

NANORACER[®]

TRUE HIGH-SPEED AFM

50 frames per second
Exceptional usability
Simply Amazing!



Highest imaging speeds up to **50 frames per second**

Designed for single molecule dynamics applications

Fully automated setup with intuitive software

Outstanding performance



NANO RACER®

True High-Speed AFM

TRUE REAL-TIME VISUALIZATION OF BIOMOLECULAR DYNAMICS

The **NanoRacer®** High-Speed AFM marks a quantum leap in quantitative imaging capabilities. The real-time visualization of dynamic biological processes with nanometer resolution has never been easier. The **NanoRacer** opens a world of new and exciting possibilities for Life Science applications, enabling researchers to gain an in-depth understanding of complex biological systems and molecular mechanisms, in a way not possible until now.

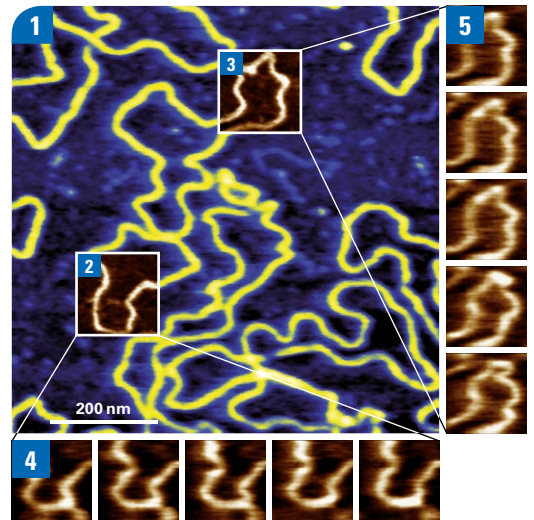


*"So many things are still hidden in biological molecules," stated Professor Toshio Ando, Nano Life Science Institute (WPI-NanoLSI), Kanazawa University, Japan. "To uncover their unexplored secrets, there is a true need to directly observe individual molecules during their functional activity. The **NanoRacer** is the fastest commercial, high-speed AFM available, enabling their direct*

*observation in real-time. A lot of innovative ideas have been incorporated for easy operation and high performance, and it is my utmost wish that many researchers will use the **NanoRacer** to reach their goals and make exciting discoveries."*

BE INSPIRED! DISCOVER NEW, EXCITING APPLICATIONS:

- Single molecule binding behavior
- Dynamics in two-dimensional protein assemblies
- Monitoring enzyme activity
- Assembly and disassembly processes of protein structures
- DNA origami assembly
- Protein/protein interactions
- Motor protein and membrane trafficking dynamics
- Virus and bacteria morphology and dynamics



Individual DNA molecules imaged in fluid on mica+PLO substrate in closed-loop.

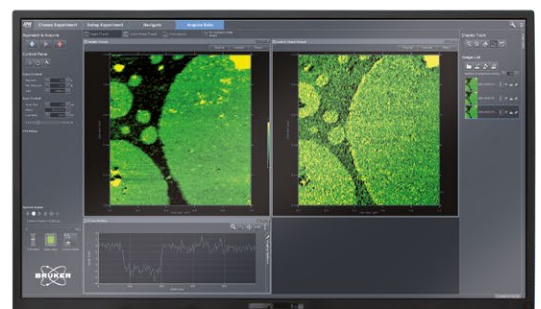
Watch the video



- 1** Overview: 0.5 frames/sec, z-range 3.4 nm
- 2+3** Image-in-image zooms: 10 frames/sec, z-range 2.3 nm
- 4** Video sequence Zoom **(2)**: 50 frames/sec, z-range 2.0 nm (shows 17th, 89th, 160th, 252nd and 370th frame of experiment)
- 5** Video sequence Zoom **(3)**: 50 frames/sec, z-range 1.9 nm (shows 13th, 176th, 428th, 773rd and 966th frame of experiment)

NANORACER, PUSHING THE BOUNDARIES

The **NanoRacer** High-Speed AFM runs at an incredible **50 frames per sec**. It has been specifically developed for highest resolution applications down to the atomic scale. Combined with JPK BioAFM's renowned stability and user friendliness, it is the ideal choice for single molecule experiments.



