BRUKER

Now with
PeakForce Tapping

NanoWizard®
ULTRA SPEED 2 AFM

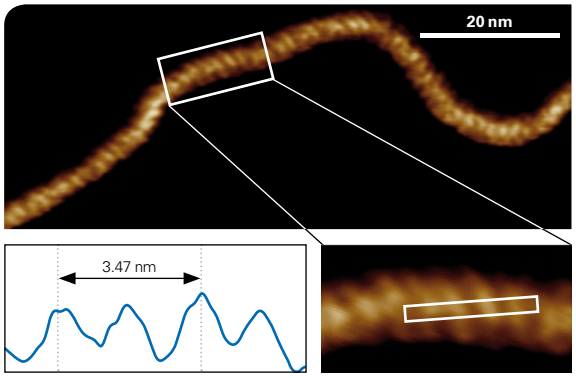
- High-speed imaging with 10 frames/sec
- Highest resolution quantitative imaging
- Perfect integration with advanced optical microscopy
- Revolutionary new workflow-based software
- Outstanding flexibility and modularity

JPK BIOAFM

NanoWizard® ULTRA Speed 2
Peak performance redefined

ULTIMATE SYSTEM PERFORMANCE

The **NanoWizard ULTRA Speed 2 AFM** delivers exceptional performance and unmatched user-friendliness. It comes with the new **Vortis™ 2** controller, a cutting-edge, workflow-based user interface, advanced scanner design, and new modes. It combines true atomic resolution and high-speed scanning with rates of 10 frames/sec. This technological breakthrough is the result of continuous enhancement and innovation by the experts for Life Science AFM technology – the JPK BioAFM team in Berlin.



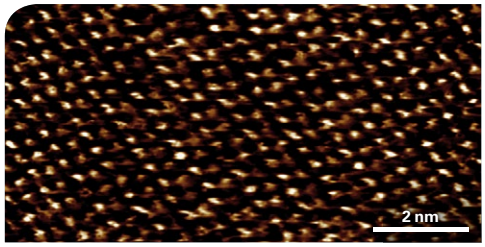
Plasmid-DNA in liquid on a polycationic covered mica substrate and cross section of the marked region. Major and minor grooves with a period of approximately 3.4 nm are clearly visible.

A NEW LEVEL OF EASE OF USE

JPK's engineering team followed a completely new approach to develop a novel software interface. The new **software V7** is workflow-based and designed to meet the varying requirements of each user. It allows the control of complex and long-term experiments, and a set of newly developed accessories and features aid and accelerate scientific output.

HIGHEST RESOLUTION AND STABILITY

The system is designed to meet the demands of high-resolution applications. The lowest noise and highest stability available on the market are key to providing true atomic resolution. In addition, direct force control at ultra-low forces prevents damage to your samples and probes. With the state-of-the-art position sensor technology, the system delivers highest accuracy and maximum precision.



True atomic resolution image of a calcite crystal plane in liquid recorded at 100 lines/sec

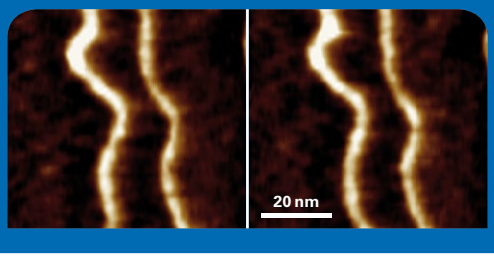
NanoWizard ULTRA Speed 2 setup on a Zeiss Axio Observer inverted optical microscope with new, workflow-based user interface and ExperimentControl feature on a tablet

By far the best high-speed AFM, even on an inverted optical microscope

BENCHMARK FOR HIGH-SPEED SCANNING ON INVERTED MICROSCOPES AT 10 FRAMES PER SEC

The new **NanoWizard ULTRA Speed 2** tip-scanner technology can reach speed levels previously unattainable with traditional AFMs. Real-time, in-situ experiments can now be performed in combination with advanced optics.

