Interactions of functionalised nanoparticles with lipid membranes

Scientific context

Do nanoparticles have special abilities to penetrate membranes and enter cells? This idea underpins a lot of work on nanoparticle drug delivery systems over the past three decades. Model lipid membranes are interesting simplified models of biological membranes. Their simplicity enables to compare experimental results with theoretical predictions but the variability of the membrane models, experimental approaches and nanomaterials used have resulted in a confused picture.[1]

Objectifs

We aim to investigate the effect of materials, size, functionalization[2–4] on nanoparticle interactions with model membranes by combining a range of biophysical techniques including optical and electrochemical techniques.[5,6] We will use suspended lipid membranes, surface-supported membranes and extruded vesicles as model systems. The project, at the interface between chemistry and biophysics, will offer an interdisciplinary training experience to a curious and motivated student.

PhD director: Raphaël Lévy (LVTS: https://lvts.fr/) , **Cosupervisor**: Giulia Fadda (LVTS)

Funding: the supervisory team is looking for a candidate that they would support to compete for an "allocation doctorale de recherche" (PhD student stipend from French government) from the école doctorale Gallilée (https://ed-galilee.univ-paris13.fr/). There are no conditions of nationality but you must have obtained (or be on course to obtain this academic year) a master in a relevant discipline. If you are interested, you must contact Giulia Fadda or Raphaël Lévy (giulia.fadda@univ-paris13.fr, raphael.levy@univ-paris13.fr) as soon as possible and on the 25th May at the latest with a CV and a motivation letter.

1. Lévy, R. & Erden, Y. J. The long life of unicorns. *Precision Nanomedicine* **3**, 677–684 (2020).
2. Benyettou, F., Guenin, E., Lalatonne, Y. & Motte, L. Microwave assisted nanoparticle surface functionalization. *Nanotechnology* **22**, 055102 (2011).
3. Colangelo, E. *et al.* Computational and experimental investigation of the structure of peptide monolayers on gold nanoparticles. *Langmuir* **33**, 438–449 (2016).
4. Sangnier, A. P. *et al.* Impact of magnetic nanoparticle surface coating on their long-term intracellular biodegradation in stem cells. *Nanoscale* **11**, 16488–16498 (2019).
5. Fadda, G. C., Lairez, D., Guennouni, Z. & Koutsioubas, A. Peptide Pores in Lipid Bilayers: Voltage Facilitation Pleads for a Revised Model. *PHYSICAL REVIEW LETTERS* **111**, (2013).
6. Fadda, G. C., Lairez, D. & Zalczer, G. Fluctuations of Ionic Current Through Lipid Bilayers at the Onset of Peptide Attacks and Pore Formation. *PHYSICAL REVIEW LETTERS* **103**, (2009).