NanoRacer:

Maximum Speed, Maximum Performance

The **NanoRacer** reinforces Bruker's technology leadership in the field of high-speed AFM. With an imaging speed of **50 frames per sec and highest resolution capabilities**, **NanoRacer** marks a milestone in state-of-the-art AFM.

OUTSTANDING RESOLUTION

Imaging atomic defects and sub-molecular resolution are now routine.

The **NanoRacer** has the lowest noise levels of any commercial AFM system available, thanks to high precision electronics and enhanced accuracy positioning sensors in each axis.

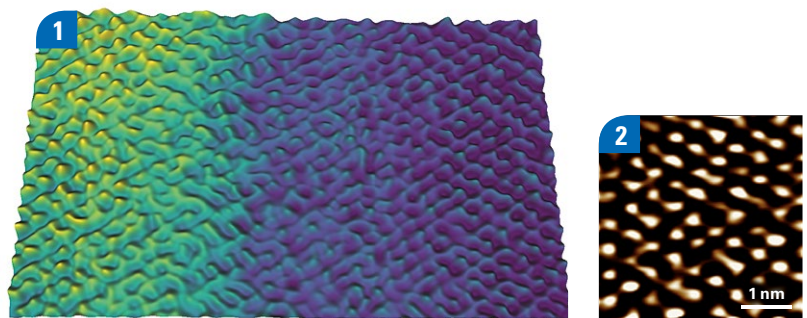
RENOWNED STABILITY, REMARKABLE ACCURACY

The **NanoRacer** reflects the pioneering work of Bruker's BioAFM team in combining technological advances with proven stability, sensitivity, and ease of use.

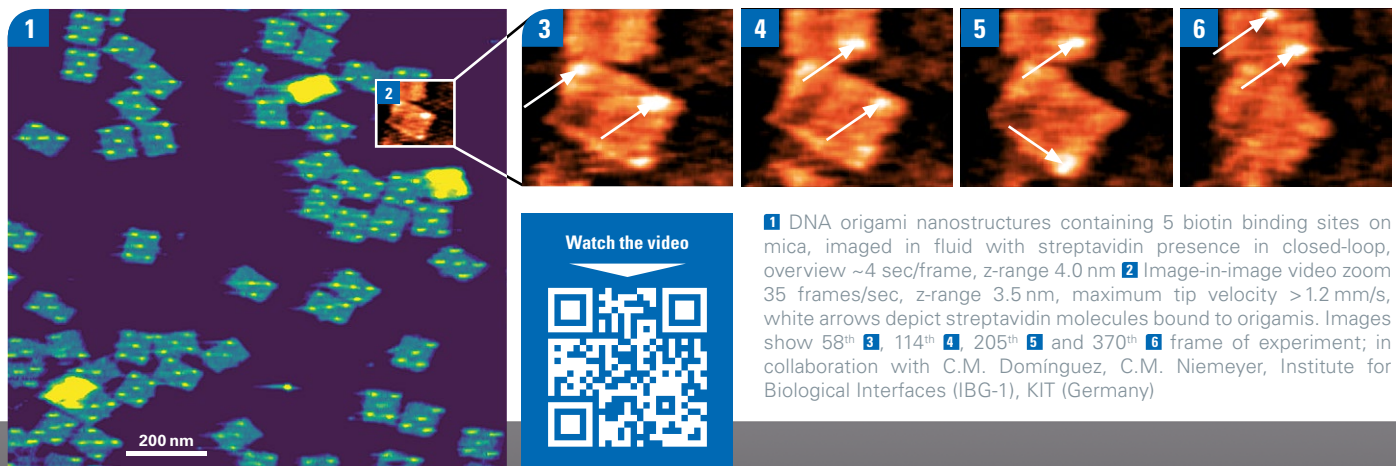
- Newly developed high-speed head and scanner unit
- Robust concentric design for utmost stability
- Optimized for small and medium-sized cantilevers
- Cutting-edge electronics

