Atomic Force Microscopy Seminar at CFIM

Quantitative characterization of adhesion and cytomechanics of single cells and their interactions with biomaterials by AFM

May 30th at 14:00, Faculty Club, Faculty of Health and Medical Sciences

Torsten Müller studied biology at Humboldt-University in Berlin, Germany. During his time as PhD and work for Evotec Technologies he was focussed in methods and applications for single cell characterisation. In 2007 he joined JPK Instruments, R&D Department - Molecular and Cellular imaging. Torsten is mainly responsible to afm based techniques and instrumentation to quantify cell adhesion and mechanics.

Topography and mechanical properties of biomaterials are crucial parameters influencing morphology, adhesion, and mechanics as well as the development of cells [1-6]. Atomic force microscopy is a powerful tool not only to study the morphology in terms of high resolution imaging and roughness measurements, but also to map mechanical and adhesive properties of the cells and tissues. Combining these remarkable abilities with optical microscopy allows for extensive characterization of biomaterials [3,4]. We developed a new force curve based AFM mode - Quantitative Imaging (QI™) for a faster and better access to soft, sticky, or fragile samples avoiding lateral sample displacement. We investigated topography, adhesion properties, and local distributed Young's modulus of living cells on related biomaterials.
A specialized platform - CellHesion® - has been developed to run single cell force spectroscopy [7] (SCFS, see Fig.1) with a need for long-range cell-surface binding experiments with up to 100 microns pulling length. SCFS quantified the cell adhesion force and the contribution of different components, e.g. from the extra cellular matrix to implant materials (e.g. cochlear implants [8]), as well as cell-cell adhesion [6]. A new solution will be demonstrated to transfer attached cells through the liquid-air interface. This approach allows measuring the adhesion of the same single cell on different materials.We present a strategy to comprehensively characterize biomaterials as well as their interaction with cells and influence on cell behavior. Nano-mechanical analysis of cells increasingly gains in importance in different fields in cell biology like developmental biology [6] and cancer research [9].

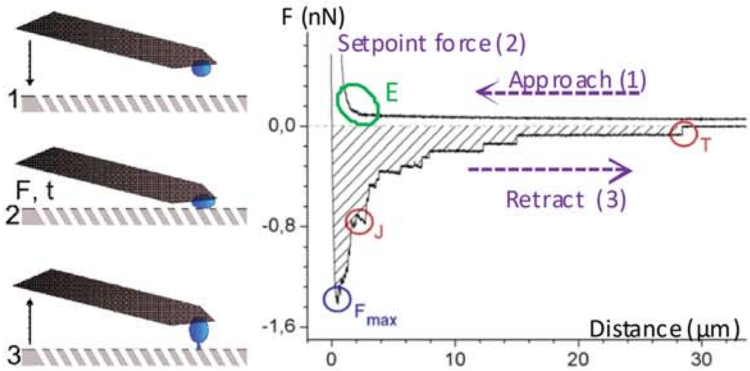

Fig. 1: Sketch of a SCFS experiment. The probe cell is approached to (1) and pressed against the substrate (2) with a defined Setpoint force (F) for a defined time (t). When the cell is separated from the sample (3) interactions like maximum adhesion force (Fmax) and single unbinding events (force jumps (J) and those that are preceded by membrane tethers (T)) are visible in the force distance curve. The contact part of the Approach curve allows for applying elasticity models (E).

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