer P(VDF-TrFE) on a gold back electrode on silicon. A sequence of voltage pulses (20 V) was generated from a bitmap template to write the logo into the piezoelectric polarization of the sample. Vertical PFM-phase image after patterning is shown. Scan size: 45 μm × 10 μm  
Phase range: 170 deg

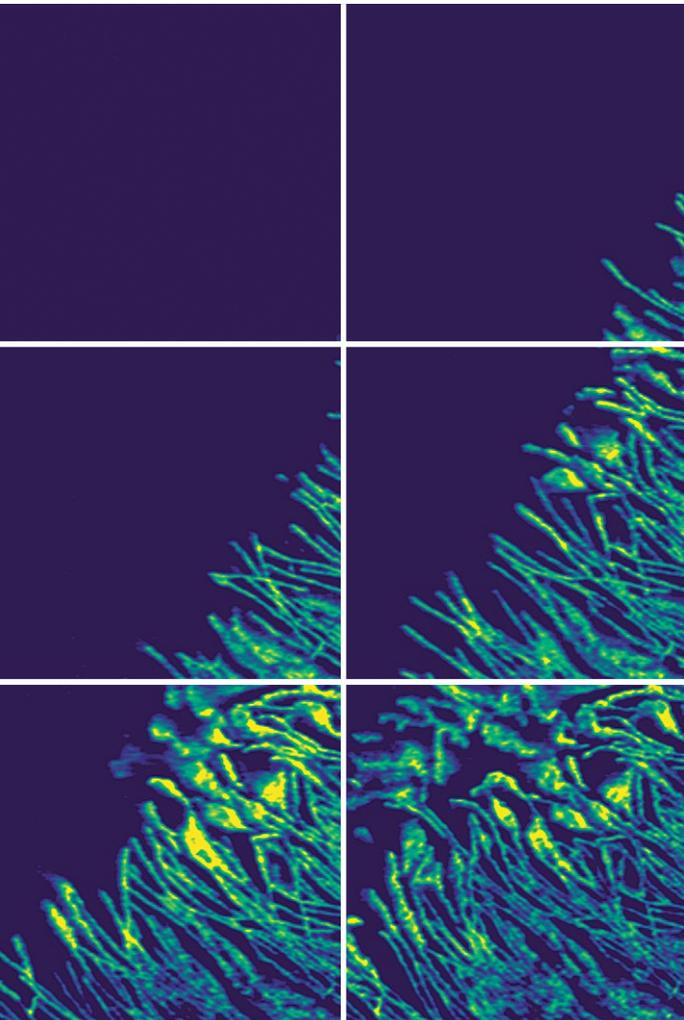
### Image bottom

SECM scan of a platinum electrode on glass taken in force mapping mode. The topography image is overlaid with a vertical section through the recorded SECM current distance dependence (tip potential -0.3 V, electrode potential 0 V, 10 mM [Ru(NH<sub>3</sub>)<sub>6</sub>]<sup>3+</sup> in 0.1 M KCl). The expected behaviour of redox-cycling (on electrode) and blocking (on glass) is clearly observed. Scan size: 15 μm × 10 μm  
Current range: 200 pA

# The New Benchmark for Fast Scanning of Large Samples

The **NanoWizard V NanoScience** platform delivers fast scanning over a large scan area. The full scan range in all three axes remains available, providing unparalleled scanning speeds and easy switching between sample features, without relocation of the sample or a reduction of imaging speed.

The Fast Scanning option is ideal for the investigation of dynamic processes, delivering the speed and accuracy necessary to study phenomena, such as crystallization, growth, melting, and domain building, in real time.



## Images left

Representative series of phase images taken in TappingMode on a thin film of Poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHB/V).

Prior to the measurements, the sample was heated to above the melting temperature and then cooled to below the melting temperature immediately before image acquisition.

The images show a growth front of the crystallizing PHB/V passing through the scan area.

The time difference between each of the displayed images is 18 seconds. The actual data acquisition was running at 2.5 seconds per frame.

Scan size: 600 nm × 600 nm  
Pixel size: 512 px × 512 px  
Scan speed: 200 lines/sec  
Phase range: 20 deg

## Innovative Fast Scanning Capabilities in an Automated AFM

- Improved productivity and maximized throughput for reliable statistics
- Fast z-piezo with high resonance frequency delivers fastest feedback
- Adaptive intelligence-based scanning routines enable scanning rates of up to 400 lines/sec
- NestedScanner technology provides fast scanning of corrugated samples with a z-range of up to 16.5 μm
- Active balancing allows fast scanning over large scan areas

## Stability and Highest Data Accuracy Meets Ease-of-Use

- Fast scanning with advanced closed-loop control
- Fast z-piezo equipped with capacitive sensor for highest data accuracy
- Accurate force control thanks to latest feedback technologies
- DirectDrive feature for increased cantilever excitation stability
- Batch processing and advanced data analysis routines
- Movie creator



