

Now with
PeakForce Tapping



NANO WIZARD[®] 4 XP

B I O S C I E N C E A F M

Extreme Performance high-resolution quantitative imaging
Fast Scanning option with up to 150 lines per sec for dynamic processes
Perfect integration with advanced optical microscopy
Revolutionary new workflow-based software
Outstanding flexibility and modularity



NANO WIZARD[®] 4 XP

Extreme Performance BioAFM

OUTSTANDING RESOLUTION, STABILITY AND ACCURACY

The **NanoWizard 4 XP BioScience AFM** combines for the first time highest resolution, fast scanning and a large scan range of 100 μm in one system. It delivers highest mechanical and thermal stability on an inverted microscope, enabling long-term experiments, even on living cells. Powered by the new **Vortis™ 2** controller, the system provides unparalleled data accuracy and can effortlessly process huge volumes of data.

PEAKFORCE TAPPING[®] – PERFECT IMAGING MADE EASY

Bruker's exclusive **PeakForce Tapping** is renowned for easy imaging of samples using minimal interaction forces, even for non-experts or occasional users. The excellent control of probe-sample interactions is vital for biological specimens, often soft and delicate, and enables the investigation of the widest range of samples. Reliable image quality, highest resolution, and an easy setup that doesn't require cantilever tuning or expert knowledge, are all advantages of PeakForce Tapping that help researchers obtain important results quickly.

NanoWizard 4 XP BioScience setup on Zeiss Axio Observer with new user interface and tablet control.

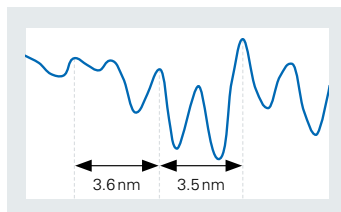


USER-FRIENDLINESS REDEFINED BY V7 SOFTWARE

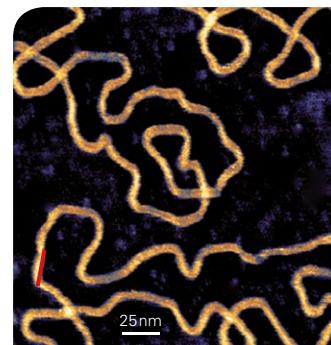
The new **software V7** transforms the user interaction by using a structured workflow which enables a natural, logical progression when performing essential tasks. At the same time, the priority was to maintain the outstanding flexibility of the NanoWizard AFM family, and reinforce the system's excellent reputation across so many different areas of research.

HIGHEST VERSATILITY IN MODES, ACCESSORIES AND FEATURES

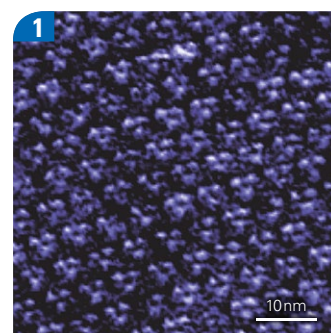
NanoWizard 4 XP comes with the largest number of accessories, modes and features of any AFM system on the market, providing full flexibility for any application.



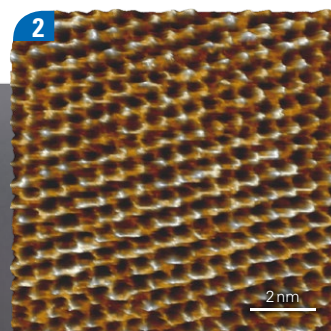
Individual DNA molecules on PLO covered mica, imaged in liquid (height range 2.6 nm). Major and minor grooves visible at various locations, e.g., inset shows helical repeat of 3.5 nm and 3.6 nm, respectively.



