Unravelling the Mechanobiology of Living Cells while Interacting with their Environment

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Active forces in biological systems define the interactions between single molecules, growing cells and developing tissues. To this end, atomic force microscopy (AFM) remains the only technique that offers premium resolution of the analyzed biological systems at near physiological conditions, while being able to simultaneously acquire information about the sample's mechanical properties.

Cells adapt their shape and react to the surrounding environment by a dynamic reorganization of the F-actin cytoskeleton. We will demonstrate the application of high-speed AFM (down to 1 frame/s) to study membrane ruffling and actin cytoskeleton rearrangement in living KPG-7 fibroblasts and CHO cells.

External mechanical stress is known to influence cell mechanics in correlation to the differences in actin cytoskeleton dynamics. A crucial aspect of investigating cellular mechanobiology is to go beyond purely elastic models. We have therefore performed rheological measurements to characterize sample response at different time scales and measure viscoelastic properties in mammalian cells over a large frequency range (0-500 Hz).

Cell-cell and cell-substrate interactions through cytoskeletal modulation, determine cell fate, shape and spreading. We will demonstrate the application of single cell force spectroscopy for quantifying the adhesion between individual cells, and cell matrix substrates.