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Elastohydrodynamic Coupling at the micro/nano scale

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Soft and wet contacts are ubiquitous across scales from geology to physiology and are crucial for engineering. Interestingly, when an object moves near a soft substrate, the generated hydrodynamic pressure would deform the substrate, then resulting in the hydrodynamic coupling. Based on the EHD coupling, we proposed a contactless way to probe the mechanical properties of soft substrate using the colloidal atomic force microscopy. For instance, we use this contactless method to studies the viscoelasticity of the soft PDMD gels. Furthermore, when there is a parallel relative motion between the object and the soft substrate, a lift force will be generated normal to the direction of the motion because of the EHD coupling. Here we also present the first direct measurement of the EHD lift force using the AFM.

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