AFM images of the same individual DNA molecule acquired in liquid at 630 lines/sec (10 frames/sec).



Watch the video

There are 400 scans between the two images, which demonstrate the low invasiveness and stability. With conventional AFM (4 lines/sec), this experiment would take > 2 hours.

HIGH-SPEED IMAGING FOR HIGH OR CORRUGATED SAMPLE STRUCTURES WITH NESTEDSCANNER™ TECHNOLOGY

Until now, performing dynamic experiments on living cells, highly corrugated samples or steep surface structures with highest spatial and temporal resolution was challenging. With the new **NestedScanner** technology, cells, bacteria or structured surfaces with sample heights of up to 8 µm can now be examined at the highest scan speeds.

1 Melting (left column) and 2 crystallization (right column) of a biodegradable polyester polycaprolactone (PCL) thin film by ramping the sample temperature from 33 °C to 62 °C and back while scanning. The NestedScanner technology allows high-speed scanning of 225 µm/sec during the entire temperature cycle by following the variation of the thickness of the PCL film (2.5 µm) during swelling and contraction (see schematic). The height range of the AFM topography images is approx. 60 nm.

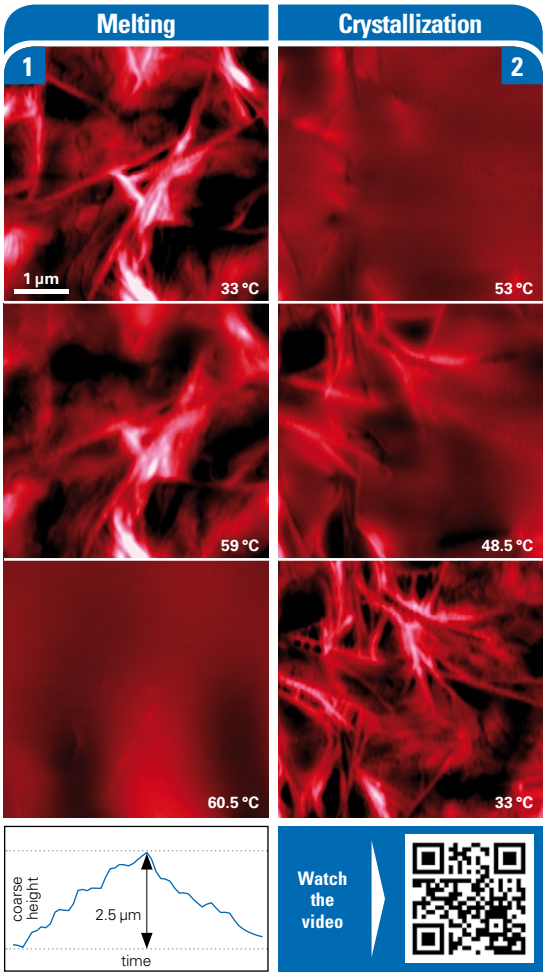
SIMULTANEOUSLY TRIGGER AND OBSERVE SAMPLE DYNAMICS IN REAL-TIME WITH AFM AND ADVANCED FLUORESCENCE MICROSCOPY

Experiments following sample dynamics often rely on the triggering of a reaction by changing the environmental conditions. With the comprehensive set of environmental control solutions (temperature control and gas or fluid exchange), combined with optical microscopy methods, the user can perform advanced AFM experiments at unmatched speeds. **NanoWizard ULTRA Speed 2** sets the standard in correlative microscopy.

