MOLECULAR MOTORS ON FUNCTIONALIZED AND PATTERNED SUBSTRATES

Albrecht Ott, M. Badoual*, D. Riveline, G. Capello*, F. Jülicher+, D. Winkelmann#, J. Prost*

Lehrstuhl Experimentalphysik 1, Universität Bayreuth, Universitätsstrasse 30, D-95440 Bayreuth, Germany

(*) Laboratoire PhysicoChimieCurie, UMR 168 du CNRS, Institut Curie, Section de Recherche, 11 rue Pierre et Marie Curie, 75231 Paris Cedex 05, France

(#) University of Medicine and Dentistry of New Jersey, Hoes Lane 675, Piscataway, New Jersey, 08854, USA

(+) Present adress: Max Planck Institut für Physik komplexer Systeme, Nöthnitzer Strasse 38, D-01887 Dresden, Germany

Following a short review of the biological function and the structure of molecular motors, we discuss the state of the art of research on the molecular motor actin-myosin. We show how the so-called motility assay can been improved by the use of antibodies, yielding clean and reproducible data of the speed of actin on a myosin coated surface. We discuss the dependence of the measured speed on parameters such as ATP concentration, myosin density and temperature; we furthermore show that the specific anchoring of the myosin molecule to the substrate is important for a clean measurement. Using PMMA (poly(methylmethacrylate)) gratings as guidance for the moving actin filaments, we are able to control the mechanical load of the motor via an electric field and to establish a force-speed diagram. The numerical values of duty ratio, internal friction and stalling force of the motor can be deduced from it. The observation of a instability of the motor around stalling conditions is particularly surprising it can be interpreted by a dynamic phase transition as a result of a collective effect in a theoretical ratchet model. We furthermore present experiments concerning the observation of the molecular motor kinesin, using a recently developed evanescent field technique: a bead labeled kinesin moves on a microtubule through a intensity-modulated optical near field, the diffracted light is recorded through a PMT. As a result positional information can be gained with high temporal resolution. We do not only observe kinesin stepping but also short time events, which can be attributed to elastic coupling of the Brownian bead to the kinesin motor.