PhD THESIS OFFER FULLY SUPPORTED BY ANR
(OFFRE DE THESE DOCTORAT FINANCEE PAR L'ANR)

Magnetowetting at drop and bubble scales
(Magnétomouillage à l'échelle d'une goutte et d'une bulle)

Web: https://simap.grenoble-inp.fr/fr/le-laboratoire/propositions-de-theses-materiaux-et-procedes

Scientific fields: Physique appliquée (applied physics), Matériaux (material sciences), sciences de l'ingénieur (engineering sciences)

Key-words: microfluidique expérimentale (microfluidics), mouillage (wetting), ébullition nucléée (nucleate boiling)

Location: The PhD thesis is located at Grenoble in two research institutes: SIMAP on the campus of Grenoble-Alpes University and LNCMI on CNRS campus (see for instance: https://simap.grenoble-inp.fr/, https://lncmi.cnrs.fr/).

Description de la thèse proposée/PhD contents : This fully founded PhD thesis is proposed in the framework of a project supported by the Agence Nationale de la Recherche (ANR): the SURFMET project. The SURFMET project proposes new technological routes to promote heat transfer enhancement. Among the different work packages in the SURFMET project, one consists in investigating how electro- and magneto-wetting affects nucleate boiling. Among challenges, there is the will to better predict the arising of critical regimes in systems which host electric and magnetic fields, such as the large magnets of LNCMI. In case of nucleate boiling, nothing is known on the influence of electro-wetting or magneto-wetting on the nucleation and growth dynamics of vapor bubbles inside a millimetric gap. As a first step, the research proposed will focus on magneto-wetting experiments at room temperature. Most of them have been conducted so far on ferrofluids. In this project, the intern will conduct experiments (and shape calculations) on diamagnetic water drops using either NdFeB permanent magnets (1T) or a large magnet (10-20T) available at LNCMI (Grenoble CNRS). Magneto-wetting properties under uniform (and later non-uniform) magnetic field conditions will be characterized. The experiments will be first carried out under as uniform as possible conditions to eliminate contributions of B-gradients (magnetophoretic forces). An exceptionally good uniformity of the magnetic field is expected from the inner of the large high field magnets at LNCMI. A first set of experiments will be carried out on sessile drops deposited on a neutral substrate either made of copper (wetting case) or made of Teflon (non-wetting case). Due to the magnetic permeability jump at the drop surface, the shape of the sessile drop is expected to be modified. The shape change will be measured from a camera and a light absorption imaging method. The shape change is a good means to validate the Laplace-Young equation to be revisited. From the experiments, the dependence of the contact angle on the magnetic actuation is expected to be obtained. Depending on the observations, complementary experiments on bubble wetting will be developed to extend the investigation up to phase change. A set-up will be developed to generate the nucleation of a vapor bubble and to investigate its dependence on magnetic field conditions.

Applicant skills: The applicant has particular motivation for modeling and experimental developments. She/He will have an Engineering degree or a Master degree either in applied physics or fluid mechanics or energetics or microfluidics or experimental physics or material sciences.
Degree required: Bac + 5, Master, Engineer

Supervision : Prof. Laurent DAVOUST (SIMaP), Dr. François DEBRAY (LNCMI)

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