LATEST TECHNOLOGICAL ADVANCES FOR PERFECT IMAGING RESULTS

- Small cantilevers and lowest forces for minimum sample damage
- Infrared laser photothermal excitation option, for clean cantilever drive, easy setup and minimized perturbation of delicate samples
- Advanced algorithms for scanner control and feedback
- Minimized force drift for long-term experiments
- Highest bandwidth digital electronics, with lowest noise, for maximum performance
- Cutting-edge, high-speed power amplifier for perfect scanner drive
- Closed-loop scanning on all axes with minimal noise levels for highest accuracy



Atomic resolution of calcite crystal step edge, imaged in fluid, 3D topography $15 \times 9 \text{ nm}^2$ (1), zoom $4 \times 4 \text{ nm}^2$ (2).



Watch the video



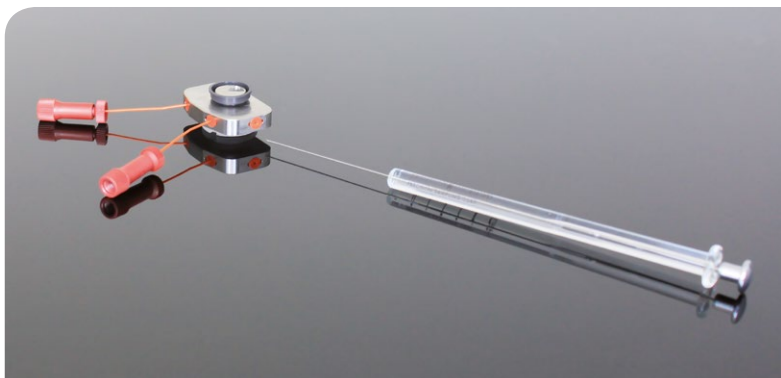
1 DNA origami nanostructures containing 5 biotin binding sites on mica, imaged in fluid with streptavidin presence in closed-loop, overview $\sim 4 \text{ sec/frame}$, z-range 4.0 nm 2 Image-in-image video zoom 35 frames/sec , z-range 3.5 nm , maximum tip velocity $> 1.2 \text{ mm/s}$, white arrows depict streptavidin molecules bound to origamis. Images show 58th 3, 114th 4, 205th 5 and 370th 6 frame of experiment; in collaboration with C.M. Domínguez, C.M. Niemeyer, Institute for Biological Interfaces (IBG-1), KIT (Germany)

Discover a new user experience

STATE-OF-THE-ART CAPABILITIES MADE EASY

The **NanoRacer** marks a new chapter in high-speed AFM and relegates complicated, time-consuming procedures to the past. Developed with the user in mind, the resulting robust and reliable design, with a host of new features, make the **NanoRacer** easy to use, even for newcomers to AFM.

All components are designed for convenient handling, from sample preparation through to fully motorized and automatic optical alignment. The streamlined handling enables easy data collection and fast results. A short time-to-data is vital for achieving dynamic results on active single molecule samples.



Newly designed 3-port liquid cell for photothermal excitation.

FULLY AUTOMATED ALIGNMENT AND SETUP WITHIN A MINUTE FOR ENHANCED EFFICIENCY

- Automated cantilever alignment
- Optimized drift compensation
- Automated photothermal laser alignment option
- Internal camera with autofocus
- Automated calibration of cantilever spring constant

Seamless handling for preparation and imaging with the transportable sample scanner. Prepare the sample conveniently on the bench and load into the NanoRacer to image.

