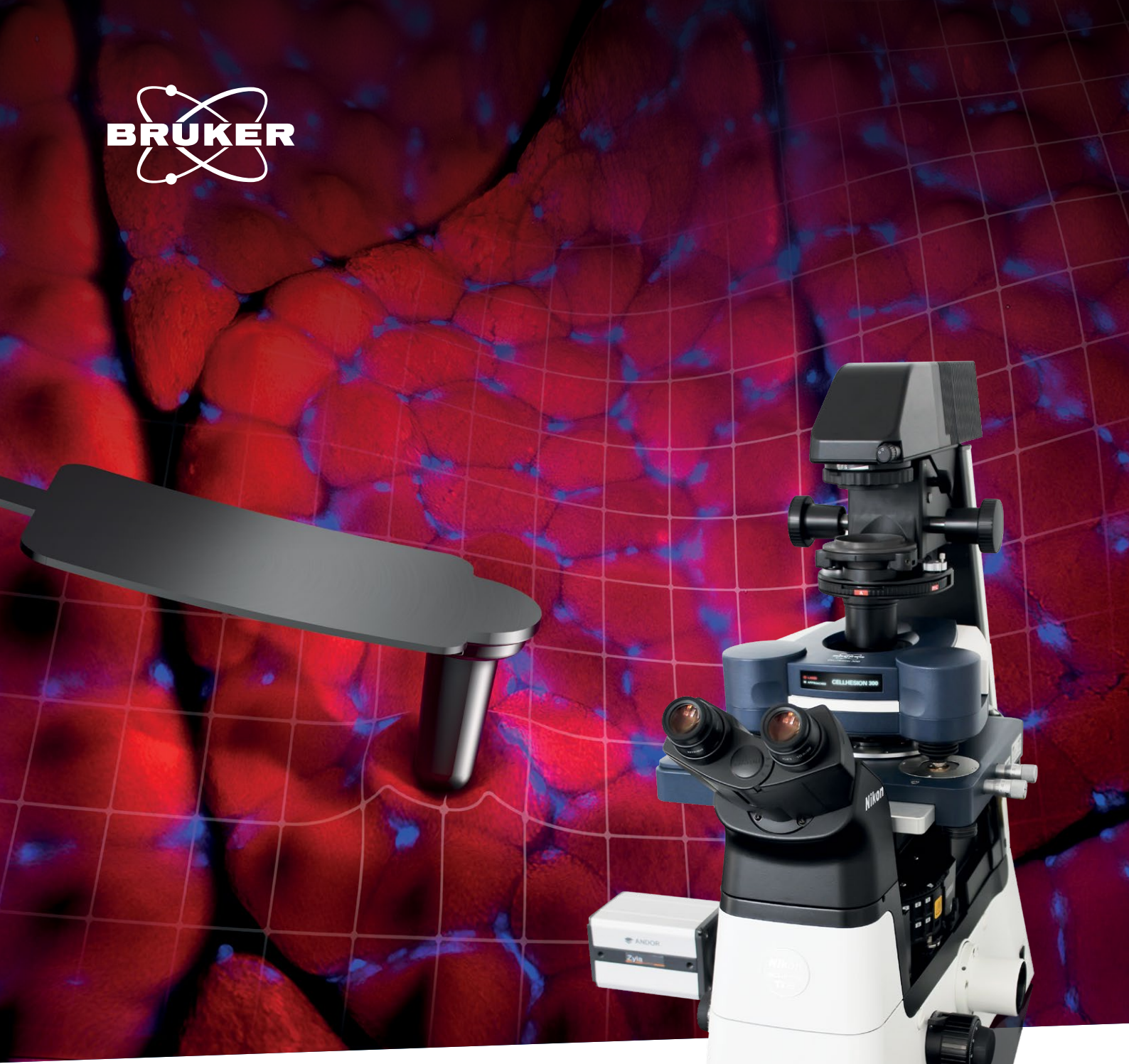


ATOMIC FORCE MICROSCOPY

CELLHESION 300

Automated, Quantitative Single-Cell and Tissue Mechanics

CellHesion 300
Understanding Biomechanics Made Easy

The automated CellHesion® 300 is the ideal tool for measuring cell-cell, cell-tissue, and cell-substrate interactions with single-molecule sensitivity. It enables fast and easy measurement of the structure, morphology, and nanomechanical properties of living biological systems, delivering crucial insights into the role they play in various pathological disorders. This innovative system creates novel possibilities for applications in biophysics, biochemistry, implant research, wound healing, developmental biology, stem cell research, infection biology and immune response studies.