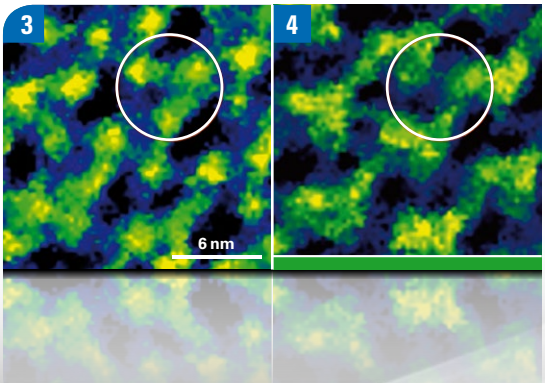
3+4 Bacteriorhodopsin (mutant D96N) photocycle AFM images acquired at 1 frame/sec in buffer. Right image depicts real-time green light (indicated by green bar) induced conformational change triggering proton flow directionality. Height range 325 pm. Sample courtesy of P. Bosshart, Basel (CH).

BENEFITS OF HIGH-SPEED SCAN OPTION

- Observe real-time sample dynamics with highest resolution
- Access to corrugated and higher surfaces with the **NestedScanner** technology
- Combine AFM and optical fluorescence microscopy for multiparametric in-situ experiments
- Enhance productivity, probe more sample positions faster



Watch the video



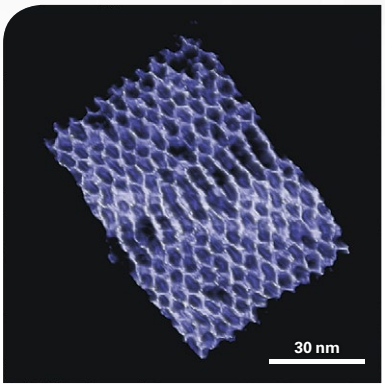
Smart automation delivers results quickly and enhances productivity

PEAKFORCE TAPPING® – THE GOLD STANDARD FOR EASY IMAGING

PeakForce Tapping enables even inexperienced users to precisely control probe-to-sample interactions and minimize imaging forces. This is vitally important for soft, and fragile biological samples. This superior force control results in the most consistent, highest resolution AFM imaging, and is suitable for the widest range of sample types. Using **PeakForce Tapping**, crystal-clear images can be obtained with just a few clicks, and without any expert knowledge or cantilever tuning necessary. Never before has it been so easy to image a sample.

AUTOMATED LARGE SAMPLE AREA MAPPING WITH NEW TILING FUNCTIONALITY

The **HybridStage**™ frees experiments from the lateral constraints of the AFM piezo range. Large-range tiling of optical images provides a clear visual overview, allowing a fast setup of optically guided experiments and direct selection of the optical features for investigation. Navigate around the sample, collect a list of regions of interest for automated measurements (MultiScan), or even map force responses over greatly extended scan ranges. The **HybridStage** introduces a newly developed modular, piezo-based sample scanner stage combined with motorized XY sample movement, which allows multi-dimensional access to the sample. The highly versatile solution for all your sample requirements.



Peakforce Tapping of DNA-Origami (GATTA-AFM, Gattaquant, Germany) on mica in TAE buffer.

