Performing Accurate Force Measurements on Biological and Soft Matter

October 23rd, 2024 | 08:00 AM PDT | 11:00 AM EDT | 5:00 PM CEST

BRUKER

Join us and special guest speaker Prof. Andreas Janshoff from Georg-August University Göttingen, Germany, for this webinar on performing accurate force measurements on biological and soft matter using atomic force microscopy (AFM).

Forces play a crucial role in biological mechanisms, such as cellular response, molecular interactions, and protein binding, and are essential for deriving the nanomechanical properties of a sample. AFM has emerged as a key platform for the precise measurement of interaction forces on the nanometer scale. AFM force spectroscopy is used to quantify forces and determine nanomechanical properties such as Young's modulus, cell adhesion, and viscoelastic properties, information that is invaluable for studying interaction-based and disease-related biomechanical changes.

Prof. Janshoff will outline his work using AFM to investigate the biomechanical properties of cell membranes, and, in particular, the viscoelastic behavior of the cell cortex.

Webinar Highlights:

- Key insights and proven strategies for achieving reliable results
- Common pitfalls and practical tips for ensuring reproducible measurements
- Q&A session with the team

Program - Wednesday, October 23rd, 2024

17:00 AM CEST | 8:00 AM PDT | 11:00 EDT

17:00 Welcome & Introduction
Oilibhe Pabsch, Scientific Affairs Manager, Bruker BioAFM

17:05 Mechanical Properties of Biomembranes
Prof. Dr. Andreas Janshoff, Institute for Physical Chemistry, University of Göttingen, Germany

17:35 Live Demo NanoWizard BioAFM
Dr. Thomas Fuhs, Application Scientist, Bruker BioAFM

17:50 Q&A

18:00 Closing

Please don't hesitate to contact us at productinfo@bruker.com if you have any questions.

Abstract and Biography

Mechanical Properties of Biomembranes

Prof. Dr. Andreas Janshoff, Institute for Physical Chemistry, Georg-August-Universität Göttingen, Germany

The mechanical properties of cells are intricately linked to the architecture and dynamics of their viscoelastic cortex. This cortex comprises a contractile, cross-linked actin mesh that attaches to the plasma membrane via linker proteins. However, our understanding of cell mechanics has primarily focused on the upper, apical side of adherent, polarized epithelial cells due to their accessibility in culture dishes. Consequently, less is known about the viscoelastic properties of basal membranes.

In our investigation, we explored the viscoelastic behavior of basolateral membranes derived from polarized MDCK II epithelial cells. These membranes were subjected to external deformation, and their response was compared to that of living cells probed at the apical side. To achieve this, MDCK II cells were cultured on porous surfaces until they formed a confluent layer. The upper cell body was then removed using a squirting-lysis protocol, leaving behind free-standing basal membranes. Through force indentation and relaxation experiments, I precisely assessed the cortical viscoelasticity of these membranes.

Interestingly, when comparing the data to reconstituted neat lipid bilayers using giant liposomes and pore-spanning membranes in conjunction with atomic force microscopy, a significant difference emerged: basal membranes exhibited an absence of energy dissipation. However, we were able to rescue this behavior by artificially attaching an actin cortex to the bilayer.

Furthermore, I developed a theoretical framework to describe force cycles and applied it to obtain the time-dependent area compressibility modulus of biomembranes. When compared to the viscoelastic response of living cells, biomembranes derived from living cells were found to be substantially less fluid and stiffer. Nevertheless, they still adhered to the same universal scaling law, provided excess area was correctly accounted for. This research sheds light on the fascinating biomechanical properties of cell membranes and their implications in cell biology.

Prof. Dr. Andreas Janshoff *is professor of biophysical chemistry at Georg-August-Universität Göttingen, Germany. He has a degree in chemistry from the University of Münster, where he also earned his Ph.D. in 1997. Following postdoctoral research at Scripps Research Institute, USA, and a habilitation at University of Münster, he became a full professor for Biophysical Chemistry in 2006. Prof. Janshoff's research centers on biophysical chemistry, in particular, the mechanics and dynamics of cellular membranes and the cytoskeleton, and the viscoelastic nature of cellular components. A key focus of his work is on the mechanical properties of cells and how these relate to disease. Prof. Janshoff has published extensively in top-tier journals and collaborates widely in the fields of biophysics, nanotechnology, and biochemistry.*