

ATOMIC FORCE MICROSCOPY  
**CELLWIZARD™ STAGE**

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Automated, AI-guided, multi-chamber  
in vitro imaging and nanomechanical analysis

# CellWizard Stage

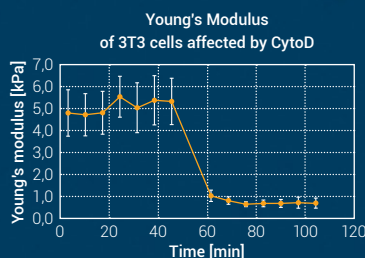
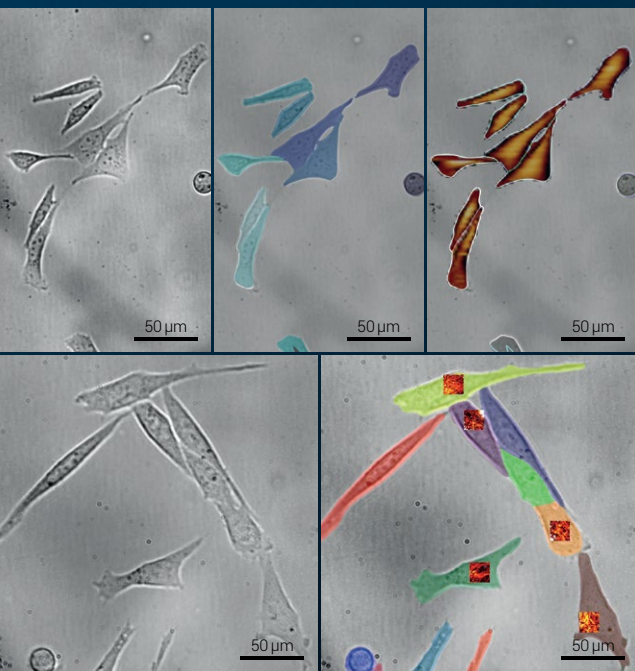
## Redefining the Future of BioAFM

Bruker's CellWizard Stage delivers pioneering, multi-compartment AFM imaging and nanomechanical analysis capabilities for life science applications, greatly extending the range, speed, and versatility of experiments possible, pushing the boundaries of performance on the nanoscale.

The CellWizard Stage embodies state-of-the-art precision engineering. Using artificial intelligence (AI), it identifies sample features of interest and navigates autonomously from well to well, performing systematic, reproducible, and highly accurate measurements in each compartment. This next-generation AFM accessory delivers automated, multiscale, and multiparametric analyses.

The ability to investigate biological samples *in vitro*, over a large scan range, and in a multi-compartment environment, allows a more comprehensive analysis and a deeper understanding of complex biological mechanisms, such as cellular communication and immune response.

The CellWizard Stage is compatible with the Bruker BioAFM atomic force microscope platform and can be seamlessly integrated into advanced optical microscopes.



## Superior Performance

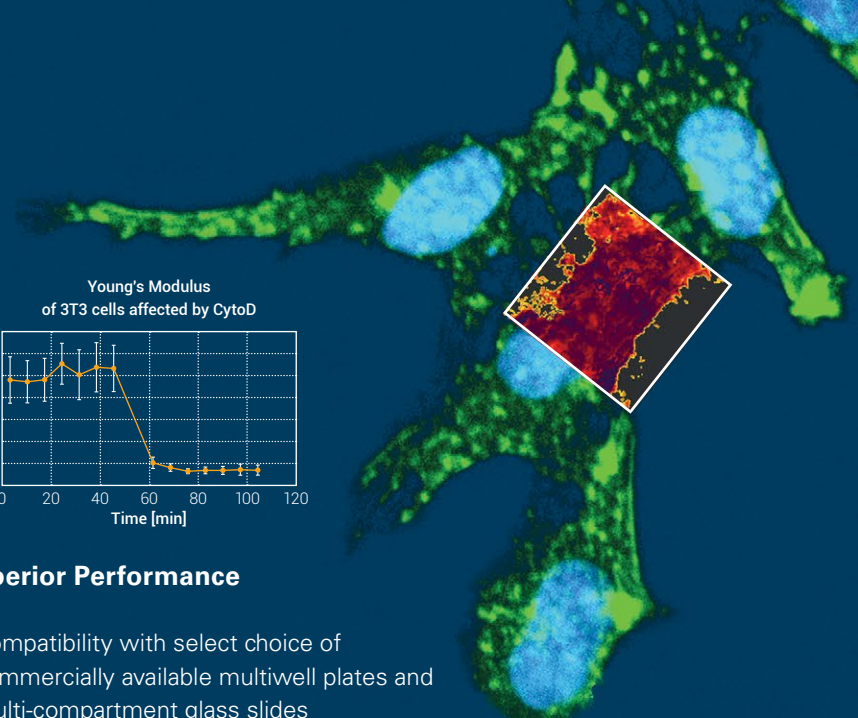
- Compatibility with select choice of commercially available multiwell plates and multi-compartment glass slides
- Fast and precise positioning with state-of-the-art encoders and custom developed firmware
- Operation with renowned Bruker modes and features including PeakForce Tapping® and SmartMapping
- Innovative software packages, such as, the AI optical image-guided AutomaticNavigation feature and the extended DirectTiling feature that now includes optical stitching and background correction