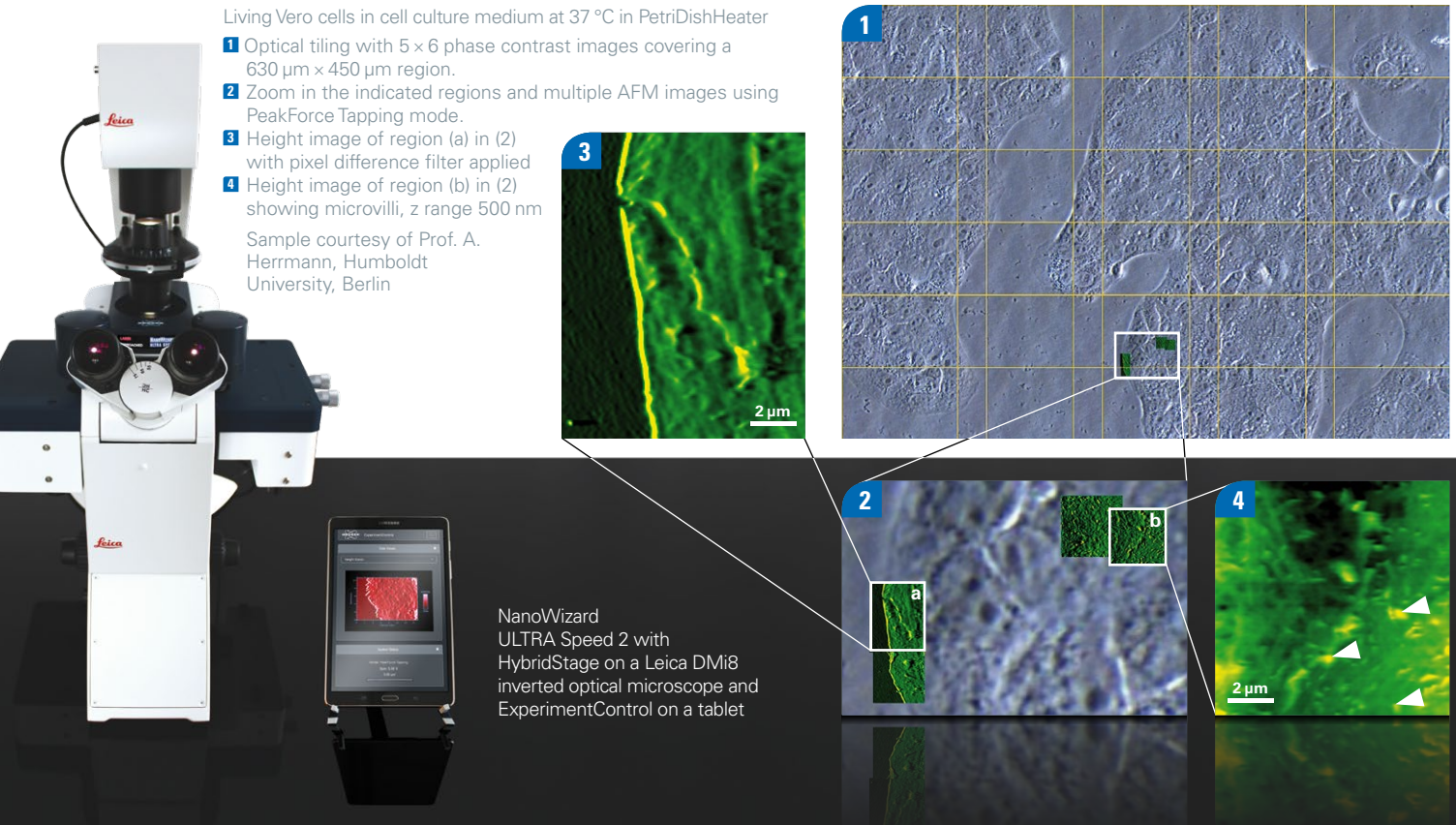
EXPERIMENTPLANNER™ & EXPERIMENTCONTROL™ IMPROVED EFFICIENCY

Certain experiments require automation to achieve precise timing control in a sequence of measurements, or just to avoid tedious repetition. **ExperimentPlanner** delivers full control over all system options such as motor positions, experiment settings or external optics, which enable the researcher to automatically run complex experiments. **ExperimentControl** allows the user to run and monitor long-term lab experiments from the office or from home over the weekend, and to streamline the setup with a tablet or smart phone.

Living Vero cells in cell culture medium at 37 °C in PetriDishHeater

1. Optical tiling with 5 × 6 phase contrast images covering a 630 µm × 450 µm region.
2. Zoom in the indicated regions and multiple AFM images using PeakForce Tapping mode.
3. Height image of region (a) in (2) with pixel difference filter applied
4. Height image of region (b) in (2) showing microvilli, z range 500 nm

Sample courtesy of Prof. A. Herrmann, Humboldt University, Berlin



NanoWizard ULTRA Speed 2 with HybridStage on a Leica DMi8 inverted optical microscope and ExperimentControl on a tablet

Revolutionary new workflow-based user interface with V7 software

ERGONOMICS & EASE OF OPERATION FOR A USER-FRIENDLY WORKFLOW

The new software interface guides users through the workflow to set up experiments intuitively. On-screen, context-sensitive help and status feedback for alignment and setup make it simple, even for users with minimal AFM experience, to progress confidently and generate high-quality data.

