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Water flow through membranes under 20 atmosphere osmotic pressure

1. Presentation and description of the project

Lipid bilayer membranes are semi-permeable, meaning water can cross them but not ions. Hence, when the two neighboring media do not have the same osmolarity, water crosses the bilayer towards the side with the highest osmolarity. We have made a setup in which a lipid bilayer suspended between two microfluidic channels is able to withstand an intriguingly high osmotic gradient: more than one molar across the 5 nm membrane, *i.e.* more than 20 bars in pressure. How can the membrane resist such high forces? How are the flows compared to the predicted ones? What is the shape of the membrane? These are the questions that will be addressed during this internship.

2. Techniques / methods used

A 100 µm diameter circular lipid bilayer is formed on a microfluidic chip built from 3D-printed molds. This membrane is suspended between two microfluidic channels in a nanoliter hole separating them. Buffers with different osmolarities are flown in each channels. The bilayer is monitored on a confocal microscope. Adding fluorescent dyes in the buffer with the lowest osmolarity provides an indicator of the water flow across the bilayer by tracking the fluorescence increase in the hole. The presence of fluorescent lipids in the membrane allows the accurate determination of the shape of the bilayer.

3. Expected results

The ability of the bilayer to resist such a high gradient was unexpected. During the internship, the composition of the bilayer, the osmolarity difference and the shape of the nanoliter hole will be varied to understand how the forces are applied and the nature of the mechanical resistance at the molecular level.

4. Skills

Experience in manipulating microfluidic chips, use of digital light processing/Stereolithography 3D-printer and fluorescence microscopy would be helpful but is not a requirement.

5. References and contact

More details and references will be provided to interested students, please contact Frédéric Pincet at the address indicated below.
Funding for a follow-up PhD is secured.

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