Hierarchical & Functional Materials for health, environment & energy | HiFunMat
The Interdisciplinary thematic institutes of the University of Strasbourg & CNRS & Inserm
funded under the Excellence Initiative program

Entry of Microparticles into Giant Lipid Vesicles by Optical Tweezers

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ABSTRACT:

Interactions between micro- or nano-sized objects and lipid membranes are crucial in many processes such as entry of viruses in host cells, drug delivery or biomedical imaging. These processes rely on biological, chemical and physical interventions therefore involving specific as well as non-specific interactions. Indeed, the engulfment of a particle by a Giant Unilamellar Vesicle (GUV) membrane can be driven only by the adhesion strength due to non-specific interactions. Mechanical and thermomechanical properties of the membrane such as membrane bending resistivity and tension tend to work against the particle adhesion. Although an important amount of theoretical and computational physical models described the interaction of a particle with model membranes, experimental evidences reporting the existence of critical parameters responsible for the different dynamics observed upon contact and subsequent penetration are still lacking[1,2] In this work, we use optical tweezers to spatially trap a colloid, bring it in contact with a GUV and perform quantitative force measurements in the picoNewton range during particle entry into a GUV. By bright field and fluorescence microscopy, we are able to image the deformations of the membrane during the process. This allows to identify the conditions which need to be fulfilled in order to observe the entry of the particle and probe the reversibility of the process.

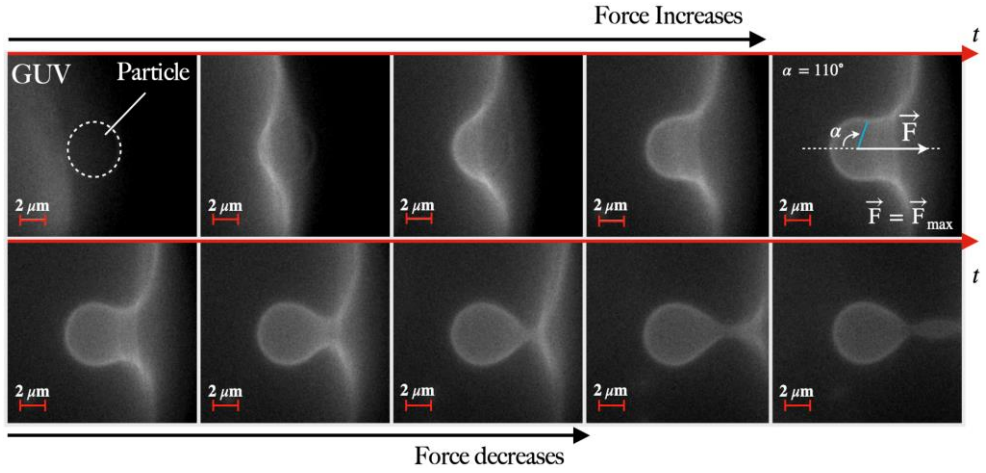

Figure 1: *Fluorescence microscopy snapshots of an optically trapped $R_p = 2.13\mu m$ silica particle forced to penetrate inside a GUV containing fluorescently labelled POPC lipids. The particle is not fluorescent and therefore not visible on these snapshots but its position can be inferred from the clear deformation of the membrane upon contact***.**

References

1- Spanke *et al*. (2020), J. Phys. Rev. Lett. 125, 198102
2- Deserno *et al*. (2003) Europhys. Lett.,62(5), pp. 767–773