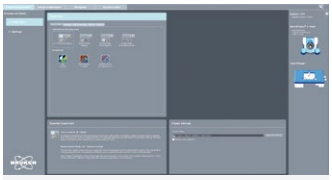
Advanced users will appreciate the efficiency of task-based experiment selection, fast access to favorite and recently used experiments, one-click probe calibration, and the clean layout that gives an instant overview of key data. Each stage of the setup and operation works as an optimized desktop that brings all vital information into focus with a single click.

USER MANAGEMENT FOR MULTI-USER ENVIRONMENTS LIKE IMAGING 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 to the experience level of the users, unlock more advanced features as students progress, or keep the options simple for those who have booked a few hours in an imaging facility.

Choose Experiment



- Choose experiment
- Instrument overview
- Context-sensitive help
- Cantilever guidance

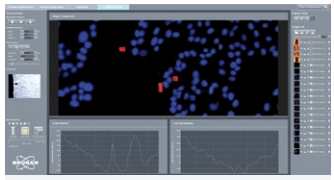
Setup Experiment

- One-click cantilever calibration
- One-click DirectOverlay™ 2
- Graphical context-sensitive help
- Status feedback

Navigate

- HybridStage Navigation
- Motorized Stage Navigation
- Optical ImageTiling

Acquire Data



- Streamlined graphical display
- Essential parameters always visible
- Advanced settings available

V7 SOFTWARE

A true multipurpose tool with new accessories, controller capabilities and modes

FLEXIBILITY AND MODULARITY
ESSENTIAL REQUIREMENTS FOR A MODERN RESEARCH LAB

The new system comes with more accessories and modes than any other AFM platform, each specifically developed to suit the broadest range of applications.

LATEST ACCESSORIES FOR ENHANCED USABILITY

- **TopViewOptics™ module** for opaque samples: Can be used on an inverted microscope.
- **Head-Up stage:** For tall samples (up to 14 cm in height)

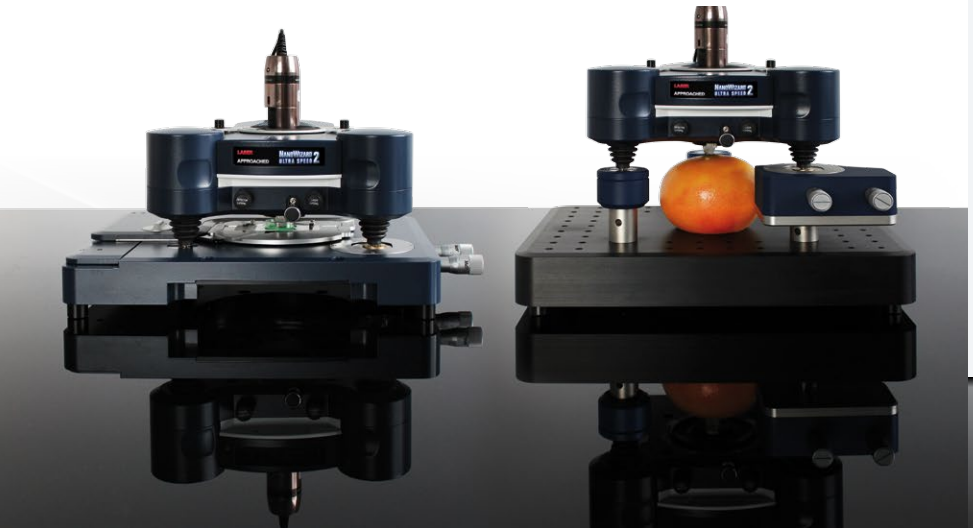
NEW VORTIS 2 CONTROLLER
TODAYS FASTEST AND MOST FLEXIBLE CONTROLLER

The new, high-speed, low-noise **Vortis 2** controller is a brilliant piece of precision engineering. With more processing and computing power than any other controller available today, **Vortis 2** sets the standard.