## New Possibilities

- Trigger different enzymatic reactions in each well
- Study cellular response to varying stimuli
- Deliver separate active ingredients to biological targets
- Study biofilm formation inhibition factors
- Quantify adhesion and disaggregation on varying substrates

“ The CellWizard Stage is a milestone development – it introduces AI-guided approaches in AFM, significantly enhancing the speed and accuracy of stage dynamics, and providing multi-throughput measurements from precise, repeatable spatial locations. AFM is now more applicable than ever, collecting large-scale, high-resolution data sets, across a range of 3D cell samples (cells, tissues, spheroids and organoids) essential for cell and molecular biology analysis. The multi-well format allows us to incorporate biological variables and the full array of BioAFM measurements in a single experiment format. ”

Prof. Lewis Francis · Biomedical Sciences, Swansea University, UK



### Image top

Confocal image of living 3T3 cells (nuclei and actin labeled with Hoechst (blue) or Cellmask™ Green Actin) after exposure to 500 nM cytochalasin D, overlaid with a QI Young's Modulus image (Timepoint 70 min). The time-dependent effect of cytochalasin D on the mechanical properties of 3T3 cells is shown in the graph on the left. The depolymerization of the actin filaments results in a reduction of the Young's modulus over time. QI scan size: 25 µm × 25 µm  
Young's modulus range: 5.0 kPa

### Images bottom

AI-driven segmentation of optical phase contrast images of living 3T3 cells, combined with successive automated AFM scan region selection and measurement using SmartMapping (upper right) of the entire cells, and QI Advanced Young's modulus imaging of the cell nuclei (lower right).

Sample courtesy of Dr. Wedepohl, Freie Universität Berlin, Germany

# Unmatched Functionality

## Outstanding Automation

CellWizard Stage encompasses state-of-the-art automation features and advanced machine-learning capabilities that significantly improve the accuracy and effectivity of repetitive workflows by alleviating user error and optimizing productivity.

The AI-guided optical segmentation tool uses optical images to identify sample features of interest and automatically creates MultiScan lists within or surrounding them. Optical snapshots or scheduled rinsing steps can be added to the planned list, and the instrument will then run measurements autonomously, with the CellWizard Stage safely changing between compartments as specified.

The AI image segmentation can use either the pre-trained models provided or user-trained custom models tailored to individual applications.

## Comprehensive Capabilities

Explore a wide spectrum of easy-to-use features and options, such as:

- Extensive optical integration options that include the DirectOverlay 2 software feature and accessories for operation on inverted optical microscopes
- Multi-chamber substrate supports: 4-well plate holder, a holder for four separate 35 mm Petri dishes, and a holder for two standard glass slides
- Bruker BioAFM PetriDishHeater options for 35 mm and 50 mm dishes
- SmartMapping option with free-hand ROI-selection and intelligent piezo and motor motion – ideal for challenging biological samples
- PeakForce QNM®, QI Advanced mode, and microrheology options for quantitative nanomechanical analysis
- Hinge-clip cantilever holder for easy operation in confined chambers