A COMPLETE SYSTEM DESIGNED FOR CONVENIENCE

- Easy sample and probe loading
- Transportable sample carrier for convenient sample preparation on the bench
- Probe exchange in a few minutes
- No calibration needed thanks to closed-loop scanner design
- Easy navigation with integrated camera for locating areas of interest on the sample
- Fluid exchange via direct injection
- Newly designed 3-port liquid cell for photothermal excitation



Focus on your experiment

NEW, WORKFLOW-BASED SOFTWARE DESIGN ACCELERATES SCIENTIFIC OUTPUT

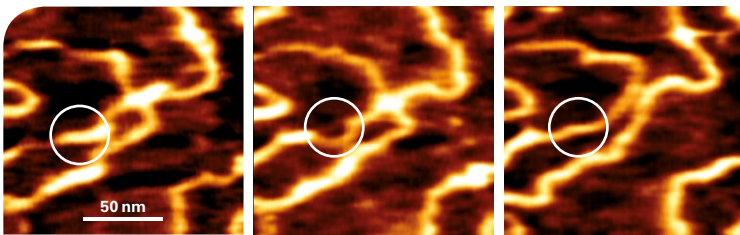
- Intuitive **V7 Software** for proven ease-of-use
- Fast time-to-data thanks to effective user guidance
- Ideal for multi-user environments and imaging facilities
- User-programmable software for advanced experiments
- ExperimentPlanner™ enables full control of all system parameters, such as scanning positions, experiment settings or external fluidics modules
- State-of-the-art data analysis and processing with video creation and intuitive data storage

V7
SOFTWARE

INTELLIGENT IMAGING CONTROLS FOR STUNNINGLY SHARP IMAGES

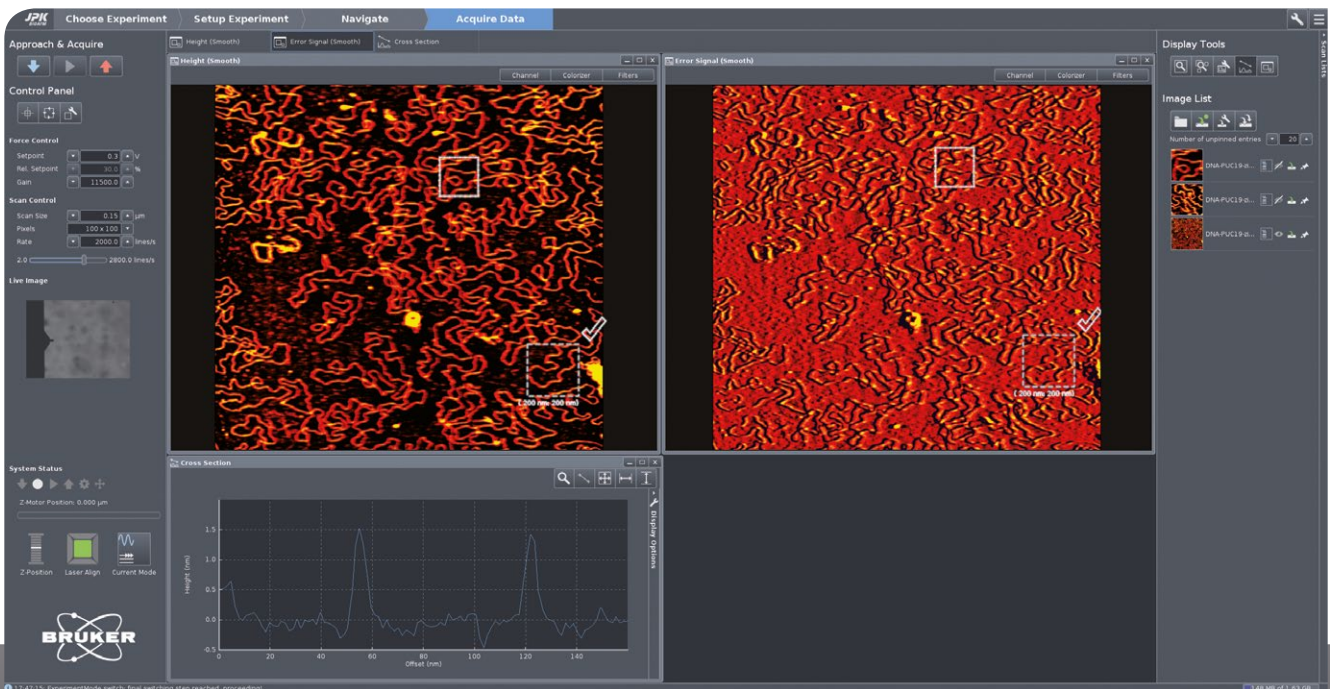
To scan fragile and mobile sample features at highest speeds and lowest forces, a highly intelligent control software is required.

