Master 2: ***International Centre for Fundamental Physics***

INTERNSHIP PROPOSAL

Laboratory name: Institut Chimie Biologie Innovation
CNRS identification code: UMR8231
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Internship location: ESPCI Paris

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

Emulsion stability probed with microfluidics

Emulsion is a widespread material encountered in various field like food, cosmetics or pharmaceutical industries and even biotechnologies. Emulsions are primarily a heterogeneous mixture of two immiscible liquids with surfactants in the form of droplets dispersed in a continuous phase. Microfluidic technology offers now an efficient tool for producing calibrated emulsion droplets. Along that line, the laboratory has developed a new microfluidic system allowing mass production of highly calibrated emulsion droplets (Fig. 1 (a)). For this project, we wish to take advantage of this capability and to further extend the use of microfabricated systems to investigate stability of model emulsions.

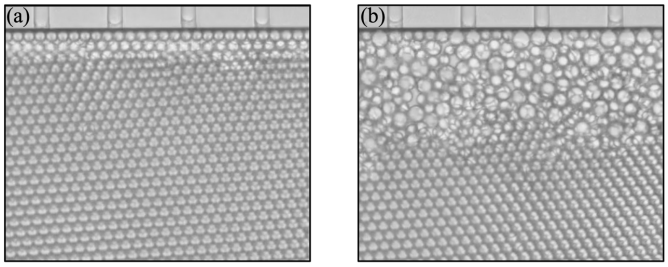

Fig. 1. (a) Microfluidic system for the creation of highly calibrated emulsion droplets. (b) Coalescence of emulsion droplets leading to inhomogeneous size. The distance between the microchannels where droplets are formed is 50 μm and the droplet size is 7 μm.

The main objective of the internship is to explore the emulsion stability in dedicated microfluidic systems as a function of the formulation, i.e. related to surfactant nature, oil type and aqueous phase properties like ionic strength for example. We will focus on the stability against coalescence, when the droplets merge (Fig. 1 (b)). This phenomenon is linked to the physicochemical features of the thin film between droplets where surfactants are adsorbed as well as the constraint imposed to the emulsion and thus to the thin films, like compression or shear. The fate of concentrated emulsions under compression and shear will be investigated.

We look for a candidate having a strong interest and background in physico-chemistry of colloidal science and soft matter and also in microfluidics. Apart from learning in depth concepts in emulsion science, the trainee will acquire or consolidate skills in physicochemical characterization techniques, like tensiometry, in image processing but also in designing and microfabrication of microsystems, from soft lithography technique to 3D printing ones. Skills in microfabrication are welcome but not mandatory. We wish to pursue this project by a PhD thesis, aiming at developing a strategy to formulate emulsions with new ingredients, mainly bio-sourced, with the help of machine learning methods.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

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