1 Topography image of bacteriorhodopsin in buffer. Height range 600 pm



2 Topography image of atomic lattice of mica in buffer. Image taken in closed-loop on an inverted microscope.



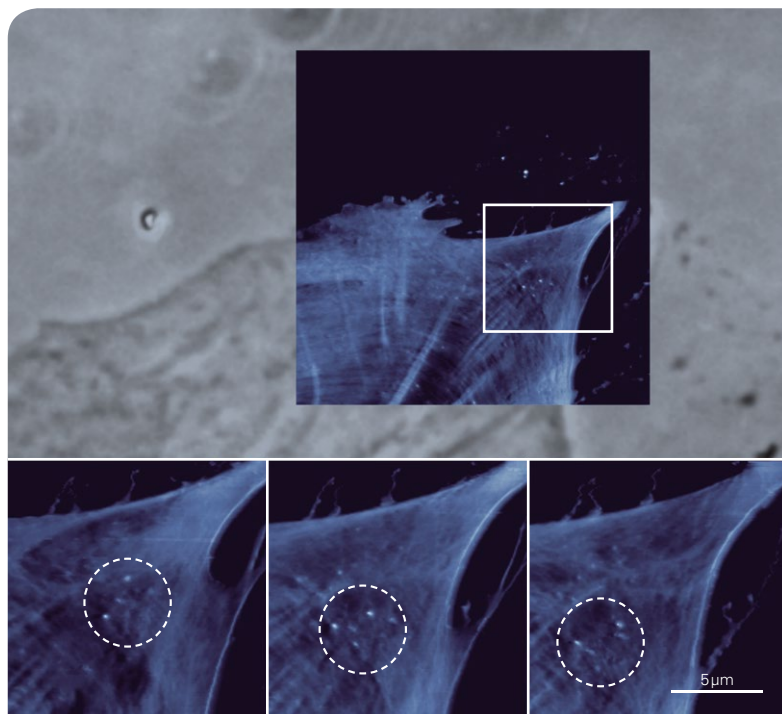
Follow sample dynamics with the Fast Scanning option

UNCOMPROMISED FAST SCANNING WITH A LARGE SCANNER

With the **Fast Scanning** option, the **NanoWizard 4 XP** can run at up to 150 lines per second. Empowered with the new Vortis 2 controller, the system includes the highest bandwidth, accurate force control and fast feedback, even with a large 100 μm scanner. This unmatched speed can be combined with simultaneous optical microscopy via a fast tip-scanner that is compatible with standard NanoWizard accessories.

NESTEDSCANNER™ TECHNOLOGY FOR HIGHER IMAGING SPEEDS ON HIGH OR CORRUGATED SAMPLE STRUCTURES

Previously, in traditional fast scanning systems, researchers had to choose either speed or range, which limited the applications for dynamic experiments on live cells or other samples with a significant height difference within or between scans. The new **NestedScanner** technology eliminates this restriction, allowing a sample height of up to 16.5 μm to be imaged with the same fast response. This opens new avenues for studying dynamics on cells, bacteria or structured surfaces.



▲ Reorganization of cytoskeletal actin in the form of transverse arcs and radial fibers during the filopodia formation of living fibroblasts at 37°C (top). Time-lapse of consecutive phase images (taken 15 s apart) allows the identification of individual dynamic events, such as vesiculation and translocation of cargo molecules (bottom). Sample courtesy of Prof. A. Herrmann, Humboldt University, Berlin.

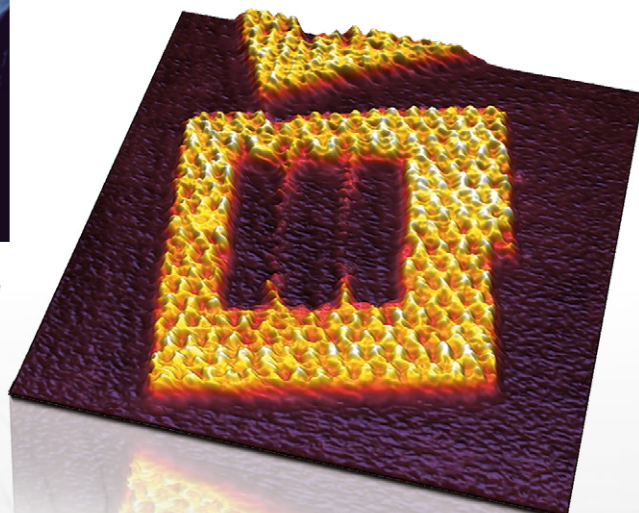
Tailored DNA origami frames imaged in TAE 10mM MgCl_2 buffer on mica. Sample ▶
courtesy of R. Willaert, VUB, Brussels (BE).
Scan field: 125 nm · Height range: 4.4 nm · Scan speed: 150 lines/sec

EASY CAPTURING OF SAMPLE DYNAMICS

Life science research is being driven by the advances in temporal and spatial resolution in optical and other types of microscopy. It is now possible to acquire high-quality data on living cells or single molecules within seconds rather than minutes, to show the dynamics of living cells in their native state. Automated batch processing of image series, with direct export using the movie creator feature, make it easy to review data. The Fast Scanning feature of the new **NanoWizard 4 XP** delivers the speed and accuracy needed for real-time experiments.

