Research Topic for the ParisTech/CSC PhD Program

Subfield: wetting, soft matter physics, physical chemistry

ParisTech School: ESPCI

Title: When is a non-wetting liquid entrained by a heterogeneous surface?

Advisor(s): Etienne Barthel (etienne.barthel@espci.fr) and Emilie Verneuil, in collaboration with Philippe Brunet (MSC, Paris Diderot).

Short description of possible research topics for a PhD:
If a solid is drawn out of a non-wetting liquid (Fig.), it can entrain a liquid film when the pull-out velocity exceeds a given threshold. In principle, the problem can be solved at the macroscopic scale but in practice, we often lack a proper understanding of dissipation at the local scale so that the real mechanisms of this dynamic wetting transition are still elusive.
Because unavoidable heterogeneities at the surface strongly impact the triple line dynamics at all lengthscales, we propose to fabricate model heterogeneous surfaces with designed heterogeneities and investigate the dynamic wetting transition with different aqueous liquids. By tuning surface chemistry, patterns and lengthscales, we will be able to probe the coupling between hydrodynamic flow, heterogeneities and local dissipative processes. These experimental advances will form the basis of an improved understanding of the dynamic wetting transition through simple numerical models based on the lubrication approximation.

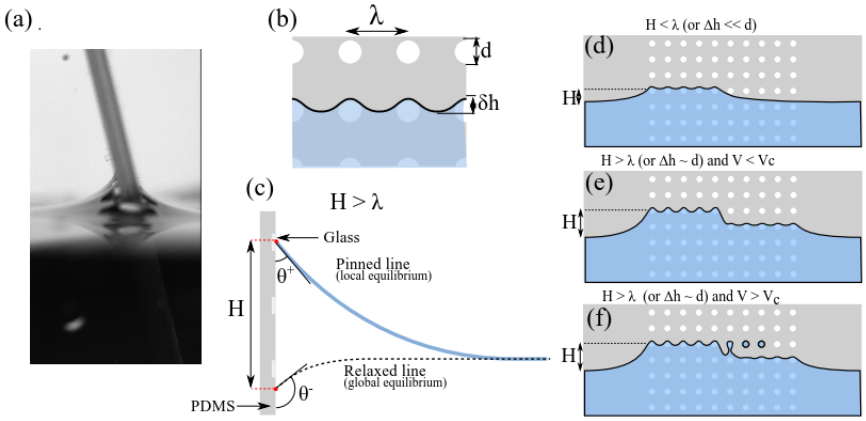

Figure: various stages towards liquid entrainment when pulling out a heterogeneous plate

Required background of the student: general physics, hydrodynamics, physical chemistry or soft matter – familiarity with wetting or surfaces would be a plus.

Publications of the group: for details see https://www.simm.espci.fr/spip.php?article806
Gauthier, A. et al. (2013). *Role of kinks in the dynamics of contact lines receding on superhydrophobic surfaces*, Phys. Rev. Lett. 110 : 046101.
Gauthier, A. et al. (2014). *Finite size effects on textured surfaces: recovering contact angles from vagarious drop edges*, Langmuir 30 : 1544-1549.
Dupas J. et al. *Glass transition accelerates the spreading of polar solvents on a soluble polymer*. Phys. Rev. Lett., 112 (2014)
Rivetti, M. et al. (2015). *Surface Fraction Dependence of Contact Angles Induced by Kinks in the Triple Line*, Phys. Rev. Lett. 115 : 016101.