Join us and our special guest speakers for this virtual workshop on “Novel Concepts in Mechanobiology - From Individual Cells to Cancer Tissues”. It will include talks and a demonstration live from our labs in Berlin.

Atomic Force Microscopy (AFM) is an advanced multi-parametric imaging technique which not only enables the 3D imaging of the topography of living biological systems in the nm-range, but also the characterisation of the nanomechanical properties of cells and tissues, and the visualization of structural changes taking place at the molecular level.

AFM has established itself as a powerful technique increasingly being featured in high-impact papers on basic cell biology or biomedical sciences. It can be fully integrated into advanced light microscopy techniques and seamlessly combined with fluorescence, confocal and super-resolution microscopy.

Our guest speakers will provide insights into their work using AFM and the impact it is having in life science and biomedical research.

Program

17:00 Welcome & Introduction
Dr Heiko Haschke, Head of Applications, Bruker BioAFM

17:10 A Personal Bag of Tricks for AFM Cell Mechanics
Dr Núria Gavara, Medical School, University of Barcelona, Spain

17:40 From Cells to Tissue - Mapping Local Viscoelasticity
Dr Thomas Fuhs, Peter Debye Institute of Soft Matter Physics, University of Leipzig, Germany

18:10 Live & Interactive Demonstration: Large Scale Mechanical Mapping Capabilities using BioAFM
Dr Torsten Müller, Senior Developer, Bruker BioAFM

18:40 Closing
Dr Heiko Haschke

Please don’t hesitate to contact us at events.bioafm@bruker.com if you have any questions.

Talk abstracts

A personal bag of tricks for AFM cell mechanics
Dr Núria Gavara, Medical School, University of Barcelona, Spain

In the past years, it has been acknowledged that cellular fate and behaviour are greatly influenced by the mechanical properties of the cells and their environment. The mechanical characterisation of cells and tissues using AFM is no longer a niche technique used by those working in biophysical sciences. Instead, it is slowly becoming an additional method in the toolkit of techniques typically boasted in high-impact papers on basic cell biology or biomedical sciences. While this constitutes a fantastic opportunity for those long working in the field, it has also posed exciting challenges. From an instrumental side, there has been a massive push aimed at building AFMs in combination with advanced light microscopy and super-resolution setups and to increase the overall user-friendliness of AFM operation.

From an experimental and modelling viewpoint, new protocols acknowledge the complexity of cellular mechanics, moving beyond the simplest hertzian models at quasi-static regimes. In addition, AFM is morphing into a high-throughput method, thus stressing the need for fully automated but reliable pipelines to extract mechanical parameters from the thousands of force-distance curves acquired. Similarly, the fact that AFMs now output maps of force-indentation curves questions the true nature of our data (1d vs 2d) but allows us to borrow image analysis tools for the characterization of mechanical maps. Finally, the advent of big data and machine learning approaches for disease diagnostic opens new avenues while raising questions on how we can turn AFM into a more 'multiplex' technique to further its impact in the life sciences and biomedicine research.

Dr Núria Gavara was trained as a physicist before obtaining a PhD in Cell Biophysics at the Medical School of the University of Barcelona (Spain). She expanded her research skills by taking postdoctoral positions at the National Institutes of Health (NIH, USA) and the Institute of Biophysics at the University of Goettingen (Germany). In 2013, she was appointed as Lecturer in Biomedical Engineering at the School of Engineering and Material Sciences at Queen Mary University of London, and was promoted to Senior Lecturer in 2018. Since 2020, her lab is based at the Medical School of the University of Barcelona.

Her research interests are at the interface of cellular biophysics, mechanobiology, computer vision, and machine learning, with the strong aim of furthering the understanding of the biological processes involved in physiology and disease. The research carried out in her lab focuses on the cell's cytoskeleton, and in particular, the characterization of its organization and mechanical properties. To do so, her lab uses a broad cellular biophysics toolbox, which includes Atomic Force Microscopy, Traction Force Microscopy, high-throughput imaging, advanced image quantification pipelines and machine learning methods.

From Cells to Tissue – Mapping Local Viscoelasticity

Dr Thomas Fuhs, Peter Debye Institute of Soft Matter Physics, University of Leipzig, Germany

The mechanical properties of cells and tissues play an important role throughout life, from embryogenesis all the way to cancer and neurodegenerative diseases like ischemic stroke. Isolating and culturing cells inevitably changes their mechanical phenotype as binding partners and tissue structure is lost. Using the large vertical range of the JPK HybridStage, it is possible to map surfaces with features taller than the 15µm typically possible with most AFMs. We will demonstrate that it is possible to image a variety of tissues, from stiffer cancer tissues to extremely soft brain tissue.

Dr Thomas Fuhs is the AFM group leader at the Peter Debye Institute of Soft Matter Physics at the University of Leipzig. The work of the soft matter group focuses on the study of the material properties of biological cells as key determinants of their character and functions, including tumor progression. This requires an integral approach that spans the length scales from molecules to tissues. Dr Thomas Fuhs's research focuses on the physics of tissues. Using AFM-based micro-rheology and high-resolution fluorescent imaging, he aims to achieve a deeper understanding of the mechanics of cells and how these correlate with the aggressiveness of tumors and the outcome of neurodegenerative diseases.