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PhD or Post-Doc Position

Thermal and directed motion in molecular friction processes investigated by Photonic Force Microscopy

Background: Friction is a complex process of energy dissipation, which is important on most length scales, time scales and across disciplines. Several theories approach the molecular origin of friction, but a comprehensive understanding is still missing. Usually, friction is quantified by a friction coefficient. We adress two main routes to determine the friction coefficient, either from a directed motion or from thermal motion.

Photonic force microscopy is based on a dynamic optical tweezers system with ultrafast interferometric Fourier plane particle tracking, to record and analyze position fluctuations of the particle.

Project: In a collaborative project, we want to answer the following three questions:

A) Friction on short and long time correlated motion: How is the macroscopic friction coefficient related to thermal fluctuations and directed movements of a (coated) bead?

B) Friction and adhesion from multidirectional, frequency-dependent on- and off- binding: What is the relation between single molecule friction and adhesion for different directions and velocities?

C) Cooperative binding and unbinding: How do the properties of single bonds determine the properties of an ensemble (e.g. film or bulk material such as hydrogels)?

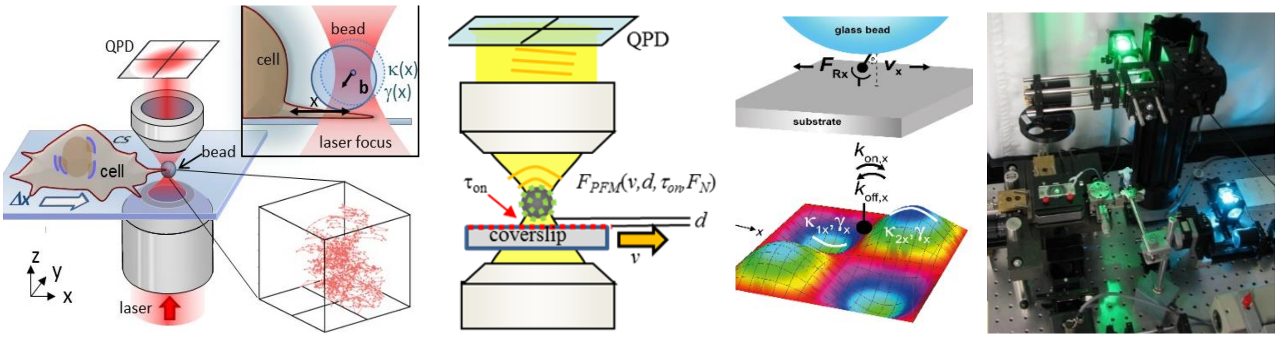

Figure: Left: An optically trapped bead fluctuates nearby a functionalized or biological surface. We analyse microsecond, nanometer position changes of the bead in the trap, which are defined by correlated Brownian motion. Using a Photonic Force Microscope (PFM), the bead is moved across the surface in different patterns to track its 3D positions fluctuations at 2 MHz temporal resolution via quadrant photo-diodes (QPDs). Schematics of the pulling direction and speed of a bead and the according surface (binding pocket). Parts from one of three Photonic Force Microscopes in our labs.

We are seeking …

…. a motivated candidate with a background / interest in softmatter physics / biophysics and optical tweezers. The candidates (PhD/PostDoc salary of 65%/100% E13) will modify the setup, prepare surfaces, perform 100Hz super-resolution microscopy (ROCS), thermal noise tracking, optical tweezing and computer modeling. The goal is to achieve unprecedented insights into the molecular origins of frictions from various perspectives to better understand (biological) transport processes as well as to design novel interfaces (cooparation with T. Hugel group).

We are looking forward to answering your questions!