

Internship location: Soft Matter Sciences and Engineering Lab (SIMM) – ESPCI – UMR7615

Industrial partnership: No

Possibility for a Doctoral thesis: ANR

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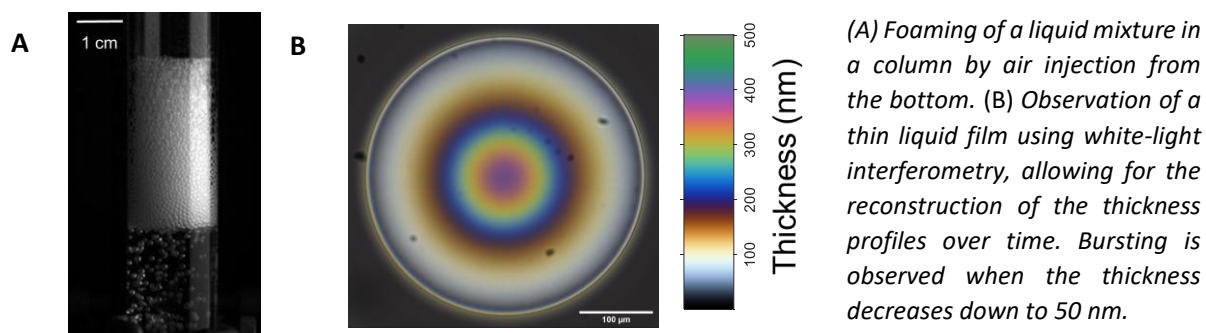
M2 Internship

Drainage of thin liquid films and lifetimes of foams

Scientific description:

Coalescence has been widely studied in surfactant solutions [1]. Nevertheless, a quantitative prediction of the lifetimes of liquid films stabilised by surfactants is still lacking. This complex problem involves intricate couplings between the flow and concentration fields as well as the disjoining pressure associated to surfactants. Even in the absence of the latter, complexity arises in particular from the timescales of surface and bulk transfers of surfactant, which can be comparable to the drainage time [2]. As a consequence, the situation for surfactant solutions is so intricate that predicting the lifetime of a liquid film in presence of surfactants remains a challenge [3]. We have identified a very simple system in which it is possible to describe quantitatively the stability of liquid films [4]. These are liquid mixtures, such as oil mixtures, miscible in all proportions, which have the following properties: first, the disjoining pressure is always attractive and independent of local variations in composition. Second, surface/volume transfers are only controlled by diffusion of species with no adsorption/desorption delays. Third, the film lifetimes can easily be varied from about 1ms to 10 s, by changing the volume fraction of the species. Lastly, they exhibit a very low pollution sensitivity, due to their low surface energy. Consequently, the question of coalescence, and its consequences on diphasic flows is well posed in these systems.

The purpose of this internship is to further describe the physical mechanisms acting to stabilize foams of two mixed liquids [4] (Fig A). To do so, we will perform experiments on single suspended liquid films (Fig B) thanks to a specially designed cell. We will particularly explore the effects of the curvature which sets the capillary pressure gradients and the drainage time. These experiments will be analyzed and compared to on-going numerical simulations to improve our understanding of the stabilizing mechanisms in oil foams.



[1] Langevin, D. Curr. Opin. Colloid Interface Sci. 2015, 20 (2), 92–97.

[2] Petkova, B.; Tcholakova, S.; Denkov, N Colloids Surf. Physicochem. Eng. Asp. 2021, 626, 127009.

[3] Champougny, L.; Roché, M.; Drenckhan, W.; Rio, E. Soft Matter 2016, 12 (24), 5276–5284.

[4] Tran, Talini, Lequeux, et al, Physical Review Letters, 2020, 125, 178002

Speciality : Soft matter Physics, Physics of liquids

Techniques/methods in use: interferometry, thin film balance

Applicant skills: taste for experimentation