Prof. Dr. Ansgar Petersen, BIH, Center for Regenerative Therapies, Charité Medical University, Berlin, Germany

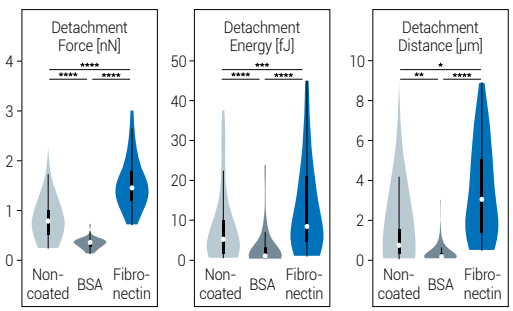
"Automatic mechanical screening of highly topographic samples with the CellHesion 300 is of great advantage for tissue characterization in the clinical context."

Only CellHesion 300 delivers:

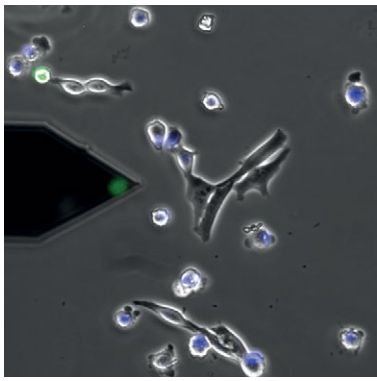
- Maximized throughput for higher productivity by automating measurements
- Correlative and label-free multiparametric, nanomechanical measurements of living samples in near-physiological conditions
- Fast and simple selection of regions of interest over large sample areas, ideal for tissue biopsies
- Systematic workflow with visual support

Increase Productivity

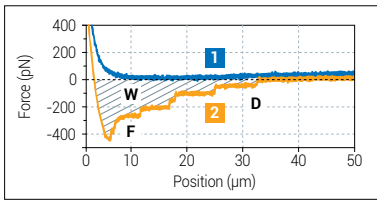
CellHesion 300 provides reproducible, quantitative data of unprecedented quality. Its high degree of automation increases throughput and delivers the productivity, performance, and statistical significance required for biomedical and clinical research environments. Important parameters, such as maximum adhesion force, individual unbinding events, and tether characteristics are automatically determined from each dataset by innovative software solutions.



Violin plots showing the distribution of Detachment Energy (W), Force (F), and Distance (D), determined by Single Cell Force Spectroscopy detachment measurements between a single 3T3 mouse fibroblast and a polyacrylamide hydrogel (50kPa) with different coatings. Sample courtesy of Dr. Stephanie Wedepohl, Freie Universität Berlin, Germany.



Probe with a single 3T3 fibroblast (green, FDA staining) attached for cell adhesion measurements on a substrate or target cells.



In a Single Cell Force Spectroscopy (SCFS) experiment, a single living cell is biochemically bound to a probe (e.g., via functionalization). The cell is brought into contact with the binding target and a defined force applied to the cell (1). After a user-defined binding period, the cell is separated from target by retracting the probe (2). The resistance to separation is measured by quantification of the probe deflection.

Perform Innovative Multi-Parametric Nanomechanical Mapping

State-of-the-art software, intuitive user guidance, and automated alignment of the detection system provide the key to autonomous operation and fast results.

The new CellHesion 300 user interface gives the operator quick and easy control of the system and its operating parameters.

The software offers an easy-to-use scripting tool for user-defined experiments. Powerful batch data processing capabilities enable the analysis and quantification of large datasets at the touch of a button.

