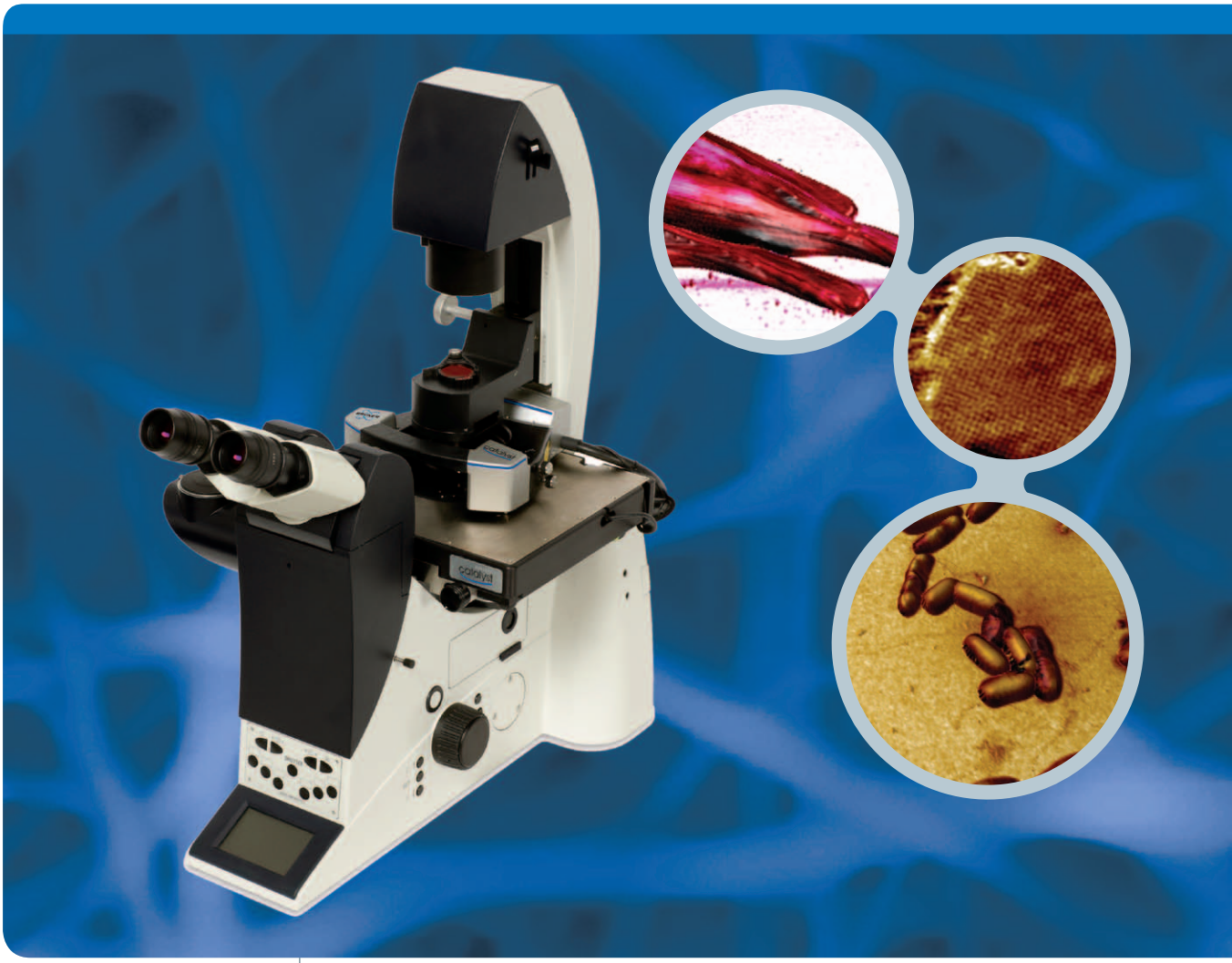
BRUKER



BioScope Catalyst

- Expanding the Boundaries of BioAFM with Unrivaled Performance & Simplicity

Innovation with Integrity

Atomic Force Microscopy

BioScope Catalyst with PeakForce Tapping

The BioScope Catalyst™ BioAFM is designed specifically to best answer the unique requirements of biologists, biophysicists, and bioengineers. PeakForce Tapping™ technology exclusively expands BioAFM performance and simplicity, enabling new discoveries.