ACCESS AND ADVANCED FLUORESCENCE ARE VITAL FOR TRIGGERING AND OBSERVING DYNAMICS

The secret to being in the right place at the right time to observe sample dynamics often lies in triggering the reaction through some change in the environment or with an optical stimulus. Comprehensive options for temperature control, and gas and fluid exchange can be combined with advanced optics and set the standard for high speed correlative microscopy.



Perfect integration of AFM and optical microscopy delivers correlated data simultaneously

NANOWIZARD AFMs – OPTICAL INTEGRATION PERFECTED

The unique, open access, tip-scanning design of the **NanoWizard 4 XP** strengthens the long-standing reputation of the NanoWizard AFM family for unparalleled optical integration. This design is essential for combining it with advanced optics, as it allows the simultaneous use of standard condensers and reflection microscopy with AFM experiments on all major inverted optical microscopes. Stability is also critical in preserving AFM resolution, even when combined with high-NA immersion objectives for simultaneous advanced optical measurements through coverslips. Even in these challenging conditions, the core design and carefully developed accessories enable the **NanoWizard 4 XP** to achieve highest performance.

PERFECT INTEGRATION WITH SUPER-RESOLUTION MICROSCOPY PLATFORMS

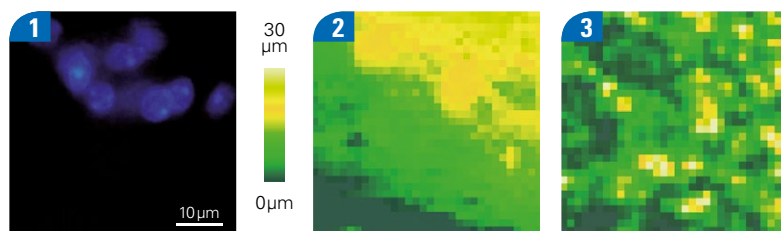
The **NanoWizard 4 XP**, with its unique tip-scanning technology and fast imaging capabilities, is ideal for taking advantage of the synergy between AFM and super-resolution microscopy. Super-resolution microscopy techniques are becoming accessible to many life scientists as they are now available as standard setups. The **NanoWizard 4 XP** is compatible with a wide range of platforms, such as those

from Zeiss (PALM/STORM, SIM), Leica (STED), PicoQuant (STED), Nikon (SIM, STORM) and Abberior (STED). The 980 nm laser option for the AFM head allows the simultaneous use of optical microscopes and focus stabilization systems, critical for long term experiments, and avoids conflicts with fluorescence or spectroscopy measurements.

ADVANCED OPTICAL TECHNIQUES FOR SIMULTANEOUS USE WITH AFM

- Brightfield
- DIC, phase contrast, or modulation contrast
- FRET, FLIM, FCS, FRAP
- Ca⁺⁺ imaging
- TIRF and IRM
- Spinning disc
- Confocal microscopy
- Structured illumination techniques (SIM)
- Super-resolution techniques such as STED, PALM/STORM

Upright
Fluorescence
Microscope
(UFM) Kit for
tissues or
other large
samples
such as
organs



Fixed mouse cerebellum tissue embedded in 4% Agarose. BioMAT Workstation was used to overlay **1** 63× upright fluorescent microscopy image of DAPI stained nucleus and **2** AFM force mapping height (z range: 30 μm) and **3** Young's modulus image (z range: 5 kPa, scan size: 50 μm). Newly developed automatic height compensation was used to overcome the typically large height differences of tissue samples. Sample courtesy: AG Prof. Jochen Guck, Dr. Elke Ulbricht, TU Dresden, Germany.

