Asymmetric Giant Vesicles under Cycles

Directeur de thèse : Antonio Stocco
INSTITUT CHARLES SADRON, 23, RUE DU LOESS, 67034 STRASBOURG
TEL: 0388414113; EMAIL: ANTONIO.STOCCO@ICS-CNRS.UNISTRA.FR

Giant vesicles can be deformed under the effects of electric fields,[1] ultrasounds[2] and shear flows.[3] These shape deformations are usually observed in Newtonian fluids and they are reversible: when the field is switched off, the vesicle relaxes towards its initial state.

By tuning the frequency and amplitude of the external field in the cycle, an instability (e.g. buckling) or a non-linear effect (e.g. viscoelastic or viscoplastic effects) could be trigged. This may break the symmetry of the cycle and results in a non-reciprocal body motion showing significant shape hysteresis. Active motion under cycles of an external field has recently been reported for microbubbles coated with lipids. Pressure cycles induce asymmetric deformations due to bucking instabilities, which result in the microbubble propulsion at very high speeds.[4]

This project is intended to: **1.** Fabricate giant vesicles showing asymmetries, see Figure 1; **2.** Realization of electric, pressure and shear cycles to observe hysteresis of vesicle deformation; **3.** Finally, study the hysteresis as a function of the cycle parameters and evaluate the work either created to self-propel the vesicle or dissipated towards the degradation of the GUV properties ("fatigue").

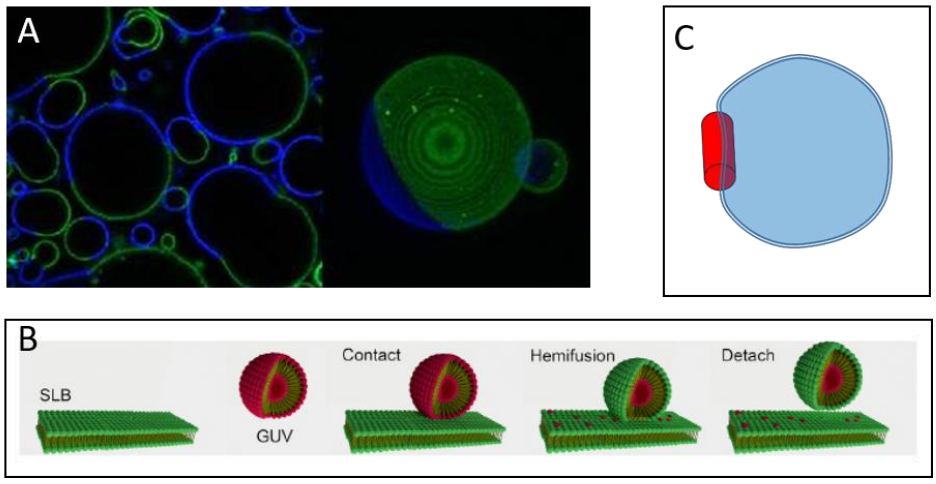

Figure 1: Giant Unilamellar Vesicle (GUV) showing asymmetries: (A) coexistence of two lipid regions, (B) sketch of GUV partially engulfing a colloidal particle, (C) sketch of the method to create asymmetry between the inner and outer leaflets in the bilayer.

The PhD candidate will implement her/his scientific program within the experimental and theoretical environment of the MCube group at the Charles Sadron Institute. She/he should have a strong interest for starting an experimental carreer in Soft Condensed Matter and Biophysics.

References :

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