Laboratoire de l'Intégration du Matériau au Système CNRS UMR 5218

Internship offer (6 months)

Solid-State Electrolyte gels in Organic ElectroChemical Tansistors (OECTs)

Organic electrochemical transistors (OECTs) are undergoing significant advancements for use in electronics and biological interfacing. Although substantial focus has been placed on the development of conjugated polymers that constitute the OECT channel, comparatively less attention has been directed towards the electrolytes that provide the ions for these devices. These electrolytes can be categorized into three main types: water-based solutions (such as NaCl, KCl, and phosphate-buffered solutions), room-temperature ionic liquids, and more complex mixtures with varying compositions. Water-based electrolytes generally yield high transconductance but low on/off ratios. Additionally, these electrolytes may experience evaporation, which can impair device performance and restrict their long-term viability. In contrast, ionic liquids, being free of water, can typically function at higher gate voltages, resulting in improved on/off ratios. Most high-performance OECTs reported to date utilize aqueous liquid electrolytes, which limits their practical applications. Therefore, the development of solid or semi-solid polymer electrolytes is essential for the future integration of OECTs into protected, flexible, printed, or conformable bioelectronic devices. Gel electrolytes are particularly promising, as they offer soft mechanical properties desirable for flexible devices and biological interfacing while mitigating the processing and leakage challenges associated with liquid electrolytes. The ionic conductivity of the gel is crucial as it influences the polarization response time of the channel, making it a key factor. However, solid electrolytes typically exhibit lower ionic conductivity compared to liquid electrolytes, leading to devices with slower switching responses.

To enhance properties such as conductivity and switching performance, we have developed a Gel (Plasticized) Polymer Electrolyte (GPE) system that comprises a ternary composition. Preliminary experiments have demonstrated the potential of our GPE system. Consequently, the primary objective of this research is to optimize the component ratios to maximize ionic conductivity and achieve an electrolyte with superior switching performance. Subsequently, natural gel electrolytes will be investigated to move towards fully biosourced and biodegradable devices.

HOST LABORATORY (Bordeaux, France)

IMS (Laboratory of Material and Systems Integration, UMR CNRS 5218). Group Organic. Supervisors: Damien Thuau. (https://oembordeaux.cnrs.fr/)

(https://www.ims-bordeaux.fr/fr/recherche/groupes-recherche/31-organique/13-organique)

FINANCING

Salary of approximately 550€ net per month (desired start beginning 2026). Duration 6 months.

RESEARCH PROFILE

We are looking for an engineering school/Master's student with solid knowledge of physics and (electro)chemistry. Good experimental/technological skills would be an additional asset.

APPLICATION

Applicants should send a CV and a cover letter to Damien Thuau (damien.thuau@ims-bordeaux.fr) before 15/11/2025. We kindly ask you to use your name to name the electronic files you will send as attachments.