Discover the Possibilities

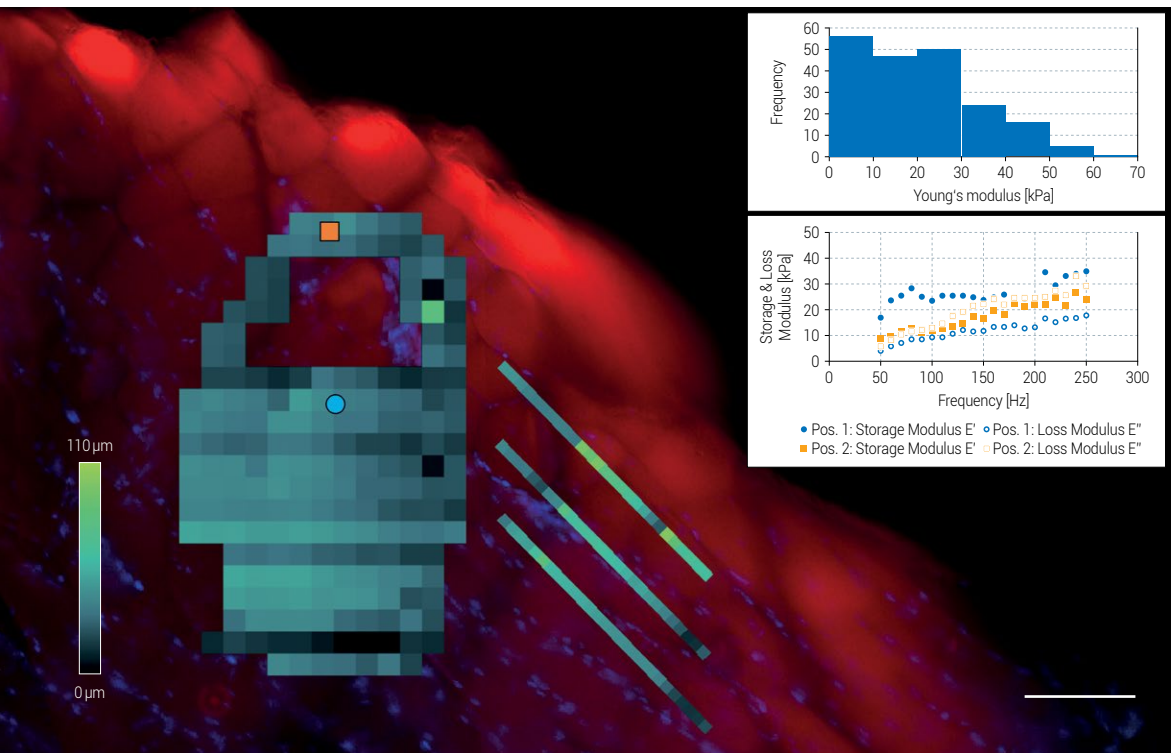
- Mapping of the viscoelastic properties of samples with a large topography range, over an extended frequency scale with an optional Z-scanner and NestedScanner capabilities
- Studying living cells under near-physiological conditions with an extensive range of accessories for control of environmental conditions, such as temperature and CO_2 levels

Automate Investigation of Large Samples

The new SmartMapping feature enables the selection of flexible, user-defined 2D shaped force maps. The optimal range of force acquisition is continuously evaluated and automatically adjusted by new large-scaled Z-motors. Using optical tiling, multiple areas of interest can be selected in advance and automatically examined, allowing the easy and effective study of large sample areas. The improved motorized stage accuracy delivers a degree of precision and velocity second to none.

Integrate Seamlessly with Optical Microscopes

CellHesion 300 can be seamlessly integrated into the latest research grade optical microscopes with advanced and super-resolution capabilities, to deliver real-time, correlative data sets for the comprehensive characterization of living biological samples. Versatile experimental setups and automated adjustment of system parameters opens new possibilities for long-term, self-regulating experiment series. CellHesion 300 is the ideal solution for the investigation of rough surfaces, densely packed cell layers, and highly corrugated tissue samples.