Performance

Superior Imaging with PeakForce Tapping

- Feedback-controlled sinusoidal drive enables ultra-low force imaging (<50pN) to protect soft samples
- Direct tip-sample force control eliminates set point drift for incredibly stable imaging at constant force over long periods

Powerful Force Mapping with PeakForce QNM®

- PeakForce QNM delivers faster and higher resolution quantitative mapping of nanomechanical properties compared to force-volume-based mapping modes of the past
- New PeakForce Capture™ feature enables the capture and analysis of force curves at each pixel

Simplicity

Exclusive Nanomechanics Package

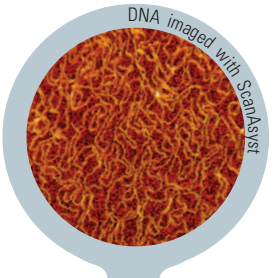
- Package allows characterization of biological samples with revolutionary PeakForce QNM, Quantitative Force-Volume Mapping, and single force curves
- Complete analysis tools obtain quantitative results using all force modes

Fastest Time from Setup to Results

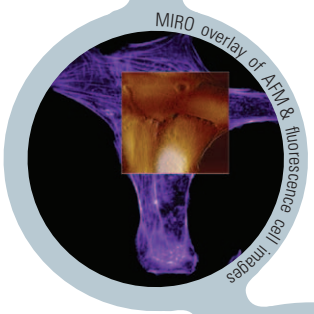
- ScanAsyst® dramatically improves ease of use, achieving expert-quality results with automatic image parameter optimization
- ScanAsyst frees users from restrictive probe selections and complicated “cantilever tunes”

ScanAsyst & PeakForce QNM
Easy Imaging on the Softest Samples

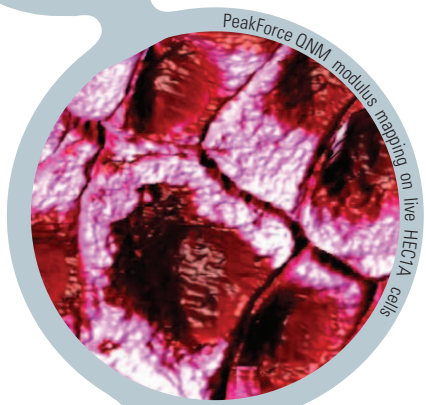
Single Molecules and Membranes
- Proteins, other biomolecules, and biomolecular assemblies
- Supported lipid monolayers and bilayers
- Isolated, purified natural membranes



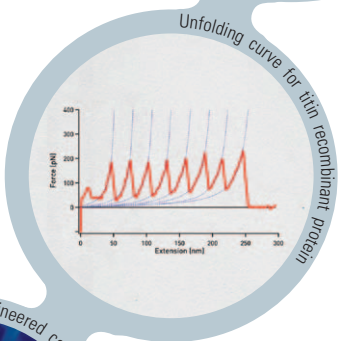
Live Cells and Tissues
- Cell morphogenesis (e.g., differentiation and development)
- Cell-cell / cell-substrate adhesion
- Biofilm and biofouling processes



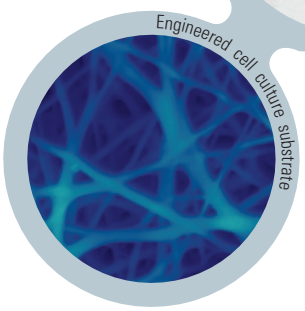
Mechanobiology and Cell Mechanics
- Mechanical properties of cells (e.g., modulus and stiffness)
- Mechanotransduction (e.g., mechanically activated cell signaling)
- Influence of cell substrate / extracellular matrix properties



Force Spectroscopy
- Protein folding, refolding, and stability
- Molecular recognition (ligand-receptor) mapping



Biomaterials and Biotechnology
- Cell and tissue engineering
- Drug delivery technologies

