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Angle-dependent investigation of single polymer adhesion at the solid-liquid interface

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With the advances in new generation of AFMs, it has become possible to control the tip position and direction with high precision by simple modifications of the experimental parameters. Traditionally, force experiments are performed in the surface normal direction, with a focus on measuring the magnitude of the force. However, force is a vectorial quantity and has not only a magnitude but also a direction.

Measuring and controlling the magnitude and direction of force acting on atoms and molecules would enable to directly address many relevant problems in organic molecular sciences, *e.g.* to control the force in the known range to influence polymer adhesion, to separate the two strands of dsDNA (unzipping) and also to induce unfolding of proteins in a direction-dependent fashion, revealing aspects of the unfolding process that have been previously inaccessible.

In our research, we have introduced direction control into single polymer adhesion force measurements, in order to describe how the polymer adsorption-desorption behavior depends on the angle at which the force is applied. The adhesion of poly(2-hydroxyethyl methacrylate) (PHEMA) end-grafted to the atomic force microscopy tip was studied on a planar surface in solution by single molecule force spectroscopy. We find that the desorption force increases with decreasing pulling angle, *i.e.* an enhanced adhesion of a polymer chain is observed. The magnitude of the desorption force depends on the strength of polymer-surface interactions.