Equipped with the latest FPGA technology and a dual core Power PC, the system can process huge amounts of data in the shortest timeframe. **Vortis 2** comes with faster, low-noise DACs and a cutting-edge position sensor readout technology. The system offers a large number of feedback modes, a powerful HV amplifier module for high speed applications, and is passively cooled to keep acoustic noise in the lab low.

NanoWizard ULTRA Speed 2 head on motorized stage with TopViewOptics module

NanoWizard ULTRA Speed 2 head on Head-up stage



SUPERIOR VERSATILITY

Nanomechanics solutions

- Enhanced QI™ mode for faster quantitative mapping
- Single molecule force spectroscopy
- Single cell force spectroscopy
- StretchingStage™ for changes in sample properties under mechanical load

Nanoelectrical/electrochemistry

- Conductive AFM module with enclosed volume
- KPM module with enclosed volume
- STM module
- EFM module with enclosed volume
- High-Voltage Piezoresponse module microscopy (PFM) module
- Electrochemistry cell ECCell™
- Photoconductive AFM

Environmental control solutions

- Gas, fluid, humidity control
- Harsh environments
- Sensitive live biological samples
- Glovebox package

Temperature control options

- Ambient to 300 °C with High Temperature Heating Stage (HTHS™)
- -35 °C to 120 °C with Heating Cooling Module (HCM™)
- CryoStage™ with temperature range of -120 °C to 220 °C

Fluid cell options

- Variety of cantilever holders
- BioCell™
- CoverslipHolder
- Electrochemistry cell ECCell
- PetriDishHeater™ and PetriDishHolder
- SmallCell™

Integration of AFM and optical microscopy by the expert

PERFECT INTEGRATION WITH ADVANCED FLUORESCENCE MICROSCOPY PLATFORMS

The combination of AFM with the Nobel prize-winning super-resolution technologies (STED, PALM/STORM) provides enhanced imaging capabilities.

The **NanoWizard ULTRA Speed 2**, with its unique tip-scanning technology, can also be integrated with single molecule techniques like FRET, FCS, FLIM, TIRF to provide additional optical data sets when performing dynamic experiments on living cells or singles molecules.

Correlation with other advanced optical techniques like confocal, spinning disc, and structured illumination techniques (SIM), combined with live cell imaging, makes this system the perfect choice for applications in medical, biophysical, chemical or material research.

DATA CORRELATION EXCEPTIONAL EASE OF USE WITH DIRECTOVERLAY 2

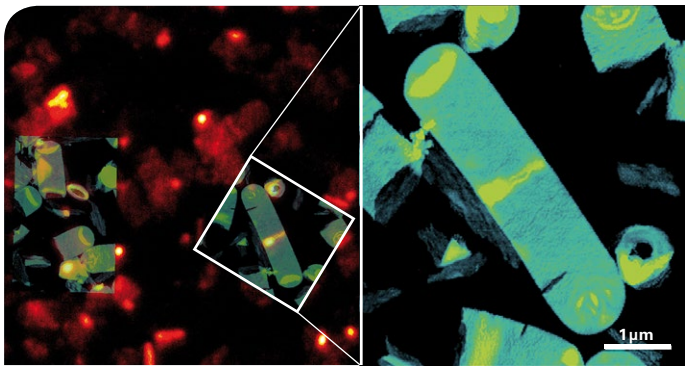
The newly enhanced **DirectOverlay 2** software module enables the direct correlation of AFM and optical data.