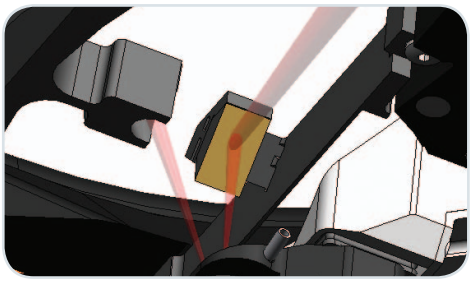


• Superior AFM Performance & Simplicity

Innovative Engineering Enables High Performance

A high-performance AFM requires powerful, low-noise control electronics and a rigid mechanical design optimized to minimize vibration, acoustic sensitivity, and thermal drift. Instead of taking the easier "one-size-fits-all" design approach, Bruker focused on achieving the best results for BioAFM applications. Thus, BioScope Catalyst has the largest XY scan range (150µm), the largest standard Z range (>20µm) available, superior optical access from both above and below, and open physical access to the sample.

The BioScope Catalyst is also designed specifically for safety and reliability when working with biological samples. The head and baseplate direct fluid vapor and liquids that might escape critical components. The piezo crystals used for XY and Z scanning are sealed and inaccessible to fluid. New, more robust probe holder designs keep liquids where they should be.



A simple, proven, top-down laser path ensures low noise and highest quality force measurements.

What is the advantage of a larger 150µm XY scanner range?

A large XY scan range is useful for more than just large scan sizes. It's also the most accurate way to reach different areas within your optical field of view. This is especially powerful when using MIRO® software to select an area of interest for imaging or force measurements. With a 50% larger range than any other BioAFM, you can access a greater portion of your optical field of view. This means faster, more convenient results.

Simple to Set Up, Faster to Acquire Quality Results

Every step of setting up the BioScope Catalyst is optimized for simplicity and speed. Loading a probe could not be easier. There are no loose parts to get lost. Aligning the laser is straightforward using the EasyAlign™ accessory. Then, you simply adjust the detector and engage on your sample. A new engage algorithm will have you imaging quickly, usually within a minute.

You will find ScanAsyst to be the ideal imaging mode for biological samples in fluid. Preconfigured "Experiments" automatically show only the relevant parameters and set appropriate default values. The software provides a clean, uncluttered, intuitive workflow, and built-in help files are available for instant guidance. Bruker also has a worldwide team of biologists and biophysicists standing by, ready to assist you every step of the way.

Don't worry, it's easy! Loading a probe shouldn't be an intimidating test of dexterity and patience.

What makes ScanAsyst the best mode for imaging in fluid?

ScanAsyst is based on Bruker's exclusive PeakForce Tapping technology. Though it's great for imaging in both air and fluid, a few unique advantages become especially valuable when operating in liquids:

- There's no need to "tune" the cantilever resonance — this sometimes complicated step is eliminated
- You directly control the imaging force at levels much lower than conventional AC modes (<50pN)
- The imaging setpoint is practically immune to drift for incredibly stable imaging at constant force
- ScanAsyst can automatically optimize scan parameters, including setpoint, gain, and scan rate

• Superior Optical Performance & Productivity

Superior Physical Integration with Light Microscopy

The BioScope Catalyst is designed to integrate with inverted light microscopes without compromising the performance of the AFM or the light microscope. It features best-in-class optical access from both above and below the AFM. You can use standard 0.5 NA condensers for transmitted light techniques and you can fully populate the objective turret for best versatility. An infrared SLD beam is used for deflection detection, which is easily blocked to avoid interference with fluorescence techniques.

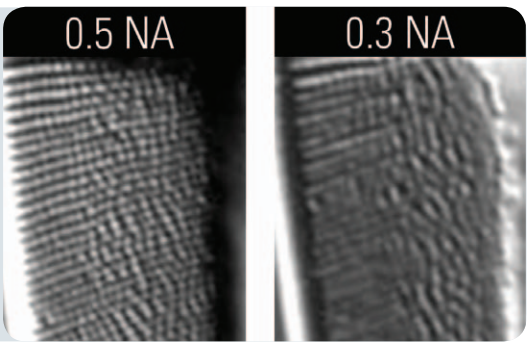
Compatible Optical Techniques

- Brightfield
- Phase Contrast
- Differential Interference Contrast (DIC)
- Modulation Contrast
- Epifluorescence
- Confocal Laser Scanning Microscopy (CLSM)
- Total Internal Reflection (TIRF)
- "F-techniques" (FCS, FRET, FLIM, FRAP)
- Super-Resolution Techniques (PALM, STED,STORM)

What are the advantages of a 0.5 NA condenser?