NanoWizard 4 XP setup on Zeiss LSM 880 confocal microscope with Airyscan



BioMAT Workstation for high NA upright optics with Zeiss Axio Imager



NanoWizard 4 XP on Olympus with PicoQuant MicroTime 200 STED

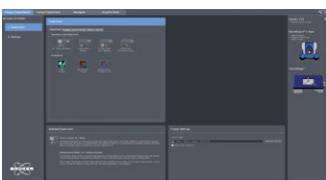

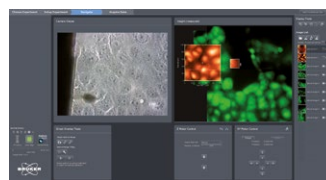
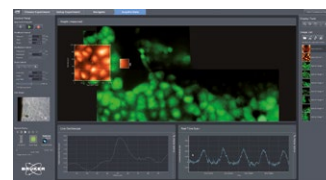


Powerful and intuitive workflow-based user interface with new V7 software



NEW WORKFLOW-BASED SOFTWARE DESIGN ACCELERATES SCIENTIFIC OUTPUT

The workflow structure and task-based desktops organize the information needed for the different steps, and guide users through setting up experiments by providing intelligent help and status feedback for alignment and setup. This straightforward route to data acquisition helps even users with minimal AFM experience to progress confidently to generating high-quality data. Researchers who are experienced with AFM will also value the efficient experiment selection and predefined modes, favorites and quick, single-click calibration.

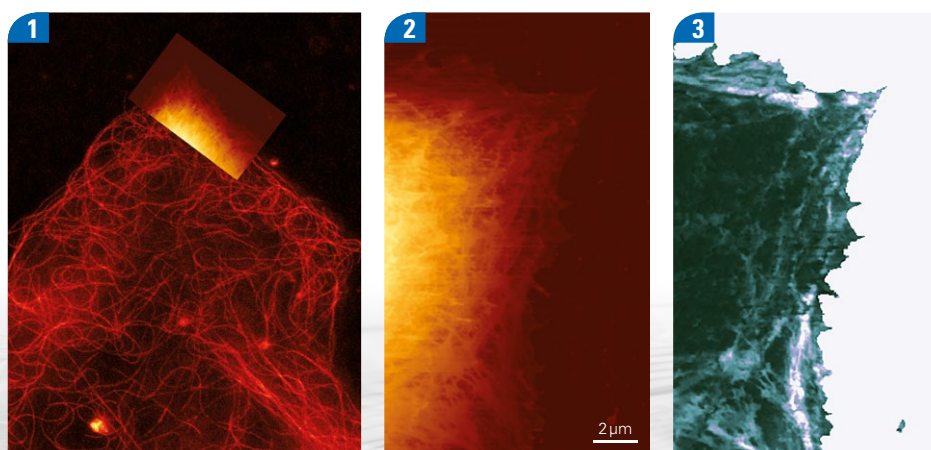
Choose Experiment	Setup Experiment	Navigate	Acquire Data
			
<ul style="list-style-type: none">■ Choose experiment■ Instrument overview■ Context-sensitive help■ Cantilever guidance	<ul style="list-style-type: none">■ One-click cantilever calibration■ One-click DirectOverlay™ 2■ Graphical context-sensitive help■ Status feedback	<ul style="list-style-type: none">■ HybridStage Navigation■ Motorized Stage Navigation■ Optical Image Tiling	<ul style="list-style-type: none">■ Streamlined graphical display■ Essential parameters always visible■ Advanced settings available

USER MANAGEMENT FEATURE DEVELOPED FOR MULTI-USER FACILITIES

The needs of beginners and advanced users are different, so why should they have to use identical software? Adapt the range of experiments and options available to the experience level of the users, unlock more advanced features as students progress, or keep the options simple for those who have just booked a few of hours in an imaging facility.

UNMATCHED DATA CORRELATION WITH NEW DIRECTOVERLAY™ 2 FEATURE

The newly developed **DirectOverlay 2** feature provides easy, optically guided navigation and smart integration. Selecting an area of interest directly in the optical image maximizes the benefits of simultaneous AFM and optical measurements. **DirectOverlay 2** is compatible with a wide range of cameras and detectors for single molecules or living cells. Time-resolved correlation is achieved by using triggering signals to synchronize data acquisition. Advanced calibration algorithms, visualization routines and usability provide the most user-friendly functionality available today.



STED and AFM experiment of living A549 cells imaged at 37 °C in medium.

