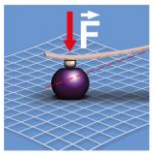

TIME TO SHARE
Nanoscale Mechanobiology

June 23rd, 2020 | 5pm CEST | 8am PDT - Online Microscopy Symposium

BRUKER

Scope of the symposium

We at Bruker JPK BioAFM are delighted to invite you to join us and a distinguished panel of experts for an international mini-symposium on Nanoscale Mechanobiology.

There is growing recognition that the study of the mechanical properties of cells, their 3D surrounding, and multicellular tissues is critical to understanding how cells regulate their molecular structure and self-organize. Cells actively sense and process the mechanical information provided by their extracellular environment. The study of cell mechanics is, therefore, key to understanding many complex biological mechanisms and their involvement in developmental and pathological processes. Nerve cells are also influenced by mechanical forces. Tissue stiffness, for example, plays an important role in how nerves function and develop, and possibly change after injury and differentiation.

Our panel of experts will share their knowledge and provide insights into their work and research in this exciting interdisciplinary field of science. They will focus on new and versatile Atomic Force Microscopy (AFM) methods for measuring the mechanical properties of biological samples in physiologically relevant conditions. They will present their findings on how AFM can be used to study and manipulate tissue mechanics and investigate the physical interactions between cells and their environment, and questions like why rigid tumors contain soft cancer cells will be answered.

Learn how Nanoscale Mechanobiology can provide new insights into your life science research.

Program

Chair: Heiko Haschke, Head of Applications, JPK BioAFM, Bruker Nano GmbH

5:00 pm **Welcome address**
Carmen Pettersson, Senior Manager Product Marketing, JPK BioAFM, Bruker Nano GmbH

5:10 pm **Using AFM for in vivo tissue mechanics measurements and manipulation**
Kristian Franze, University of Cambridge, UK

5:40 pm **Mechanical regulation of cells and multicellular tissues**
Alexander Cartagena-Rivera, National Institutes of Health, Bethesda, MD, U.S.

6:10 pm **Why do rigid tumors contain soft cancer cells**
Prof. Dr. Josef A. Käs, University of Leipzig, Germany

6:40 pm **Open forum discussion**
Heiko Haschke

6:55 pm **Closing**
Carmen Pettersson

Talk abstracts

5:10 pm - Using AFM for *in vivo* tissue mechanics measurements and manipulation

During development and pathological processes, cells in the central nervous system (CNS) are highly motile. Despite the fact that cell motion is driven by forces, our current understanding of the physical interactions between CNS cells and their environment is very limited. We will show here how AFM can be used to study developmental tissue mechanics. *In vivo* time-lapse AFM revealed stiffness gradients in developing brain tissue, where axons moved towards soft tissue. Using AFM to interfere with brain stiffness *in vivo* led to aberrant neuronal growth patterns. We will also introduce a new AFM data analysis approach which enables the measurement of cell mechanics in soft environments. Our results indicate that tissue mechanics provide crucial signals which impact cell development and function.

Speaker: Kristian Franze
Reader in Neuronal Mechanics & Fellow of St. John's College, Department of Physiology, Development and Neuroscience
University of Cambridge, UK

Kristian Franze qualified as a Veterinarian at the University of Leipzig in Germany, where he also obtained a PhD in Physics. He then did his postdoc at the Cavendish Laboratory of the University of Cambridge. In 2011, he started his group at the Department of Physiology, Development and Neuroscience in Cambridge, where he was promoted to Reader in 2017. He has received numerous international honours for his research, including an ERC Consolidator Grant in 2018. In 2020 he was awarded an Alexander von Humboldt Professorship. His research focuses on how mechanical signals contribute to regulating the development and regeneration of the nervous system.