Higher NA condensers make a difference that you can see in the resolution of transmitted light images. Resolution matters when you want to correlate AFM and optical images. Other advantages include:

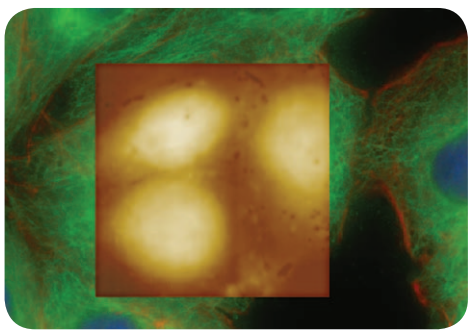
- Compatibilty with higher magnification and oil immersion objectives (you are typically limited to 40X air objectives with 0.3 NA condensers)
- Compatibilty with DIC and modulation contrast techniques (many microscopes don't support these techniques at all with 0.3 NA condensers)



Superior Functional Integration with Light Microscopy

Bruker's exclusive MIRO (Microscope Image Registration and Overlay) software makes using the light microscope and AFM together easier and more productive. With MIRO you can capture optical images directly into the NanoScope® AFM software and then simply select an area of the image for AFM imaging or define points for "Point and Shoot" force measurements.

A simple calibration ensures precise registration between the optical field of view and AFM images and/or force measurements. Once captured, it's simple to adjust the color, transparency and blending of the images to best present the data. Then you can define a region of interest and automatically export cropped AFM and optical images from that area. There's no simpler way to achieve true correlative imaging with AFM and light microscopy.



AFM image overlaid on fluorescence image using MIRO software.

What are the real differences between sample-scanning and tip-scanning BioAFMs?

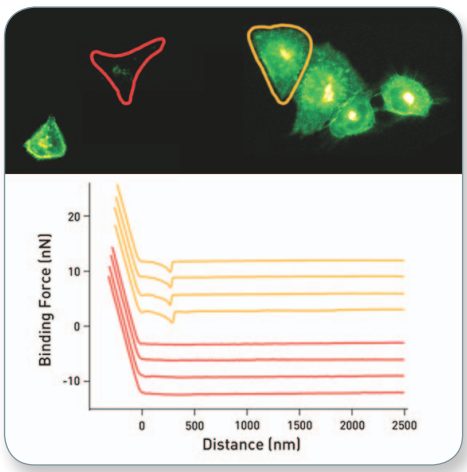
You might think there's a clear advantage to tip-scanning BioAFMs because the sample does not move over the optics while scanning. While logical at first glance, the idea ignores some important realities:

- There are very few cases where optical images must be captured during AFM images. Typically an optical image will be captured before an AFM image (e.g., with MIRO), and sometimes after for comparison.
- There's a big difference in image acquisition time for light microscopy compared to atomic force microscopy. Thousands of optical images could be captured during an AFM image, but the tip shadow would obscure transmitted light images and photobleaching would interfere with fluorescence techniques over the longer timeframe.
- A common use case is when the AFM probe is used to mechanically stimulate cells with force curves and the response is observed optically. This is no problem for sample-scanning AFMs because XY remains stationary.

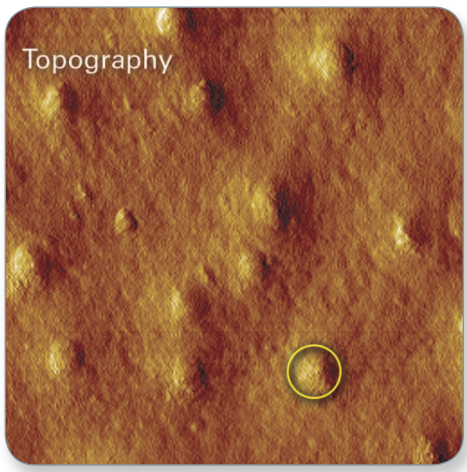
• Nanomechanics Package — All the Tools for Mechanobiology & Cell Mechanics

