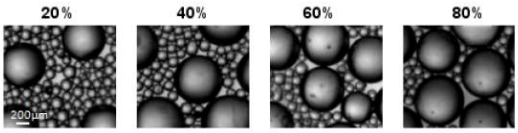
Institut für Strömungslehre und Wärmeübertragung

Bachelor / Master Thesis

Patchy raft properties

The interest for microparticles at fluid interfaces has considerably increased in the last decades. Once adsorbed at interfaces, they allow for their stabilization, which has opened routes to elaborate and manufacture new materials or membranes. For example, it has been proposed to use such particles to reversibly encapsulate fluids in the form of coated droplets, which can thus be used to collect, transport and deliver some actives or pollutants. One idea could then be to combine different types of particles, in the form of "patches", to locally tune the properties of these capsules.

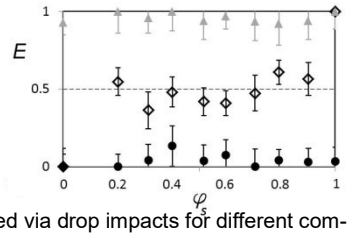
Indeed, it has been shown that larger particles provide greater robustness than smaller ones. Mixtures of small and large particles have also been considered but only when mixed homogeneously, see figures 1 and 2. Thus, the question remains: can "patches" of different particle types be assembled to produce a membrane whose properties are locally adjusted? In this work, we propose to test this idea using particles of different sizes and buoyancy. The purpose of this project is to evaluate the applicability of this concept, which will be done by transposing methods used for the characterization of homogeneous rafts to "patchy" ones composed by different types of particles. The characterization methods to be adapted have been developed in house and are of two kinds: (i) stress propagation in quasi-static compressed rafts (Bachelor thesis of P. Schoefmann, 2023), (ii) the dynamic relaxation of compressed rafts (Bachelor thesis of M. Nabernik, 2022).



Top views (photographs) of particle rafts made of mixtures of hydrophobic microbeads. Two particle sizes are considered and the ratio of small/large particles is varied.

From [1], Physical Review E (2016), Petit et al

Left: drop on a particle raft.



Right: raft robustness probed via drop impacts for different composition (φ_s relative amount of small particles)

From [2], Soft Matter (2018), Planchette et al

Tasks

- Prepare patchy rafts made of hydrophobic hollow and full glass beads of different sizes.
- Characterize the geometry of the patchy rafts (size and numbers of the patches)
- Characterize the patchy rafts using existing set-ups: (i) uniaxial quasi-static compression, (ii) decompression visualized via high speed imaging
- Data treatment (image analysis) and interpretation
- Writing the corresponding scientific documentation.

We offer

- A scientific supervision of high quality
- An international and dynamic work atmosphere
- Access to all the required facilities of the Institute

The master project will be accomplished at the Institute of Fluid Mechanics and Heat Transfer (Institut für Strömungslehre und Wärmeübertragung). The project can start any time. If interested, please contact Dr. Carole Planchette, Tel. 0316 873-7357, Email carole.planchette@tugraz.at