Pressure profile in hydrogel membranes

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Level: M2

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Scientific context

Osmosis flux through permeable membranes is a fundamental process of life. On the macroscopic scale, concentration differences between two sides of a membrane create a pressure difference, leading to a net fluid transport [1, 2]. In addition, when the membrane elasticy is comparable to the pressure difference, it will undergo mechanical deformations that will couple to internal flows (Fig. 1A). While osmotic fluxes have been extensively studied, osmotic-induced deformations in soft membranes have been largely overlooked.

The aim of this project is to characterize mechanical deformations inside soft membranes under an osmotic flux. The membrane fabrication method will rely on photo-polymerization of hydrogels, and the characterization on micromechanics experiments, which allow for the visualization of materials displacements inside a hydrogel [3] (Fig. 1B). Beyond bringing fundamental insight into soft membranes, this project will have far-reaching implications in the fields of biophysics and polymer physics.

Outlooks You will be using state of the art imaging and numerical analysis tools, and the expected results are likely to be published in a peer-reviewed international journal. The opportunity to continue as a Ph.D. student can be considered and will require a funding application.

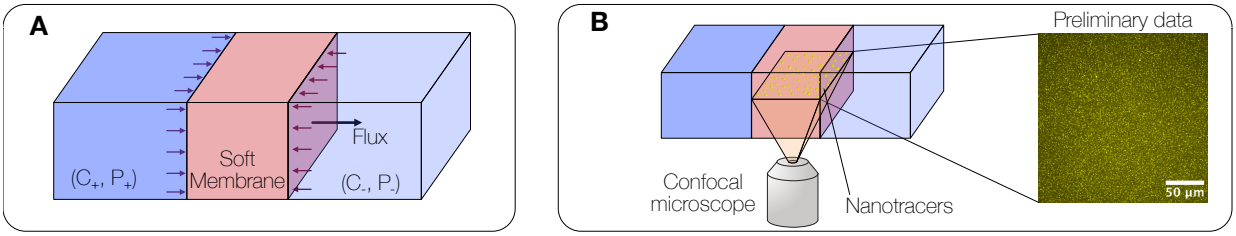

Figure 1: Project overview (A) Concentration differences between two sides of a membrane create a pressure difference and a net flux. (B) We will use micromechanics experiments to measure deformations inside a soft membrane.

Bibliography

[1] G. S. Manning and A. R. Kay. en. 2023.
[2] S. Marbach and L. Bocquet. en. *Chemical Society Reviews* (2019).
[3] N. Bain et al. *arXiv preprint arXiv:2410.09158* (2024).