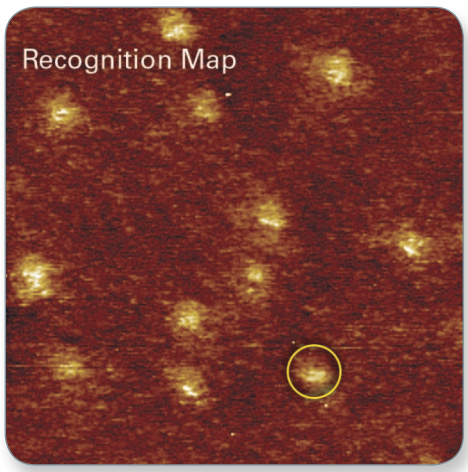
The Most Comprehensive Set of Tools for Productive Mechanobiology

The BioScope Catalyst includes powerful capabilities for interacting mechanically with samples. Conventional, single force curves can be targeted with "Point and Shoot" MIRO on optical or AFM images. The new Quantitative Force-Volume Mapping mode brings direct real-time and offline modulus and adhesion mapping to that widely used technique. Now, Bruker's exclusive PeakForce QNM mode also includes the Sneddon model for soft biological samples. Furthermore, the new PeakForce Capture feature allows a force curve to be captured at each pixel in PeakForce QNM mode. No matter which technique you choose, Bruker's NanoScope software offers a full range of tools.



MIRO "Point and Shoot" force curves are the ideal way to quickly perform force measurements on many different cells.

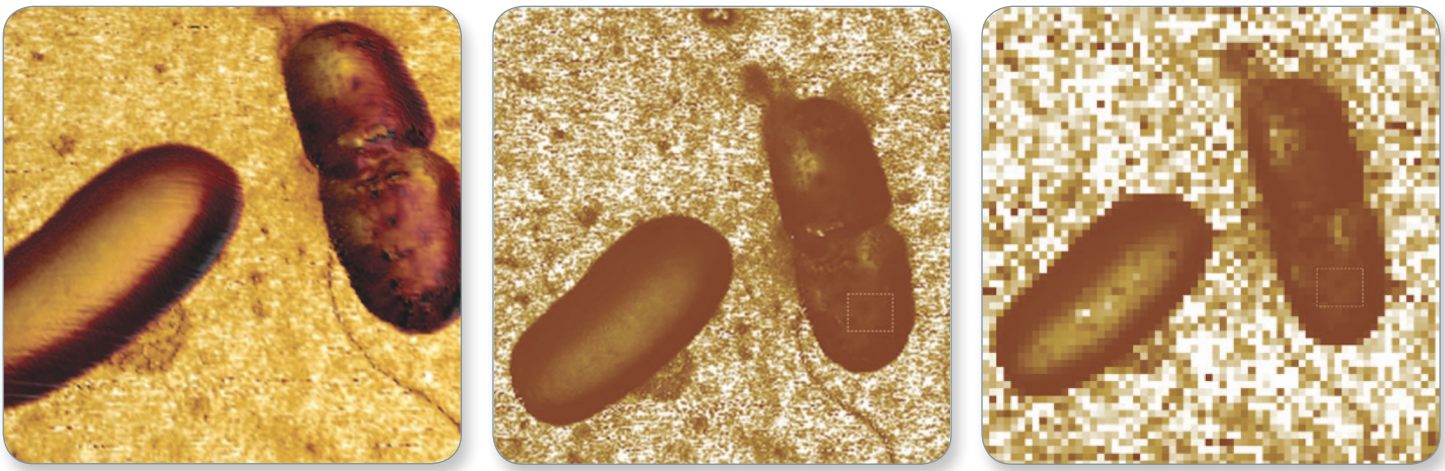




Along with a functionalized probe, PeakForce QNM can be used for molecular recognition mapping. Here, malaria infected red blood cells were imaged with functionalized probes to identify knob-like features in topography as CD36 binding sites (e.g., yellow circles).

