Fabrication of a Bio-Inspired Plant Cell: Flexible Osmotic Pump

Academic Year: 2025–2026
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Host Laboratory: Institut des Sciences du Mouvement UMR7287, SBI Team
Location: Aix-en-Provence (IUT Aix campus)
Duration: 6 months
Salary: Yes
Recommended Level: BAC+5 (Engineering or Master's 2nd year)
Required Skills: Microfabrication, Microelectronics

Summary:

Pressurized cellular solids are ubiquitous in the biological world. In plants, a change in turgor pressure alters mechanical properties (stiffness/rigidity), as seen when plants wilt due to lack of water. The goal of this internship is to replicate the swelling of a plant cell using an electro-osmotic device.

The project involves creating a small-scale (millimeter-sized), pressurizable plant cell model using synthetic and elastic materials, based on techniques already employed in other laboratories [1,2]. The main challenge is to fabricate the osmotic pump using flexible materials.

Internship Tasks:

1. Conduct a literature review on various fabrication techniques for osmotic pumps and soft electronics
2. Investigate optimization and miniaturization solutions for valve fabrication, with a focus on low-voltage operation (<60V) and the use of an affordable dipolar liquid
3. Place orders with suppliers for materials specific to electro-osmotic pumps
4. Develop an optimized rigid osmotic pump (low voltage)
5. Explore fabrication solutions for a flexible osmotic valve.
6. Fabricate a flexible osmotic pump.

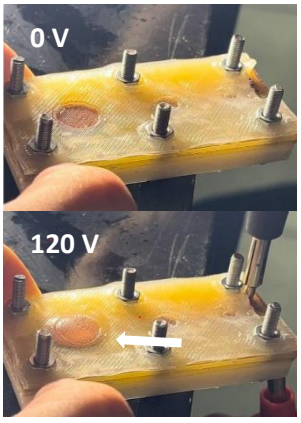

Figure 5 Pressurisation par électro-osmose réalisée au laboratoire.

This internship may lead to a patent filing and potential PhD opportunities.

Work Environment:

The Institut des Sciences du Mouvement (ISM) is a multidisciplinary research unit. The laboratory's research focuses on the study of locomotion in living organisms from various perspectives. The Bio-Inspired Systems (SBI) team at ISM aims to study principles and strategies derived from biological systems to inspire and design innovative technological systems.

References:

[1] Must, I., Sinibaldi, E., & Mazzolai, B. (2019). A variable-stiffness tendril-like soft robot based on reversible osmotic actuation. Nature Communications, 10(1), 344.

[2] Shultz, C., & Harrison, C. (2023, April). Flat panel haptics: Embedded electroosmotic pumps for scalable shape displays. In Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems (pp. 1–16).