Force maps of user-defined shapes on a cross-section of sheep muscle tissue overlayed with an optical fluorescence tiling image (scalebar 100 µm). Muscle fibers, rich in actin filaments, were stained with phalloidin-TRITC (red) and cell nuclei with DAPI (blue). Internal dark areas depict unlabeled connective tissue. Force maps were acquired in SmartMapping mode and illustrate the combined height measurement of samples with large topographies.
Upper inset: Distribution of Young's modulus values.
Lower inset: Plot of storage modulus and loss modulus at 2 different positions on the tissue sample (blue circle and orange square).
Sheep muscle sample also used for cover image. Sample courtesy of Prof. Dr. Ansgar Petersen, BIH, Center for Regenerative Therapies, Charité Medical University, Berlin, Germany

CellHesion 300 Specifications

System Specifications	• Automatic optical beam deflection system adjustment • Vortis 2.1 SPM Controller platform • Vertical travel Range >19 mm	• 100 µm capacitive Z-scanner (SLD 880 nm) with closed-loop control • Optional 100 µm capacitive Z-scanner (SLD 980 nm) with closed-loop control • Optional additional 15 µm Z-Piezo
Software	• Automated cantilever and detector alignment • User-specific experiment design for remote monitoring • Data Processing (DP): data export, fitting, filtering, edge detection, 3D rendering, FFT, cross section, video creation, etc.	• Batch processing of force curves and images, WLC, FJC, step-fitting, JKR, DMT model, etc. • Optional SmartMapping: flexible ROI selection, automatic Z-position and Z-motor adjustment
Stages	• Inverted optical Microscopes: Zeiss, Nikon, Olympus, Leica • Motorized Precision Stage: 20 mm × 20 mm travel range	• Manual Precision Stage: 20 mm × 20 mm travel range
Sample Holders	• Petri dishes, coverslips, microscope slides, metal SPM discs	
Accessories (see accessories handbook)	• PetriDishHeater and PetriDishHolder for living cell handling • BioCell and CoverslipHolder for advanced optics with molecules • Active humidity control for PetriDishHeater	• SmallCell for small fluid quantities • Stretching Stage • SideView Cantilever Holder • FluidFM® ADD-ON from Cytosurge® • Biocompatible Probes
Optical Configurations	• Upright macroscopes and stereo microscopes: Zeiss AxioZoom V.16, Leica Z16 ApoA, Leica M205FA, Olympus MVX10, etc. • TopViewOptics, video optics for opaque samples with 12× zoom	• Simultaneous operation with brightfield optical phase contrast and DIC using standard condensers • Compatible with light microscopy techniques: DIC, phase contrast, fluorescence, and super-resolution techniques TIRF, FRAP, CLSM, STED, STORM, etc.
Standard Operating Modes	• Contact Mode Force spectroscopy • Force Mapping	• Advanced Force Mapping • Advanced spectroscopy: force clamp modes, ramp designs
Optional Modes	• Microrheology in CellMech Package • DirectOverlay	• DirectTiling • ExperimentPlanner for designing specific measurement workflow

Short selection of peer-reviewed scientific publications using the CellHesion technology

1. Abuhattum et al., Adipose cells and tissues soften with lipid accumulation while in diabetes adipose tissue stiffens. Sci Rep 12, 10325 (2022).
2. Michael et al., Measuring the elastic modulus of soft culture surfaces and three-dimensional hydrogels using atomic force microscopy. Nat Protoc 16, 2418–2449 (2021).
3. Liebsch et al., Quantification of heparin's antimetastatic effect by single-cell force spectroscopy. J Mol Recognit. 34, e2854 (2021).
4. Möllmert et al., Zebrafish Spinal Cord Repair Is Accompanied by Transient Tissue Stiffening. Biophys J. 118(2), 448-463 (2020).
5. Shen et al., Reduction of Liver Metastasis Stiffness Improves Response to Bevacizumab in Metastatic Colorectal Cancer. Cancer Cell 37(6), 800-817 (2020).
6. Rheinlaender et al., Cortical cell stiffness is independent of substrate mechanics, Nat. Mater. 19, 1019–1025 (2020).

Visit www.bruker.com/bioafm/cellhesion for more literature.

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CellHesion 300 setup on Zeiss Axio Observer inverted microscope with intuitive software interface.

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