Nanomechanics Package

	PeakForce QNM	Quantitative Force-Volume Mapping	Single Force Curves
Measurement	Continuous high-speed, sinusoidal force-distance curves are measured while raster scanning. Tip-sample force is directly controlled using a continuous feedback loop. Curves are analyzed in real-time to generate modulus and adhesion maps.	Single force curves are measured at points on a 2D grid. Tip-sample force is controlled by discrete force triggering at each point. Curves are analyzed in real-time to generate modulus and adhesion maps.	Single force curves are measured at discrete points, targeted either manually or using "Point and Shoot" on optical or AFM images.
Offline Analysis	New PeakForce Capture function captures a force curve at each pixel. The entire image of curves can be reprocessed offline, e.g., with different indentation models, to obtain updated property maps.	Because every force curve is captured, the entire image can be reprocessed offline, e.g., with different indentation models, to obtain updated property maps.	A full suite of force curve analysis tools is available, including baseline correction, filtering, indentation analysis, and adhesion peak finding. All functions may be automated for batch analysis of multiple curves.
Benefits	Feedback-controlled sinusoidal drive uniquely enables the highest speed and highest lateral resolution property mapping with excellent precision force control. PeakForce Capture provides full access to force curves for additional offline analysis.	Technique performs highly accurate force measurements, and is widely used and cited for property mapping.	Highly accurate discrete force measurements can be precisely targeted using "Point and Shoot."
Disadvantages	None	The lateral resolution is typically lower and image aquisition slower. Increasing the ramp rate results in overshoot of the force trigger, an unavoidable issue with mapping modes that use triggered, linear ramps.	None
Ideal Use Case	Technique is best for high-speed, high-resolution property mapping on biological samples with corresponding high-resolution topography.	Technique serves as a comparison to modern PeakForce QNM technique. It is also ideal for special cases where loading rate dependence is critical (e.g., extracting kinetic parameters of binding/unfolding).	Technique is best for cases where it is more valuable to have a few measurements on many cells instead of many measurements on a few cells.



PeakForce QNM and Quantitative Force-Volume Mapping can provide similar modulus mapping on soft samples. However, PeakForce QNM is considerably faster and higher resolution. Analysis of individual force curves from each indicates very good agreement between the two techniques. Here, modulus maps of *E. coli* bacteria were captured with PeakForce QNM (middle) and Quantitative Force-Volume Mapping (right). Both maps are generated by analysis of force curves at each pixel with the Sneddon conical indenter model and yielded similar results. However, the PeakForce QNM image was captured with 256x256 pixels while the force-volume image was captured with only 64x64. The image on the left shows the PeakForce QNM modulus data painted on the 3D topography of the cells. All images show 5µm scan areas and are shown with the same 50MPa range color scale. The average modulus of the cell on the left was approximately 15MPa, while that the right was approximately 2MPa.

• Most Productive BioAFM for Live Cell Imaging & Studies

Compatibility with Common Biological Substrates

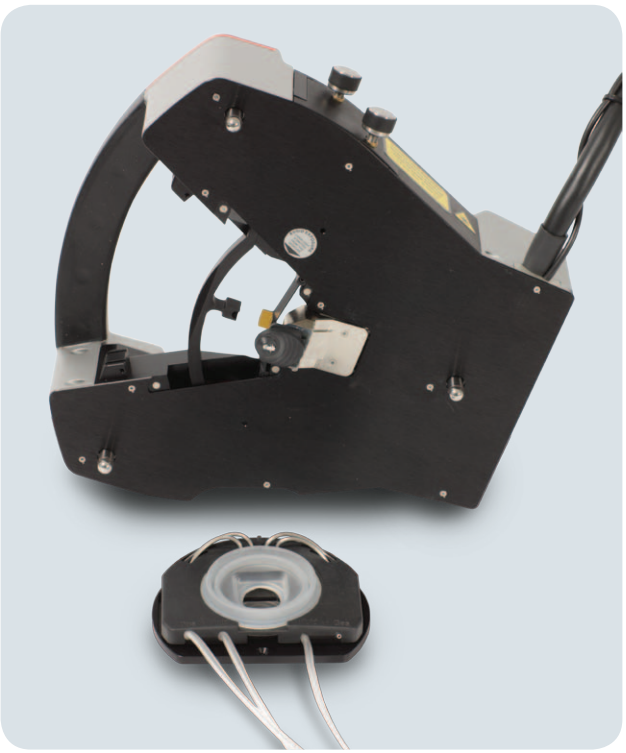
The BioScope Catalyst works with a wide range of sample types, including coverslips, glass slides, 35 and 60mm plastic petri dishes, and 50mm glass-bottom petri dishes, which are conveniently held with magnetic clamps. Any of these may be used with the included sample heater for imaging at up to 40°C.

