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 as 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, the PMIECs were not enough investigated to offer the most reliable characteristics. 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 the more reliable organic neuromorphics circuits.

1) Missions

In such a scientific context, the objective of the PhD consists of creating neuromorphic circuits based on OECTs, as the first brick of a new artificial intelligence architecture which could interface directly with the living world. The doctoral student will aim to develop an hardware artificial neural network made up of OECTs. As a first objective, the key physical parameters (such as short and long term potentiation and depreciation, number of conductance states, etc.) allowing the establishment of organic synapse type behavior will be highlighted. Therefore, the design, the implementation and the fabrication of such hardware analog electronics as well as the electrical tests to characterize a 2D crossbar architecture will be carried out in order to evaluate its capabilities as ultraflexible artificial neural networks. Finally, the doctoral student will manufacture his/ her devices in clean room, benefiting from technical know-how for OECTs fabrication.

2) Applicant profile

The candidate must hold a Master of Science degree in electrical engineering from University or equivalent from Graduate Engineering Schools. 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, electrical test, physics of electronic devices and materials science. Past knowledge or experience in (Bio)Organic Electronics are 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) How to apply and/or ask more details

For all information about the position, please contact:

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Useful 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