Flexible Electronics Department
Provence Microelectronics Center
PhD fellowship in organic neuromorphics

Mines Saint-Etienne is a graduate engineering school of the Institut Mines-Télécom (IMT), the leading public group of engineering and management schools in France. IMT is an EPSCP (large establishment) under the supervision of the Ministry of the Economy, Finance and Industrial and Digital Sovereignty.
The École Nationale Supérieure des Mines de Saint-Étienne (Mines Saint-Etienne) is responsible for training, research and innovation, transfer to industry and scientific, technical and industrial culture.
Mines Saint-Etienne represents: 2,400 engineering students and researchers in training, 480 staff (150 researchers and teacher-researchers), a consolidated budget of €46 million, 3 campuses dedicated i) to industry in Saint-Etienne and Lyon (AURA region), ii) to microelectronics and connected objects in Gardanne (Aix-Marseille Provence area, PACA region) and iii) to engineering for health in Saint-Etienne; 6 research units; 5 training and research centers; a leading technical and industrial scientific culture center in France "La Rotonde" (> 50,000 visitors / year).
The Provence Microelectronics Center (CMP) is located in Gardanne (in Bouches-du-Rhône, 13). It is one of Mines Saint-Etienne's five training and research centers. It includes four research departments including the Flexible Electronics department (FEL) within which the PhD fellowship is opened. Since 2005, the FEL department has been interested in activities relating to hybrid electronic systems. Most of the work is carried out around communicating electronic systems made on flexible substrates. At the technological level, research is carried out in the School's clean room in partnership with the Micropacks and IDFab technological platforms. The areas of application affect all sectors of society, in connection with sensor networks (medical patches for patient monitoring, abandoned sensors for the environment,…), advanced human-machine interfaces, etc.

Scientific Context and Objectives

Ultra-flexible, conformable and implantable organic electronic devices incorporating artificial intelligence promise to revolutionize real-time monitoring and treatment of chronic diseases. Such devices could be based on organic electrochemical transistors (OECTs) exploiting mixed ion-electron polymer conductors (PMIECs) as active layers. Indeed, PMIECs have emerged as an excellent hardware platform for interfacing biology with conventional electronics; identified as the "organic or plastic bioelectronics" field. The organic electrochemical transistor (OECTs) is considered one of the key elements to make such transduction. Its efficiency is evaluated through few Figures of Merit (FoM): i) transconductance (g_m), ii) switching times (ionic vs. electronic), iii) in situ imaging of the dedoping propagation front (for example, measurement of ionic mobility), iv) the electrochemical impedance to establish the equivalent electrical circuit and extract the capacitance. Beyond these physico-chemical properties, our current understanding demonstrated short and long-term potentiation and depreciation, as well as pair-pulsed facilitation (PPF), properties in OECTs in order to elaborate organic synapse-like behavior. Indeed, the state-of-the-art has shown the realization of 2D crossbar architectures based on ElectroChemical (EC)-RAM-like devices. Nonetheless, measurements were done under non-atmospheric conditions. Moreover, the PMIECs were not enough investigated to offer the most reliable properties. This PhD project is embedded in an european consortium dealing with the synthesis of new PMIECs architecture and the understanding of PMIECs structure-property relationship by spectroscopic investigations *in-situ* & *operando* OECTs, in order to develop organic neuromorphics circuits.

1) Missions

In such a scientific context, The aim of the PhD consists of creating neuromorphic circuits based on OECTs, as the first building block of organic artificial intelligence. The PhD candidate will aim to develop an hardware artificial neural network based on OECTs building blocks. In particular, as a first objective, key physical parameters (as short and long-term potentiation and depreciation,…) to establish an organic synapse-like behavior will be highlighted. Consequently, the analog electronics design, the hardware implementation & fabrication and the electrical setup to characterize a 2D crossbar architecture will be performed in order to evaluate the capabilities to finalize the realization of ultraflexible & biocompatible artifical neural networks. Last but not least, the PhD candidate will fabricate his/her devices in clean room, benefiting from a technical support for the manufacturing of the OECTs by a post-doc fellow.

2) Applicant profile

The candidate must hold a Master of Science degree or equivalent from Graduate Engineering Schools in electrical engineering. The candidate must aim to i) work in a collaborative context and ii) to propose scientific investigations that are at the interface between electronics design & test, physics of electronic devices and materials science. Past knowledge or experience in (Bio)Organic Electronics is advantageously taken into account. The following skills are expected:

- previous experience in the driving/ development of electronics design & engineering,
- skills for interdisciplinary work and multidisciplinary collaborations,
- autonomy, initiative,
- excellent communication and writing skills in English.

3) Hiring Conditions

PhD contract in public law.
Salary fees according to the rules defined by the Institut Mines Télécom.
The position is open to all with, upon request, accommodations for candidates with disabilities.
The missions will be carried out on the Provence Microelectronics Campus in Gardanne city, Bouches du Rhône (13), FR.
Desired starting date: September 2024
Benefits:

- 49 days of annual leave (leave + RTT) for a full-time executive package,
- Public transport costs covered up to 75%,
- Sustainable mobility package,
- Staff home (sporting, cultural activities, CE benefits for leisure and social time)

4) Applications procedures

Application files must include:

- A letter of application,
- A curriculum vitae,
- Letter(s) of recommendation,
- The copy of the diploma certificate,
- A copy of the passport

Selected candidates for an audition will be informed as soon as possible. Part of the exchanges will be carried out in English. As part of its Equality, Diversity and Inclusion policy, the École des Mines de Saint Etienne is an employer concerned about fair treatment between applications.

5) Pour en savoir plus

For all information about the position, please contact:

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Links :

https://www.mines-stetienne.fr/en/

https://www.imt.fr/

https://www.youtube.com/watch?v=QUeuC5iQiN0

Protection of your data :
https://www.mines-stetienne.fr/wp-content/uploads/2018/12/Informations-des-candidats-sur-les-traitements-de-donn%C3%A9es-personnelles.pdf