## Extensive Flexibility

CellWizard Stage can be seamlessly combined with advanced optical techniques, such as confocal and super-resolution microscopy, for enhanced analysis capabilities and precise, correlated, multiparametric measurements. It is compatible with the Bruker BioAFM family of instruments and its extensive range of modes, add-ons, and accessories, e.g.:

- Humidity control
- QR code reader for probes
- Nanolithography and Nanomanipulation
- ExperimentPlanner
- Cytosurge FluidFM® options
- Focus tracking support

The CellWizard Stage delivers the flexibility necessary for interdisciplinary research facilities and collaborative scientific environments.



### Images top and middle row

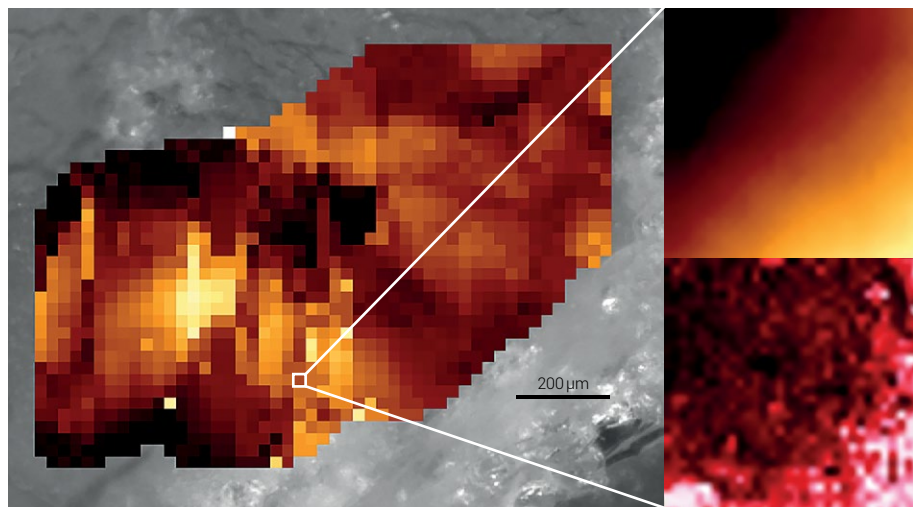
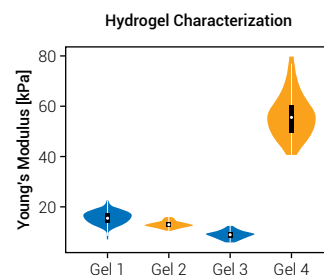
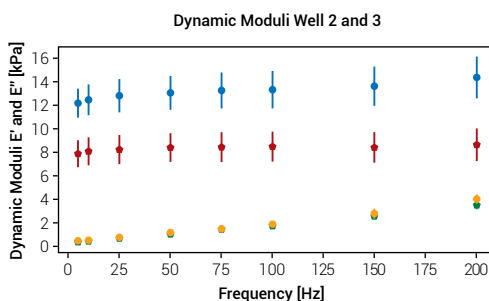
A 4-well plate mounted on the corresponding holder. Each well was filled with a 1% agarose gel, sourced from different vendors (Roth 6351.1, Sigma A9414, Biozym 850111 Genetic, Roth 2268.1), and filled with PBS buffer. The results of the automated acquisition of the Young's Modulus (violin plot over 100 measurement points per gel) and the frequency-dependent viscoelastic properties (storage - blue and red - and loss modulus - orange and green - for 2 gels) are presented in the graphs below.