- 1 STED image of microtubules labelled with silicon rhodamine overlaid with AFM topography
- 2 AFM QI topography image at 240 pN imaging force (height range 3.5 μm)
- 3 Corresponding QI Young's modulus image (z range 100 kPa)

Smart automation for quick results and enhanced productivity

AUTOMATED MAPPING OF LARGE SAMPLE AREAS WITH NEW TILING FUNCTIONALITY

The **HybridStage™** or **Motorized Precision Stage** transforms experiments by enabling direct access to a large sample area, with automated, motorized movement to selected positions, grids and mapping regions. Begin with the **DirectOverlay 2** optical calibration, and then select a region for optical tiling up to millimeters in size. Precise motor movements automatically bring the whole sample into view, making it easy to select regions and features for further investigation. A single click navigates from point to point or **MultiScan** experiments automate a sequence of measurements at selected points.

The modular functions of the **HybridStage** include motorized sample scanners and a 3-axis, large range, piezo sample scanner. In particular, the addition of the long Z piezo (> 100 µm) for extended force measurements allows the user to map large scan regions using the XY motors. This makes it a highly versatile system for investigating the adhesion or mechanics of cells, scaffolds or tissue mapping.

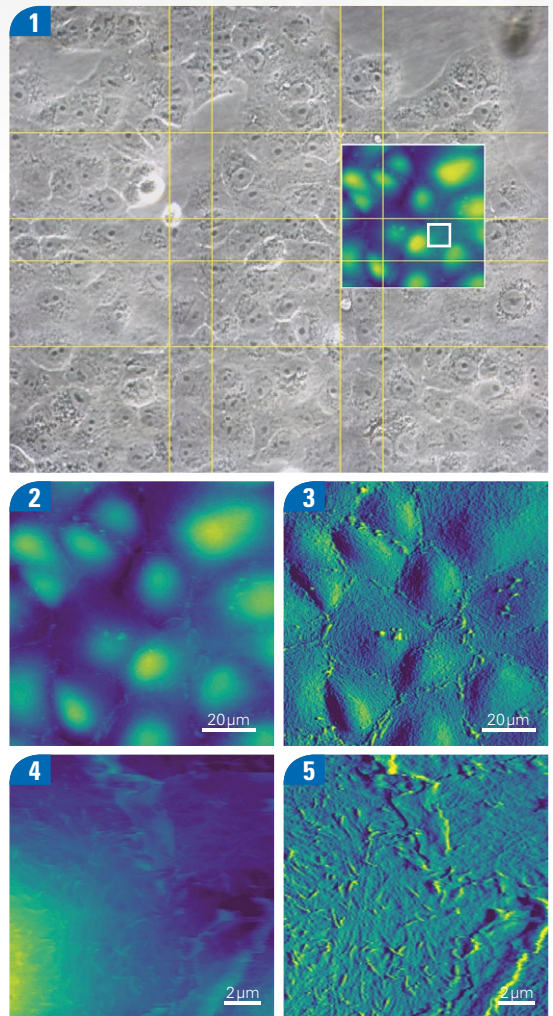
EXPERIMENTPLANNER™ & EXPERIMENTCONTROL™ FOR ENHANCED EFFICIENCY

As automation is not only important for position control, the **ExperimentPlanner** delivers a comprehensive package of options. The advantages of automatic experiment control, optical triggering, environmental temperature or liquid flow are clear. Ensure repeatability of the experimental parameters when setting up advanced experiments, achieve precise timing control in a measurement sequence and avoid repetitive settings.

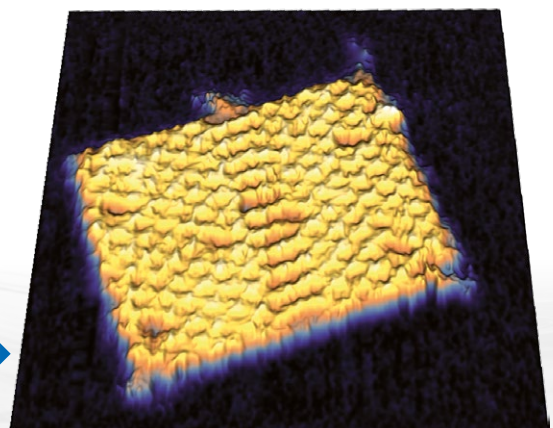
ExperimentControl allows the user to access their experiment from anywhere via a browser interface for an easy setup of complex systems, or to monitor progress remotely.

