**« Instabilities of microcapsules in flow: breakup and wrinkles »**

**Abstract :**

Deformable particles such as cells, vesicles and microcapsules exhibit abundant spatiotemporal dynamics in flows. In particular, it is commonly accepted that the membrane mechanical properties and flow types govern these dynamics, for example global deformation and shape oscillation.

 There also exist locally self-organized shape modulations in response to the flows, for example wrinkling and breakup instabilities. The objective of this thesis is to understand the emergence of such instabilities on microcapsules. The challenge comes to the tunability and control of the membrane rheological properties. We first develop a new formulation of assembling microcapsules made of a thin membrane with widely tunable properties. We describe an original visualization set-up that images microcapsules in orthogonal views, allowing a 3D characterization of pattern formation and the first measurement of wrinkles wavelength.

The wrinkling instability is characterized by various scaling laws to highlight the salient parameters. Especially, wrinkling pattern appears above a unique critical capillary number regardless of membrane properties. Wrinkles-to-folds transition is observed if the capillary number is greater than the second critical capillary number. However, under extremely high capillary number, microcapsules surface become stable again, prior to breakup. A phase diagram of capsules breakup in extensional flow is also established and compared to the case of droplets.

**Keywords:** microcapsule, mechanical instabilities, wrinkles, breakup, interfacial rheology, Stokes flow.