### Images bottom row

TopView optical image of a freshly prepared Zebrafish tumor tissue slice overlaid with an AFM SmartMapping topography image, measured in PBS using a CellHesion 300 AFM head on the CellWizard Stage (left). AFM pixel size: 25  $\mu\text{m}$   
AFM height range: 200  $\mu\text{m}$

Corresponding AFM topography (upper right) and Young's Modulus (lower right) of a zoomed-in scan:  
Scan size: 30  $\mu\text{m}$   $\times$  30  $\mu\text{m}$   
Pixel size: 1  $\mu\text{m}$   
Height range: 35  $\mu\text{m}$   
Young's modulus range: 8.0 kPa

Sample courtesy of Prof. Sack, Charité-Universitätsmedizin Berlin, Germany





## CellWizard Stage Specifications

<b>Stage specifications</b>	<ul style="list-style-type: none"> <li>Lateral travel range: 38 mm × 38 mm</li> <li>Accuracy: &lt; 1 µm at full range, &lt; 500 nm for maps less than 1 mm</li> </ul>	<ul style="list-style-type: none"> <li>Velocity: up to 6 mm/s, range dependent</li> <li>Closed-loop control using optical encoders with 50 nm accuracy</li> </ul>
<b>Software V8</b>	<ul style="list-style-type: none"> <li>The CellWizard Stage is fully implemented in SPM V8.2</li> <li>Fully automated sensitivity and spring constant calibration using thermal noise or Sader method</li> <li>Powerful batch processing of force curves and images, including WLC, FJC, step-fitting, DMT model, and other analysis methods</li> <li>MultiScan feature for automated multiple scan procedure</li> </ul>	<ul style="list-style-type: none"> <li>DirectOverlay 2 option for combining optical and AFM datasets</li> <li>DirectTiling option with optical image stitching and background subtraction</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>User management, ideal for multi-user imaging facilities</li> </ul>
<b>Compatibility</b>	<ul style="list-style-type: none"> <li>Compatible with several Bruker BioAFM heads, e.g., NanoWizard® V, CellHesion® 300, NanoWizard ULTRA Speed 3, etc.</li> <li>Compatible with commercial Zeiss Axio Observer inverted and Axio Zoom upright optical microscopes and, on request, with Nikon and Evident/Olympus</li> <li>All objective lense turret spaces on Zeiss microscopes can be used</li> <li>Sample support for two microscope slides simultaneously included</li> <li>Suitable for commercially available, multi-compartment plates and glass slides, e.g., 4-well plate (SPL) option</li> </ul>	<ul style="list-style-type: none"> <li>Petri dish heater (PDH) options for 35 mm and 50 mm Petri dishes</li> <li>Large 91 mm × 76 mm free sample area, up to 15,6 mm sample height</li> <li>Adaption of standard incubator solutions (LIS, Okolab, PeCon) according to customer requirements will be supported</li> <li>Focus tracking support with Zeiss Definite Focus 2/3 and SlimFocus objective lens z-Scanner</li> <li>PetriDishHeater 35 mm prepared for Humidifier for JPK PetriDishHeater offered on request</li> </ul>
<b>Widest range of accessories and probes</b> (see accessories handbook)	<ul style="list-style-type: none"> <li>Numerous environment control options (ambient, liquid, and gas) and liquid cells (also for aggressive solvents)</li> <li>Multiple cantilever holder options, including hinge-clip cantilever holder</li> </ul>	<ul style="list-style-type: none"> <li>Extensive range of probes 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>Simultaneous AFM operation with commercially available transmission optical modes, e.g., brightfield, optical phase contrast, and DIC, using standard condensers (NA 0.3)</li> <li>Combination of AFM with advanced commercial confocal microscopes and fluorescence techniques, e.g., FCS, FRET, TIRF, FLIM, FRAP, STED, STORM/PALM, SIM, and more</li> </ul>	<ul style="list-style-type: none"> <li>Large range of cameras supported</li> <li>Upright Fluorescence kit for combining AFM with Stereo-Zoom Microscopes on request</li> <li>TopViewOptics: video optics for opaque samples with 12x zoom</li> </ul>
<b>Operating modes</b>	<ul style="list-style-type: none"> <li>PeakForce Tapping and QI Imaging modes</li> <li>Optional SmartMapping feature</li> <li>AutomaticNavigation option, incl. AI segmentation</li> <li>Contact mode with lateral force microscopy (LFM)</li> </ul>	<ul style="list-style-type: none"> <li>TappingMode™ with Phaselming™</li> <li>Static and dynamic force spectroscopy</li> <li>Force Mapping</li> <li>ExperimentControl feature for remote monitoring of experiments</li> </ul>



CellWizard Stage setup on inverted fluorescence microscope

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CellWizard Stage

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