Master 2 internship proposal

Physique et Mécanique des Milieux Hétérogènes

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Levitation of fizzy droplets

A volatile liquid placed on a sufficiently hot solid levitates on its own vapor [1]. The absence of liquid-solid contact provides the so-called Leidenfrost droplets with intriguing properties such as the absence of adhesion, extreme mobility, and thermal insulation with its substrate. At ambient temperature, carbonated water droplets can also levitate on a superhydrophobic solid due to the continuous release of the CO_2 dissolved in the drop (Figure 1) [2]. The project will aim to experimentally visualize and measure the interface beneath a levitating drop using interfero-microscopy techniques. The experimental measurements will be confronted to numerical simulations and theoretical models to infer the dynamics of gas films insulating levitating droplet [3]. In particular, the expected results will contribute to a better understanding of the onset of droplet levitation, a question which remains to be understood in both Leidenfrost and carbonated droplets.

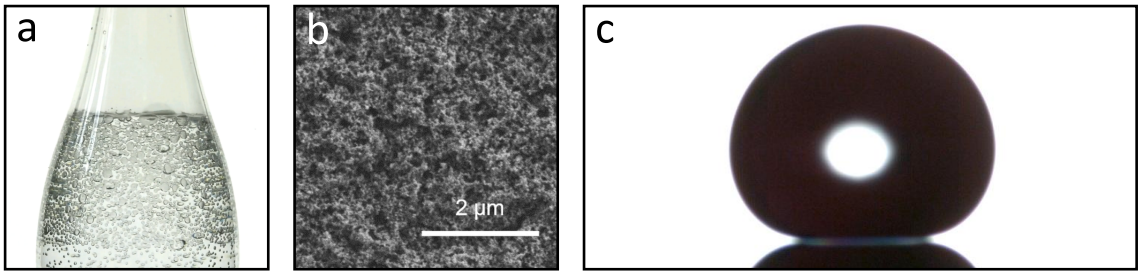

Figure 1: Levitation of fizzy water drops on a superhydrophobic solid. **a)** Image of the fizzy water obtained by pressurizing $CO_2(g)$ into deionized water. **b)** SEM image of a transparent superhydrophobic coating made by a random assembly of hydrophobic silica particles leading to a submicron-scale roughness. **c)** Photograph of a 30 μL carbonated water drop deposited on a silicon wafer made superhydrophobic. The thin ray of light between the drop and its reflection on the solid indicates the levitation of the drop on a micrometric-scale gas cushion.

References:

[1] D. Quéré, Leidenfrost dynamics, *Annual Review of Fluid Mechanics* 45 (2013).
[2] D. Panchanathan, **P. Bourrianne**, P. Nicollier, A. Chottratanapituk, K.K. Varanasi and G.H. McKinley, Levitation of fizzy drops. *Science Advances* 7 (2021).
[3] **L. Duchemin**, J.R. Lister and U. Lange, Static shapes of levitated viscous drops. *Journal of Fluid Mechanics* 533 (2005).

The applicant should have interests in fluid mechanics and soft matter.
The applicant will be encouraged to apply for a PhD.