◀ NanoWizard 4 XP with HybridStage on Zeiss Axio Observer

▶ PeakForce Tapping (4 kHz) of DNA-Origami (GATTA-AFM, Gattaquant, Germany) on mica in TAE buffer.
Scan field: 120 nm × 110 nm
Height range: 3.0 nm



1 Living Vero cells in cell culture medium at 37 °C in the PetriDish-Heater (40× Ph2 objective, Zeiss). Overview 3×3 optical tiling grid of phase contrast images covering 385 µm × 330 µm with inset PeakForce Tapping image. **2-5** Zoom into region scanned with AFM showing 100 µm × 100 µm scan (height range 5 µm) and inset 15 µm × 15 µm (height range 2 µm) scan topography images using PeakForce Tapping. The feedback correction signal images highlight the surface membrane features, particularly in the zoomed image. Microvilli dominate the center of the cell, with membrane ruffles at the cell boundary.



Outstanding quantitative data from molecules, cells and tissues

PERFECT NANOMECHANICAL SOLUTIONS FOR BIOLOGICAL SAMPLES

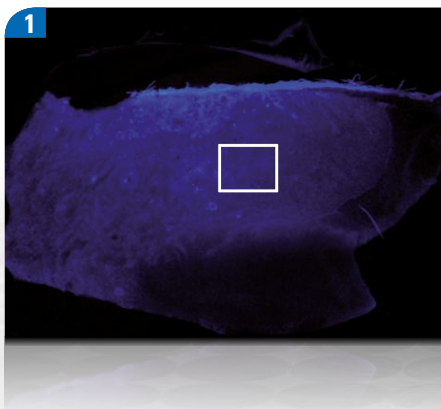
The **NanoWizard 4 XP** benefits from 20 years of development and Bruker's position as the leader in force measurements for life sciences. It provides comprehensive solutions for determining the nanomechanics of samples, in particular, biological materials.

A variety of scanning modules cover adhesion, mechanics and even viscoelasticity measurements on samples ranging from single molecules via single cell force spectroscopy (SCFS) to large structures, substrates or tissue samples. Convenient, well-designed accessories ensure that cells or tissue samples can be kept under physiological conditions with full access for simultaneous optical microscopy to guide or interpret the mechanical measurements. This comprehensive toolset provides tailored solutions to all your research questions in this field.

1-2 Stiffness mapping of non-cancerous human cervix tissue with a HybridStage. The inset in the fluorescently-labelled (Hoechst) slab was used for mapping of a 5 × 4 quadrant area of 1000 μm × 800 μm with overlaid composite Young's modulus map shown in the middle panel.

3 The representative topography channel from an individual 200 μm × 200 μm channel is given in the right panel.

Sample courtesy of Dr. T. Fuhs and Prof. J.A. Käs, University of Leipzig, Germany

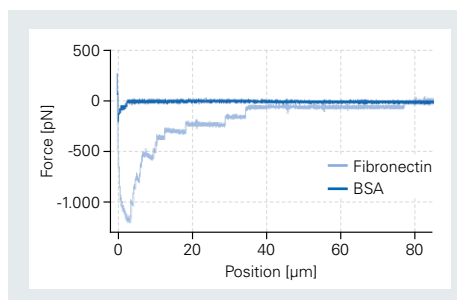


LEADING IN FORCE SPECTROSCOPY

QI™ Advanced, based on real force curves, offers both astounding speed and resolution for applications ranging from single molecules to living cells. The quantitative data allows precise and fast analysis of mechanical or biochemical interactions, e.g., localization of binding sites, directly overlaid with fluorescent labelling and topography with **Molecular Recognition Imaging**. Advanced batch processing options include multiple models for modulus fitting and can reveal surface topography at zero force with **Contact Point Imaging (CPI)**.