## NanoWizard V NanoScience Technical Specifications

<b>System specifications</b>	<ul style="list-style-type: none"> <li>• <b>Tip-scanning</b>, stand-alone system, with a rigid low-noise design and drift-minimized mechanics</li> <li>• <b>Vortis 2.1</b> SPM Controller generation</li> <li>• Atomic lattice resolution on inverted optical microscope in closed-loop</li> </ul>	<ul style="list-style-type: none"> <li>• Liquid-safe AFM with integrated vapor barrier, specialized encapsulated piezo drive and tip-moving design</li> <li>• 100×100×15 μm<sup>3</sup> scan range and 1.5 μm extra z range with PeakForce-QI and Fast Scanning option</li> </ul>
<b>Software V8</b>	<ul style="list-style-type: none"> <li>• <b>Fully automated cantilever and detector alignment</b> routines</li> <li>• User-specific experiment design for unattended/remote long-term measurements</li> <li>• True multi-user platform, perfect for imaging facilities</li> <li>• <b>Fully automated sensitivity and spring constant calibration</b> using thermal noise Sader method</li> </ul>	<ul style="list-style-type: none"> <li>• DirectOverlay 2 for correlation of optical and AFM data</li> <li>• Powerful Data Processing (DP) with full functionality for data export, fitting, filtering, edge detection, 3D rendering, FFT, cross section, video creation etc.</li> <li>• Powerful batch processing of force curves and images, including WLC, FJC, step-fitting, JKR, DMT model, and other analysis methods</li> </ul>
<b>Stages and sample holders</b>	<ul style="list-style-type: none"> <li>• Stages are available for <b>all major inverted optical microscope manufacturers</b>, such as Zeiss, Nikon, Olympus and Leica</li> <li>• Motorized Precision Stage with 20×20 mm<sup>2</sup> travel range, with joystick and/or software control</li> <li>• Manual Precision Stage with 20×20 mm<sup>2</sup> travel range</li> </ul>	<ul style="list-style-type: none"> <li>• Holders are available for petri dishes, coverslips, microscope slides, or metal SPM discs</li> <li>• Large Ø 140×18 mm<sup>3</sup> free sample volume, up to 14 cm in z with new Head-Up stage</li> </ul>
<b>Widest range of accessories and probes</b> (see accessories handbook)	<ul style="list-style-type: none"> <li>• <b>Large choice of temperature control options</b> (for ambient, liquid and gas) and liquid cells, even for aggressive solvents</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Complete range of probes</b> for all operating modes</li> <li>• Vibration and acoustic isolation from leading suppliers</li> </ul>
<b>Optical configurations</b>	<ul style="list-style-type: none"> <li>• Fully simultaneous AFM operation with <b>brightfield optical phase contrast and DIC</b> using standard condensers</li> <li>• Combine AFM with advanced commercial confocal microscopes and fluorescence optical techniques, such as FCS, FRET, TIRF, FLIM, FRAP, STED, STORM/PALM, SIM, and more</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Upright Fluorescence kit</b> – enables the combined use of AFM and upright optical fluorescence microscopes</li> <li>• TopViewOptics, video optics for opaque samples with 12× zoom</li> <li>• BioMAT option for high-NA upright fluorescence optics combined with AFM on opaque samples</li> <li>• Large range of cameras supported</li> </ul>
<b>Standard operating modes</b>	<ul style="list-style-type: none"> <li>• <b>Now with PeakForce-QI</b>, PeakForce Tapping and QI</li> <li>• Including fast PeakForce Tapping and PeakForce-QI with <b>nested scanner</b> technology</li> <li>• Contact mode with lateral force microscopy (LFM)</li> </ul>	<ul style="list-style-type: none"> <li>• TappingMode with Phasemaging™</li> <li>• <b>ExperimentPlanner</b> for designing a specific measurement workflow</li> <li>• Static and dynamic force spectroscopy</li> <li>• Advanced Force Mapping</li> </ul>
<b>Optional modes</b>	<ul style="list-style-type: none"> <li>• Advanced spectroscopy modes, such as various force clamp modes or ramp designs</li> <li>• <b>Fast Scanning option</b> with line rates of up to 200 Hz (400 lines/sec)</li> <li>• QI Advanced mode for quantitative data, perfect for soft samples</li> <li>• <b>ScanAsyst</b> automated gain in PeakForce Tapping and PeakForce-QI</li> <li>• Advanced AC modes such as FM and PM with Q-control and Active Gain Control</li> </ul>	<ul style="list-style-type: none"> <li>• Microrheology in <b>CellMech Package</b></li> <li>• Kelvin Probe Microscopy and EFM, MFM, Conductive AFM, STM</li> <li>• Electrical spectroscopy modes</li> <li>• Piezoresponse Microscopy for high voltages</li> <li>• <b>Electrochemistry and Scanning Electrochemistry</b> with temperature control and optical microscopy</li> <li>• NanoLithography and NanoManipulation</li> <li>• NanoIndentation</li> <li>• Scanning Thermal AFM</li> <li>• <b>FluidFM</b>® solution from Cytosurge®</li> <li>• ExperimentControl feature for remote experiment control</li> <li>• Additional XY and/or Z sample movement stages available with <b>CellHesion, TAO and HybridStage module</b></li> </ul>

We regularly come across informative scientific articles relating to AFM life science research. For a regular update on new and interesting scientific publications, sign-up for the BioAFM Journal Club and automatically receive our free, monthly journal club email. Members receive brief reviews of select papers and direct links to the full article.



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