INTERNSHIP PROPOSAL

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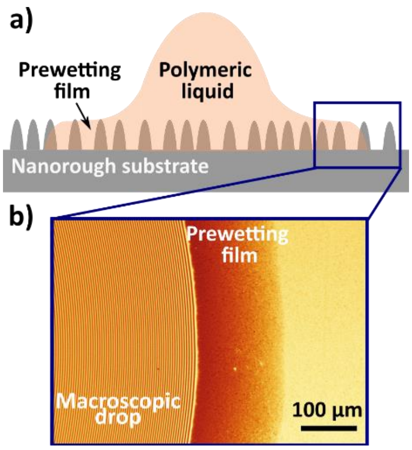
Internship location: LLB (CEA Saclay)
Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: ANR

Wetting dynamics of polymeric liquids at the nanoscale

Dynamic wetting refers to situations in which a liquid coats a surface: this phenomenon is ubiquitous in our daily lives, whether it is a drop of water on the grass or the spreading of paint. Although this interfacial process is observed in many applications, fully understanding and predicting the wetting dynamics for a given system remains a challenge due to the inherent complexity of this dynamic process. The main difficulty in describing this phenomenon lies in the vast range of length scales involved, from the millimeter size of a drop to the nanometric range of the liquid/substrate interaction[1].

The mechanisms of energy dissipation at the contact line are still largely unknown, especially on rough surfaces. On atomically flat and chemically homogeneous surfaces, it has been shown that a film, called the precursor film, precedes the macroscopic drop. The presence of this film was predicted theoretically, but was difficult to observe experimentally because of its thinness (<100 nm). In practice, most substrates display a nanometric roughness, which is close to the thickness of the precursor film. The question of the existence and propagation dynamics of such a film on these surfaces remains entirely open[2].



a) Illustration of a droplet spreading on nanorough substrate. b) Top view picture of a drop of silicone oil on a nanorough surface. A prewetting film spreads ahead of the macroscopic drop.

The aim of this project is to understand how **nanometric roughness affect the spontaneous spreading dynamics of a liquid**. Notably, can a precursor film form and propagate? We propose systematic model experiments that allow a multi-scale visualization and characterization of the spreading of a polymer liquid.

In this internship, the student will prepare and characterize (atomic force microscopy) the purely topographic nanotextured surfaces. They will then study the wetting of these surfaces with polymeric liquids (silicone oils) of different molecular weight (so different viscosities). Conventional optical microscopy techniques will be used to probe macroscopic scales (see figure). Nanometric precursor film will be probed by X-ray reflectivity (XRR, device at LLB).

This internship is part of a funded ANR project. It can be followed by a **PhD position** offered to the the candidate. The goal of the PhD will be to describe the energy dissipation mechanisms (viscous, viscoelasticity, friction...) at the contact line for polymer liquid spreading on 1) purely topographic nanometric roughness and 2) on chemical nano-coating, polymer brush-type **.**

References: **(1)** Bonn, D.; Eggers, J.; Indekeu, J.; Meunier, J.; Rolley, E. Wetting and Spreading. *Rev. Mod. Phys.* **2009**, 81 (2), 739–805. **(2)** Popescu, M. N.; Oshanin, G.; Dietrich, S.; Cazabat, A.-M. Precursor Films in Wetting Phenomena. *J. Phys. Condens. Matter* **2012**, 24 (24), 243102.