Master 2 Internship Offer

Analysis of Organic Mixed Ionic/Electronic Conductors Properties

Scientific Context and Objectives

Organic Mixed Ionic/Electronic Conductors (OMIECs) have emerged as an excellent materials platform to interface biology with conventional electronics; identified as the "organic or plastic bioelectronics" field [1,2]. The Organic ElectroChemical Transistor (OECT) is considered as one of the key building-block to operate such a transduction [3]. Its efficiency is evaluated following some Figures of Merits: i) the transconductance (g_m) [4], ii) the switching times (τ_{ionic} vs. $\tau_{electronic}$), iii) an in-situ imaging of the dedoping propagating front (e.g. ionic mobility measurement) [5], iv) the electrochemical impedance to establish the electrical equivalent circuit and extract volumetric capacitance. Our current understanding shows that swelling properties of such (macro)molecular OMIECs are vital to properly drive OECTs. Indeed, the swelling of the hydrophilic (thus ionic) rich-phases authorizes the ions to penetrate and to move in vicinity of the hydrophobic π-conjugated rich phases, modulating their doping states and thus the amount of electronic current flowing in the channel of OECTs. Consequently, the total surface that ionic & π-conjugated phases exchange in between and their self-organization may play pivotal roles since such a transduction takes place in all the volume of the channel layer of an OECT.
The recording of OMIECs properties (ionic & electronic mobility) and the understanding of its physical operation are of great importance to improve the OECTs transduction mechanism.
In such a context, the M2 intern candidate will setup the recording of such ionic mobility by performing dedoping propagating front measurements. Thus, the M2 candidate will setup structure / property improvements in order to highlight OMIECs properties.

Laboratory Location & Collaborative Context

Internship is located in an Excellence and collaborative environment, in the Centre de Microélectronique de Provence (CMP) (880, avenue de Mimet, Gardanne 13120, France). CMP belongs to the IMT – Mines Saint-Etienne Graduate Engineering School. The intern applicant will evolve in the Flexible Electronics Department of CMP.
All the organic (bio)electronics devices will be designed, fabricated, first-proof demonstrated and characterized in the 650 m^2 State-of-the-Art (*SoA*) MicroPackS cleanroom platform of CMP. The candidate will have a full and free access to that *SoA* cleanroom to complete his(her) scientific purposes.
The intern candidate will evolve in a collaborative framework, involving 2 academics laboratories in Grenoble and Paris (France). He/ she will have hence a close research collaboration with partners, particularly with PhDs and post-docs driving i) design & synthesis of OMIECs and ii) OECTs modelling, respectively.
Duration: 6 months-long, **Starting Date**: from February/March 2022
Grant: 600 net euros/ month

Candidate Profile/ Skills

The Intern candidate is about to earn a Master degree or have a university degree equivalent to a European Master's degree in Instrumentation & Physics Measurements correlated to Materials Science purposes. An ability to work in a collaborative context and to propose scientific investigations that are at the interface between Physics of Electronic Devices and Materials Science is required. Knowledges or past experiences in Instrumentation, Electronics are advantageously considered.

Application & Selection Process

The Intern application is immediately opened for submission.

Applicants should provide a single pdf file combining i) a copy of passport, ii) a curriculum vitae, iii) a cover letter, iv) a copy of obtained diploma (i.e a certification letter of M1 Degree and anterior diploma) and v) reference letters from past supervisors or professors.

This single pdf e-file should be addressed both to Dr. S. Sanaur (sanaur@emse.fr). We encourage candidates to apply as soon as possible, since applications are evaluated as arising.

Applications will be evaluated through the following steps:

1) Eligibility check of applications based on the submitted e-file,

2) Those applications will be evaluated and shortlisted candidates will be invited for an interview session via videoconference. All applicants qualified for videoconference will be notified of the final decision.

Bibliography

1. Someya, T., Bao, Z. & Malliaras, G. G. The rise of plastic bioelectronics. *Nature* **540**, 379–385 (2016).
2. Berggren, M. & Richter-Dahlfors, A. Organic Bioelectronics. *Advanced Materials* **19**, 3201–3213 (2007).
3. Rivnay, J. *et al.* Organic electrochemical transistors. *Nature Reviews Materials* **3**, 1–14 (2018).
4. Khodagholy, D. *et al.* High transconductance organic electrochemical transistors. *Nature Communications* **4**, 2133 (2013).
5. Stavrinidou, E. *et al.* Direct Measurement of Ion Mobility in a Conducting Polymer. *Advanced Materials* **25**, 4488–4493 (2013).