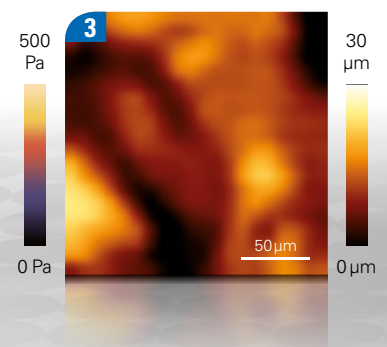
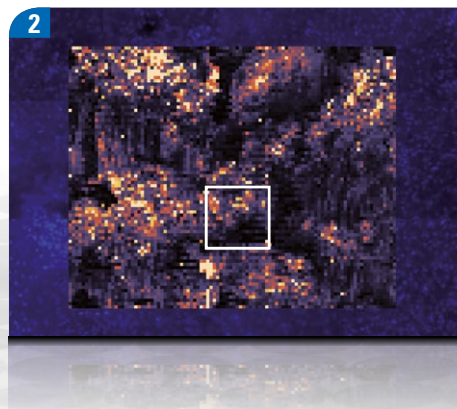
COMPLETE HARDWARE AND SOFTWARE SOLUTIONS FOR FORCE MEASUREMENTS ON BIOLOGICAL SAMPLES

- **Microrheology mode**: Viscoelastic sample properties at separate locations or as maps for probing polymers, gels and living cells at defined frequencies
- **Contact Resonance Imaging**: Fast mechanical contrast on samples such as polymers or cartilage with elastic moduli in the GPa range
- **RampDesigner™**: Unique design of force segments for customized measurements
- **ExperimentPlanner**: Advanced control of experimental workflow. Vary sample conditions by changing buffers or adding drugs, or automate complex experiment series
- **CellHesion®**: Optional 100 μm z range for live cell adhesion studies
- **HybridStage**: Automated mapping of sample properties over a large range for structured substrates, cells and tissue samples



Single cell force spectroscopy measurements using the CellHesion module with an increased z range of 100 μm, showing the detachment force curves of a single A549 cell from fibronectin (FN) and from bovine serum albumin (BSA) coated culture dishes.

Note, that the detachment of the cell from fibronectin results in a very large pulling range of 77 μm.



Specifications for the NanoWizard 4 XP BioScience AFM



System specifications

- Atomic lattice resolution on inverted microscope in closed-loop (<0.030nm RMS z height noise level)
- Ultra-low noise level of cantilever deflection detection system <2pm RMS free (0.1 Hz-1 kHz)
- Highest detector bandwidth of 8MHz for high speed signal capture
- Tip-scanning, stand-alone system, with a rigid low-noise design and drift-minimized mechanics
- The only liquid-safe AFM with integrated vapor barrier, special encapsulated piezo drives and tip-moving design
- IR deflection detection light source with low coherence
- Transmission illumination with standard condensers for precise brightfield, DIC and phase contrast
- Scanner unit
 - 100 × 100 × 15 μm³ scan range with 1.5 μm extra z range with high-speed option
 - Sensor noise level <0.09nm RMS in xy
 - 0.04 nm RMS sensor noise level in z

Vortis 2 SPMControl electronics

- State-of-the-art digital controller with lowest noise levels and highest flexibility

New workflow-based V7 SPMControl software

- True multi-user platform, perfect for imaging facilities
- User-programmable software
- Fully automated sensitivity and spring constant calibration using thermal noise or Sader method
- New DirectOverlay 2 for combined optical and AFM information
- Improved ForceWatch™ and TipSaver™ mode for force spectroscopy and imaging
- Advanced spectroscopy modes such as various force clamp modes or ramp designs
- Powerful Data Processing (DP) with full functionality for data export, fitting, filtering, edge detection, 3D rendering, FFT, cross section, etc.
- Powerful batch processing of force curves and images including WLC, FJC, step-fitting, JKR, DMT model and other analyses

Stages and sample holders

- Stages are available for all major inverted optical microscope manufacturers such as Zeiss, Nikon, Olympus and Leica
- Motorized precision stage with 20 × 20 mm² travel range with joystick or software control
- Manual precision stage with 20 × 20 mm² travel range
- Holders for Petri dishes, coverslips, microscope slides or metal SPM discs are available
- Special holders and liquid cells possible
- Large Ø140 × 18 mm³ free sample volume up to 14cm in z with new Head-Up stage

Largest number of accessories and probes

(see accessories handbook)

