INTERNSHIP PROPOSAL

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Internship location: LLB (CEA Saclay)
Thesis possibility after internship: YES
Funding: NO. Candidates might apply to EDPIF or CEA grants.

Wetting dynamics of polymer liquids from the macro to the nanoscale

Situations where a liquid covers a surface, known as dynamic wetting, is nowadays well understood when liquids spread on flat solid substrates. Nevertheless, real life substrates are not atomically flat. Then, a difficulty to describe this phenomenon comes from the broad range of length scales involved, from the millimeter size of a drop to the nanometric range of the liquid/substrate interaction[1].

Indeed, energy dissipation mechanisms at the contact line are still largely unknown on rough surfaces. On atomically flat, chemically homogeneous surfaces, it has been shown that a film, known as the precursor film, precedes the macroscopic drop. The presence of this film was predicted theoretically, but was difficult to observe experimentally due to its small thickness (<100 nm). How nanometric roughness, with a characteristic size close to the precursor film thickness, influences the spreading behaviors is still an open question[2].

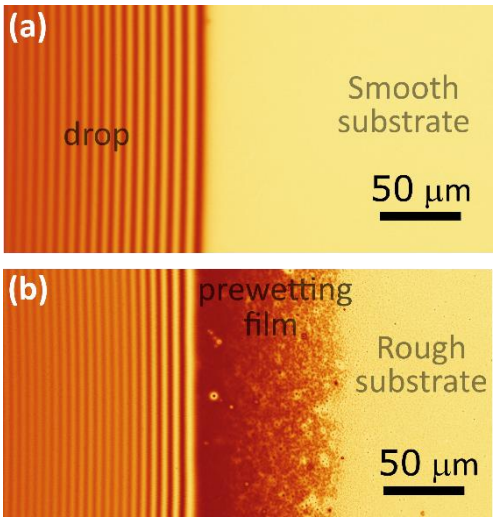

Fig. 1: Optical images of a drop of silicone oil spreading on (a) a "smooth" and (b) a "nanorough" substrate. The nanoroughness of the substrate initiates the formation of a prewetting film, which appears to be inhomogeneous. Preliminary experiments.

The aim of this project is to understand how **purely topographic roughness at the nanoscale** 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 and X-ray reflectivity) the nanotextured surfaces. They will then study the wetting of these surfaces with silicone oils of different viscosities. Conventional optical microscopy techniques will be used to probe macroscopic scales (see Fig. 1 for preliminary experiments). Nanometric scales will be probed by X-ray reflectivity (device at LLB).

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.