- Dynamic PID, a key component for the precise investigation of sample morphology
- Rapid response time for cantilever-deflection detection system is ensured by shortest dead times in feedback loop, fastest electronics and intelligent FPGA algorithms
- Drift correction of setpoint and automatic detector realignment
- Cantilever excitation with photothermal option or Bruker's proven DirectDrive™
- Highest scan speed with advanced adaptive scanner algorithms



DNA metastable bubble formation and closure, imaged in fluid in closed-loop at 2000 lines per second, z-range 1.5 nm. Circles illustrate location of a bubble on DNA molecule ~30 nm in length.

The closed-loop scanning and convenient interface make it easy to set the location directly from an overview image. Move from place to place with a single click, selecting interesting features and landing wherever you choose, without needing to adjust scan settings.



System Specifications for the NanoRacer High-Speed AFM

System specifications

- Maximum scan speed of up to 50 frames/sec with 100 × 100 nm² scan range and 10 k pixels
- Atomic defect resolution in closed-loop
- Designed for medium to small sized cantilevers for lowest forces and highest scan speeds
- Ultra-low noise cantilever-deflection detection system
- IR cantilever-deflection detection light source with small spot size
- Optional photothermal cantilever drive. 730 nm wavelength ensures minimal sample interaction compared to blue-light excitation
- Highest detector bandwidth of 8 MHz for high speed signal capture
- Automated laser and detector alignment
- Scanner unit
 - 2 × 2 × 1.5 μm³ scan range
 - Sensor noise level < 0.09 nm RMS in xy
 - 0.04 nm RMS sensor noise level in z
 - Highest resonance frequency for z axis of > 180 kHz
 - Typical sample size 4 mm diameter

Control electronics

- Vortis™ 2 Speed controller: State-of-the-art, digital controller with lowest noise levels and highest flexibility
- Newly designed, high-voltage power amplifier drives the scanner unit

New workflow-based V7 SPMControl software

- True multi-user platform, ideal for imaging facilities
- User-programmable software
- AutoAlignment and setup
- Advanced feedback algorithms
- Fully automated sensitivity and spring constant calibration using thermal noise or Sader method
- Improved ForceWatch™ and TipSaver™ mode for force spectroscopy and imaging
- Advanced spectroscopy modes, e.g. 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



STANDARD OPERATING MODES

Imaging modes

- TappingMode™ with PhaseImaging™
- Contact mode with lateral force microscopy (LFM)

Force measurements

- Static and dynamic spectroscopy
- Advanced force mapping

OPTIONAL MODES

- PeakForce Tapping for imaging
- Advanced AC modes such as FM and PM with Q-control & Active Gain Control
- Higher harmonics imaging
- NanoManipulation
- ExperimentPlanner for designing specific measurement workflows
- RampDesigner™ for custom-designed clamp and ramp experiments
- ExperimentControl™ feature for remote control of experiment

PROBES COMPATIBILITY

- High speed probes from Bruker, Nanoworld and Olympus etc.



NanoRacer, Vortis, DirectDrive, ExperimentPlanner, ExperimentControl, RampDesigner, ForceWatch, TipSaver, PeakForce, TappingMode and PhaseImaging are trademarks or registered trademarks of Bruker Nano GmbH or Bruker Corporation. All other trademarks are the property of their respective companies.



JPK BioAFM Business
Bruker Nano GmbH
Am Studio 2D · 12489 Berlin, Germany
productinfo@bruker.com
www.bruker.com/bioafm



Follow us on Facebook,
Youtube and LinkedIn.

