Flexible Electronics Department
Provence Microelectronics Center
Postdoctoral fellowship in instrumentation of organic bioelectronic devices

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 to industry in Saint-Etienne and Lyon (region AURA), to microelectronics and connected objects in Gardanne (Aix-Marseille Provence area, region PACA) and 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 departments including the Flexible Electronics department (FEL) within which the post-doctoral fellowship is open. 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. The control of hierarchical self-organization and the choice of the most favorable morphology in PMIECs are of paramount importance to improve the functioning of OECTs transduction. Beyond transduction applications, in the longer term, OECT is interesting for creating emerging applications in neuromorphic or bioelectronic circuits. Simple inverters have been presented in a CMOS type configuration. This provides a promising basis for studying advanced circuits.
Our current understanding shows that the swelling (or ionic penetration) properties of these (macro)molecular PMIECs are essential to properly drive OECTs. Indeed, the swelling of the rich hydrophilic (hence ionic) phases allows the ions to penetrate and move in the vicinity of the rich

hydrophobic π-conjugated phases, modulating their doping states and therefore the quantity of electronic current circulating in the OECTs channel. Therefore, the total surface area exchanged between ionic and π-conjugated phases and their self-organization play a central role since such transduction takes place throughout the volume of the channel layer of an OECT.

1) Missions

In such a scientific context, the postdoctoral fellow (PDF) will develop new instrumentation which will make it possible to record the ion mobility of the PMIEC by analyzing the frontal (de)doping mechanisms. In particular, as a first objective, the PDF will develop computer control, driving and synchronization (Python programming environment) of several spectroscopic, optoelectronic and electrical equipment to automatically extract key physicochemical parameters from PMIECs. By combining spectroscopic data between the project partners, these investigations will contribute to establishing the engineering rules and optimal structure-property relationships of PMIECs which will optimize the transduction operation of OECTs. Last but not least, the PDF will fabricate his/her devices, but will benefit from technical support for the manufacturing of the OECTs in clean room. He/she will monitor and analyze key FoMs using the developed instrumentation and electrical and electrochemical characterizations. Finally, a final objective of the post-doctoral fellowship will consist of creating neuromorphic circuits based on OECTs, as the first building block of organic electronics artificial intelligence.

2) Applicant profile

The candidate must hold a PhD in instrumentation and spectroscopy, or in materials science or 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 the 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 instruments to analyze (opto)(bio)electronic devices,
- skills for interdisciplinary work and multidisciplinary collaborations,
- autonomy, initiative,
- excellent communication and writing skills in English.

3) Hiring Conditions

Post-doctoral 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 (13) in MinesSaint-Etienne.**
- **The PDF duration is 12 months-long (possible extension + 6 months)**
- **Desired starting date: as soon as possible**

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)
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4) Applications procedures

Application files must include:

- A letter of application,

- A curriculum vitae detailing teaching activities, research work (10 pages maximum),
- Letter(s) of recommendation,
- The copy of the PhD certificate,
- A copy of an identity document

Applications must be submitted on the RECRUITEE platform :
Deposit URL : https://institutminestelecom.recruitee.com/o/postdoctoral-fellowship-in-instrumentation-of-organic-bioelectronic-devices-cdd-12-mois

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

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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