Micro-Volume Perfusion Cell for Easy Fluid Exchange

The included micro-volume perfusion cell can be used along with almost any sample substrate to form a closed volume of about 60µL, through which fluid can be perfused with a syringe through microbore tubing. It's ideal for use when expensive or scarce drugs, proteins, or other compounds are to be used.

Unique Perfusing Stage Incubator for Live Cell Research

The optional Perfusing Stage Incubator is simply the best solution for long duration live cell studies with an AFM. The cells can be held under ideal temperature, humidity and CO_2 for over 48 hours!



Perfusing Stage Incubator maintains live cells under ideal conditions over many hours.

Supported Configurations

Inverted Optical Microscopes	Leica Microsystems DMI 3000, 4000, 6000; Zeiss Axio Observer A1, D1, Z1 (also Axiovert 100, 135, 200); Nikon Eclipse Ti-E/U/S (also TE2000-E/U/S); Olympus IX51, IX71, IX81 (also IX70); (also supports stand-alone operation)
Transmitted Light Condensers	Leica S28 (0.55 NA, 28mm WD); Zeiss LD (0.55 NA, 26mm WD); Nikon LWD (0.52 NA, 30mm WD); Olympus IX2-MLWCD (0.50 NA, 45mm WD)
Confocal Laser Scanning Microsopes	Compatible with most models based on the inverted light microscope models listed above
Cameras	Enhanced support for Andor iXonEM, Hamamatsu ORCA, and Photometrics CoolSNAP cameras allows direct image acquisition through NanoScope software (inquire about compatibility of specific models); supports all other cameras through TIFF, JPEG or BMP image file import
AFM Controller	NanoScope V
Computer	Intel 2.4GHz Quad Core, 4GB RAM, 500GB hard drive, DVD-RW drive; single 30in. LCD display

AFM Specifications

X-Y Scan Range	≥150µm, open-loop or closed-loop operation
Z Scan Range	≥20µm, open-loop or closed-loop operation
Deflection Detection	IR super luminescent diode (SLD), λ=850nm
Height Noise	<0.1nm RMS (air); <0.2nm RMS (fluid) (typical with appropriate vibration isolation)
Force Noise	Thermally-limited, PicoForce-quality force measurements, <10pN RMS for cantilever with k=20pN/nm
XY Sample Stage	Motorized stage with 10x10mm range; includes magnetic sample clamps for 1x3in. slides, 25mm coverslips, 35 and 60mm plastic petri dishes, and 50mm glass bottom petri dishes

Accessories

MIRO Software	Allows real-time import and registration of optical and AFM images; optical images can be used to guide AFM imaging or force measurements; offline features allow image overlay, adjustment of colors and opacities, and flexible data export options (included with Catalyst Premium configurations)
Perfusion Cells	Petri dish perfusion for 50mm glass-bottom petri dishes; (included with the Catalyst Premium configuration); Micro-volume perfusion cell (<60µL cell volume), (included with all Catalyst configurations); Perfusing Stage Incubator for long-duration live-cell research (optional with all Catalyst configurations)
Sample Heating	Enables operation up to 40°C in liquid (included with Catalyst Premium configurations); physiological temperature range imaging (up to 40°C)
Top-View Optics	Available in both a standalone configuration and a configuration that allows use while AFM remains mounted on the inverted microscope
Nanomechanics Package	PeakForce QNM, Quantitative Force-Volume Mapping; single force curves; and comprehensive suite of force curve analysis tools (PeakForce QNM included with Catalyst Premium configurations)
Electrical Modes	Electric force microscopy, surface potential microscopy; and piezoresponse microscope are standard available modes; Conductive AFM accessory is optional

Facility Requirements

Vibration Isolation	Vibration isolation table or integrated vibration/acoustic isolation enclosure required
Power	1800W, single-phase; 100, 120, or 240V; 50 or 60Hz, dedicated circuit

Bruker Nano Surfaces Division

Santa Barbara, CA • USA
Phone +1.805.967.1400/800.873.9750
productinfo@bruker.com
www.bruker.com

Cover images
Top: PeakForce QNM modulus mapping on diatoms. Middle: Bacterial S-Layer membrane. Bottom: PeakForce QNM modulus mapping on bacteria.