ECOLE DOCTORALE
ED468
« «Mécanique, Energétique, Génie Civil, Procédés »

Campagne d'Allocations 2017
Proposition de sujet de thèse[1]

Title	Effect of heterogenous wettability on condensation and boiling phenomena
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Subject description :

Even if liquid-vapor two-phase systems are effective, their control under microgravity conditions is not yet completed, as the gravity forces do not allow the evacuation of the dispersed phase anymore. The present subject deals with the use of surface tension forces induced by heterogeneous wettability to solve this problem. It is considered that a heterogeneous wettability property of a solid surface enables the mechanical non-equilibrium of the embryos forming on the wall. First, a theoretical model has been developed. The model was then used to analyze contact angle hysteresis (CAH) effects on experimental data with liquid droplets available in the open literature. The results demonstrate that the effect of CAH on the droplet motion is huge, and that heterogeneities of this CAH have to be taken into account to accurately reproduce the behavior obtained experimentally. In order to understand the implications for passively enhancing heat transfer, a setup was also built allowing both condensation and boiling experiments.

For condensation, the following tasks are proposed: optimization of the chemical surface treatment; realization of specific experiments to measure the wettability gradient attenuation according to time when the substrate is exposed to condensation cycles; design and realization of an optimized wettability gradient surface; design and realization of an optimized hybrid etched/coated surface. We planned also to design and realize dedicated substrates for microgravity experiments and to participate to parabolic flight campaign.
For boiling situation, the aim is to study the effect of a wettability gradient on both the Onset of Nucleate Boiling and the heat transfer laws. A substrate will be first chemically treated to create one or several zones with uniform wettability or wettability gradient. Experiments will be carried out in pool boiling configuration using test cell already developed. The substrate will be heated on one face, while the other face will be in direct contact with the working fluid (water). Both heat flux and wall temperature will be measured simultaneously with direct visualisations. The apparatus will allow the substrate to be tilted in order to study the effect of gravity on the boiling behaviour. Recommendations will then be proposed for the enhancement of boiling heat transfer, and for designing a specific experiment for the ISS thermal platform.

[1] Ce document sera diffusé sur le site web pour l'appel à candidatures