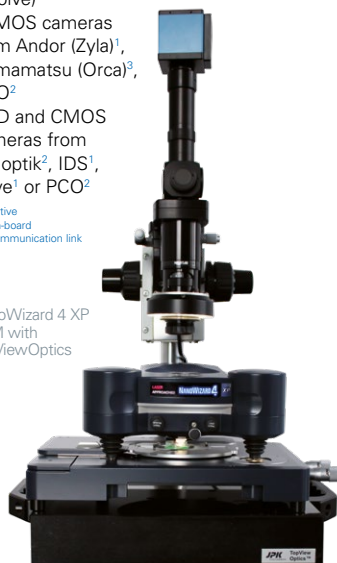
- Large choice of temperature controls (for ambient, liquid and gas), liquid cells even for aggressive solvents
- Vibration and acoustic isolation from leading suppliers

Optical configurations

- Fits on inverted microscopes from
 - Zeiss (Axio Observer, Axio Vert 100/200, Axio Vert A1)
 - Olympus (IX line)
 - Nikon (TE 2000, Ti/Ti2 line)
 - and Leica (DMi line)
- AFM simultaneously with optical microscopy
 - Fully simultaneous operation with optical phase contrast and DIC using standard condensers
 - Combine AFM with advanced commercial confocal microscopes and fluorescence optical techniques such as FCS, FRET, TIRF, FLIM, FRAP, STED, STORM/PALM, SIM and more
- TopViewOptics video optics for opaque samples with 12× zoom
- BioMAT option (see BioMAT brochure)
 - For high-NA upright fluorescence optics combined with AFM on opaque samples
 - Supports upright research microscopes such as Zeiss Axio Imager and Axioscope, Olympus BX51/53 and BX FM, LEXT, Leica DM 4000/5000
- Upright Fluorescence Microscope (UFM) Kit
 - Enables the combined use of AFM and upright fluorescence microscopes such as Zeiss Axio Zoom V16, Leica Macroscope Z16 ApoA, Leica M100/200 Line, Olympus MVX 10 MacroView
- Large range of supported cameras
 - High-end EM-CCD cameras such as models from Andor (iXon)¹, Hamamatsu³ and Photometrics (Evolve)³
 - sCMOS cameras from Andor (Zyla)¹, Hamamatsu (Orca)³, PCO²
 - CCD and CMOS cameras from Jenoptik², IDS¹, μEye¹ or PCO²



NanoWizard 4 XP AFM with TopViewOptics



(1) Native
(2) On-board
(3) Communication link

STANDARD OPERATING MODES

Imaging modes

- Now with PeakForce Tapping
- Contact mode with lateral force microscopy (LFM)
- Tapping Mode™ with PhaseImaging™

Force measurements

- Static and dynamic spectroscopy
- Advanced Force Mapping

OPTIONAL MODES

- High-speed scanning option up to 150 lines/sec **NEW**
- Fast QI Advanced mode for quantitative data, perfect for soft samples
 - Mechanical properties such as adhesion, elasticity, stiffness, deformation
 - Conductivity and charge distribution mapping
 - Contact Point Imaging (CPI) with zero force
 - Molecular recognition imaging for binding site mapping
- Advanced AC modes such as FM and PM with Q-control & Active Gain Control
- Higher harmonics imaging
- Kelvin Probe Microscopy and SCM
- MFM and EFM (see also QI mode)
- Conductive AFM (see also QI mode)
- STM
- Electrical spectroscopy modes
- Piezoresponse Microscopy for high voltages
- Electrochemistry with temperature control and optical microscopy
- NanoLithography
- NanoManipulation
- Nanoindentation
- Scanning Thermal AFM
- FluidFM® solution from Cytosurge **NEW**
- ExperimentPlanner for designing a specific measurement workflow
- RampDesigner for custom designed clamp and ramp experiments
- ExperimentControl feature for remote experiment control
- DirectOverlay 2 for combined AFM and optical microscopy **NEW**
- Additional XY or Z sample movement stages available with CellHesion, TAO and HybridStage module

NanoWizard, CellHesion, TAO, BioMAT, Vortis, DirectOverlay, ExperimentPlanner, ExperimentControl, RampDesigner, ForceWatch, TipSaver, HybridStage, BioCell, TopViewOptics, PetriDishHeater, QI, NestedScanner, PeakForce, Tapping Mode and PhaseImaging are trademarks or registered trademarks of Bruker Nano GmbH or Bruker Corporation. All other trademarks are the property of their respective companies.



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