5:40 pm - Mechanical regulation of cells and multicellular tissues

The ability of complex structures within tissues and organs to inter- and intra-cellularly self-organize is a critical multistep process required for development, morphogenesis, and homeostasis. Dr. Cartagena-Rivera's lab develops novel and highly versatile AFM approaches for measuring mechanical properties in a wide-variety of complex biological samples, particularly cells and tissues of physiologically relevant conditions. He recently adapted a non-contact Frequency Modulation AFM (FM-AFM) method that utilizes acoustic frequency sweeps acquired using cantilevers with an attached microsphere to determine the supracellular apical surface tension, effective viscosity, and intercellular

adhesive forces in polarized epitheliums. Non-contact acoustic FM-AFM enables the relevant physiological and quantitative investigation of critical mechanical properties in intact biological tissues and could be used to decipher the molecular-mechanical regulation of epithelial organization and morphogenesis. He will show that reorganization of the prejunctional actomyosin cytoskeleton by depletion of zonula occludes proteins ZO-1/ZO-2 significantly elevates the apical epithelial tension and effective viscosity. He will also present the use of noncontact FM-AFM in mice cochlea explants to investigate the stereociliary hair bundle stiffness and damping.

Speaker: Alexander Cartagena-Rivera
Section on Mechanobiology, National Institute of Biomedical Imaging and Bioengineering
National Institutes of Health, Bethesda, MD, U.S.

Dr. Cartagena-Rivera received a bachelor's degree in Mechanical Engineering from the University of Puerto Rico and his Ph.D. in Mechanical Engineering from Purdue University. He completed a Post-Doctoral IRTA Fellowship in the National Institute on Deafness and Other Communication Disorders at the National Institutes of Health. He is now an Earl Stadtman (Tenure-Track) Investigator and chief of the Section on Mechanobiology at the National Institute of Biomedical Imaging and Bioengineering, where his laboratory research focuses on understanding the cellular and tissue molecular-mechanical regulation and development of advanced Atomic Force Microscopy tools for cancer biology and hearing research. In 2019 he received the prestigious NIH Distinguished Scholars Program award.

Contact details: cartagenariveax@nih.gov

6:10 pm - Why do rigid tumors contain soft cancer cells?

Palpation used since ancient times, utilizes the fact that solid tumors are stiffer than surrounding tissue. However, cancer cell lines are softer, which facilitates invasion. This paradox raises several questions: Does softness emerge from adaptation to mechanical and chemical cues in the external microenvironment? Or are soft cells already present inside a rigid primary tumor? We investigated primary samples from patients with mammary and cervical carcinomas on multiple length scales from tissue level down to single cells. We have shown that primary tumors are highly heterogeneous in their mechanical properties starting on the tissue level, this heterogeneity persists down to the individual cells that exhibit a broad distribution of rigidities, with a higher fraction of softer and more elongated cells compared to normal tissue. Mechanical modelling based on patient data reveals that tumors remain solid containing a significant fraction of very soft cells. Moreover, it predicts that in such tissues, softer cells spontaneously self-organize into multicellular streams, which we observe experimentally.

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Speaker: Prof. Dr. Josef A. Käs
Principal Investigator & Head of the Soft Matter Physics Division
University of Leipzig, Germany

Prof. Käs qualified as a physicist at the University of Munich, Germany, where he also obtained his PhD in Physics. He did his postdoc at the Harvard Medical School, Boston. In 1996, he went on to the University of Texas where, from 2001–2002, he was a Full-Professor at the Department of Physics. In 2002 he moved to the Department for Soft Matter Physics at the Peter Debye Institute for Soft Matter Physics, University of Leipzig, Germany, where he was Director from 2008 to 2016. He has been a member of the Leipzig University Cancer Center since 2016.

He has had a distinguished career, becoming an ICMB Fellow at the Institute of Molecular and Cell Biology, University of Texas (1999-2001) and winning the Wolfgang Paul Prize (2002). He was a finalist in the Saatchi & Saatchi Award for World Changing Ideas (2006), became a Fellow of the American Physical Society (2014) and held a Woolmer lecture at the Institute of Physics and Engineering in Medicine (2017).

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