The capabilities of our calibration algorithms, visualization routines, and usability have all be been expanded to provide the most user-friendly functionality available today.

NanoWizard ULTRA Speed 2 setup on Zeiss LSM 880

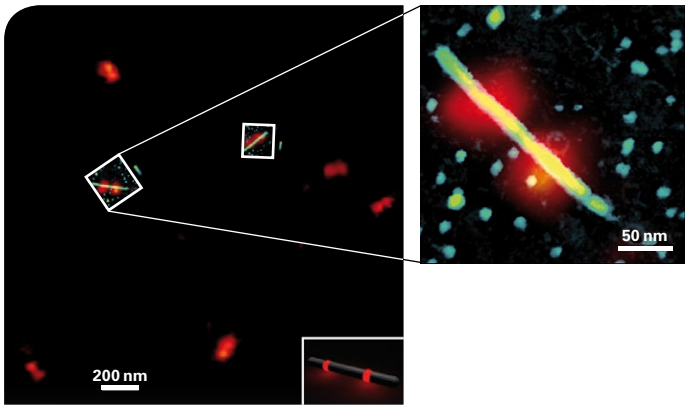
USE ADVANCED OPTICAL TECHNIQUES SIMULTANEOUSLY WITH AFM

- Transmission illumination (brightfield, phase, DIC)
- FRET, FLIM, FCS, FRAP
- TIRF, IRM
- Confocal and spinning disc
- SIM
- Super-resolution (STED, PALM/STORM)



Correlative STED and AFM images of isolated sacculi of *Bacillus subtilis* with cell division protein (FtsZ) labeled for highlighting z rings. AFM image in PBS with QI™ (height range: 150 nm).
Sample courtesy: R.K. Tank[1,3] · R.D. Turner[2,3] · S. Kumar[1,3] N. Mullin[1,3] · A. Cadby[1,3] · S.J. Foster[2,3] · J.K. Hobbs[1,3].

[1] Department of Physics and Astronomy
[2] Department of Molecular Biology and Biotechnology
[3] The Krebs Institute; all University of Sheffield, UK



Correlative Experiment of AFM and STED on ATTO-647N labelled DNA nanorulers in TAE-buffer.

STED images show dimers of 12-15 ATTO-647N molecules 70 nm apart (see schematic inset). AFM QI image shows a 200 nm long DNA nanorod with 8 nm diameter (height range: 12 nm).

Sample courtesy GATTAQUANT GmbH (Germany).

Specifications for the NanoWizard ULTRA Speed 2 AFM

System specifications
- True atomic resolution on inverted microscope in closed-loop (< 0.015 nm RMS z height noise level)
- Ultra-low noise level of cantilever deflection detection system < 2 pm RMS free (0.1 Hz - 1 kHz)
- Highest detector bandwidth of 8 MHz 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
  - 30 × 30 × 6.5 µm³ scan range with 1.5 µm extra z range with high-speed option
  - Sensor noise level < 0.09 nm 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
- Large Ø 140 × 18 mm³ free sample volume up to 14 cm 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 200, Axio Vert A1)
  - Olympus (IX line)
  - Nikon (TE 2000, Ti line)
  - 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 optical fluorescence microscopes such as Zeiss Axio Zoom V16, Leica Macroscope Z16 ApoA, Olympus MVX 10 MacroView
- Large range of supported cameras
  - High-end EM-CCD cameras such as models from Andor (iXon)(1), Hamamatsu(3) and Photometrics (Evolve)(3)
  - sCMOS cameras from Andor (Zyla)(1) or Hamamatsu (Orca)(3)
  - CCD and CMOS cameras from Jenoptik(2), IDS(1), µEye(1) or PCO(2)

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

NanoWizard ULTRA Speed 2 AFM with TopViewOptics

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 10 frames/sec NEW
- Fast QI Advanced mode for quantitative data, perfect for soft samples NEW
  - 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

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