INTERNSHIP PROPOSAL

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Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: CIFRE

Stability of Thin liquid films: silicone coatings for glass

Coatings of liquids on surfaces such as glass are commonly used in manufacturing processes. For instance, the inside of glass syringes can be coated by liquid silicone to promote lubrication of the plunger, or in between fibers of insulation wool to enhance their mechanical strength via capillary bridges. The stability and homogeneity of these liquid films is of course crucial to these applications. In the case of silicone oils coating glass, a rough estimate of the long-range interactions such as Van der Waals' shows that such films should bear a uniform thickness at equilibrium: repulsive interactions should tend to a flat thick film. However, in practical situation, initially heterogeneous films never get uniform in thickness in a timely manner. As examples, defects on glass substrates lead to thickness heterogeneities that grow over time rather than heal (Figure, left). When starting from a collection of droplets sprayed onto a flat substrate (shown as dark blue disks in the Figure, right), a nanometer-thick film first spreads around the droplets (shown in yellow and turquoise), and delays the spreading and coalescence of the droplets.
The goal is to gain insights into the behavior of silicone oil on glass and to elucidate the mechanisms underlying the time evolution of such coatings. To do so, model systems will be used (plane glass or silicon wafers, well-characterized silicone oils), and experimental set-ups will be developed, in order to measure and model the time variation of silicone oil coatings. Imaging techniques such as ellipsometry or profilometry will be used.

Two cases will be particularly studied (see Figures)
- Time evolution of oil spread onto substrates decorated will well-controlled defects
- Spreading dynamics of several droplets deposited on smooth substrates.

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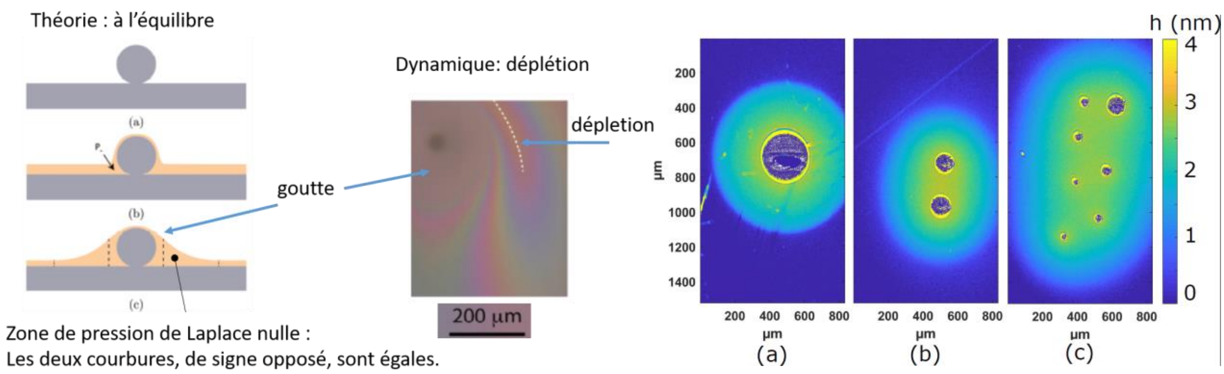

(left) Liquid suction around a topological defect on the glass surface. (center) White light reflection image (Newton rings) showing the accumulation of liquid around the defect and the depletion around this drop in the transient regime. (right) Thickness mapping obtained by ellipsometric microscopy around drops deposited on an oxidized silicon wafer. A nanometric film develops between the drops before they merge.

Condensed Matter Physics: NO Soft Matter and Biological Physics: YES
Quantum Physics: NO Theoretical Physics: NO