

Tuning surface forces using AC electric fields

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A basic tenet of tribology is that the adhesion and friction between two materials is fully determined by the properties of the surface material and of any added lubricant. Recently, a series of pioneering experiments challenged this view: friction and adhesion may be controlled by means of external stimuli such as mechanical excitation or photo-switching, without need for altering the material components. An alternative route to external control of surface interactions is through electrical polarisation of one or both surfaces; a few pioneering cases of friction and adhesion control with electric fields have been reported.

In this talk, I will describe electric field control of adhesion using a different mechanism. By applying an alternating (AC) electric field perpendicular to two surfaces with a liquid film between, we introduce a force which can be used to drive the surfaces in and out of adhesive contact. Taking advantage of the oscillatory interaction potential between the surfaces across the liquid, the AC actuation allows us to choose between the available adhesive states and thus provides exquisite control of the adhesion strength. Our measurements, carried out with a surface force balance (SFB), have resolution in surface separation of ~ 0.1 nm and therefore provide insight into the adhesion process at the level of individual liquid layers between the surfaces.