DOCTORAL RESEARCH SCHOLARSHIP IN PHYSICAL CHEMISTRY

ALL-PRINTED, FLEXIBLE, ORGANIC THERMOELECTRIC GENERATORS

The problem of environmental degradation is pushing researchers towards the quest for efficient and environmentally friendly energy sources or conversion technologies. Thermoelectric materials (TEMs) have attracted considerable attention in the last twenty years, as heat is a readily available energy source because of solar radiation and is also the inevitable "side product" of almost any industrial activity. Our PhD project focuses on energy harvesting from industrial activity by designing and printing large-area thermoelectric generator (TEG) flexible devices able to harvest energy from low but continuous temperature gradients. The utilisation of printing method allows the fabrication of very large TEG devices able to counterbalance low heat gradients while flexibility allows the TEG device to conform to the most frequently encountered elements of production chains (pipes, serpentines…). Organic semiconductors (OSCs) seem promising candidates for the fabrication of thermoelectric systems because of their processability at room temperature in liquid phase and their excellent mechanical robustness and flexibility.

The goal of this thesis is the development of **all-printed, organic thermoelectric generators (OTEGs) fabricated on flexible substrates**. The first part of the thesis project will consist in developing organic semiconducting inks necessary for the fabrication of the thermoelectric devices and in defining a process-flow for the fabrication of such all-printed devices on flexible foils. Later on, a protocol to test the stability of the printed OTEGs when subjected to mechanical stresses will be defined, the main objective being the description of the relationships existing between the mechanical and thermoelectric properties of printed organic semiconducting layers. The final aim of the thesis project is to obtain low-cost, flexible, high-power conversion, all-printed OTEGs suitable for non-planar and large-area applications.

Most of the PhD student's experimental activities will be carried out at the ITODYS Laboratory of Université Paris Cité in France (https://www.itodys.univ-paris-diderot.fr/fr/) but this project is developed within an international collaboration with the Institut National de la Recherche Scientifique of Canada (INRS - https://inrs.ca/en/).

In addition to carrying out the experiments necessary to achieve the aforementioned scientific objectives, in collaboration with the supervisors, the PhD student will regularly present his/her activities at group and laboratory meetings. He/she will also contribute to the preparation of the manuscripts of scientific publications and present his/her project at local and national conferences, in order to engage with the wider scientific community.

Supervisors: Prof. Benoît PIRO, Dr. Giorgio MATTANA
Duration of the contract: 36 months
Gross salary: 1975 €/month (taxable, social security contribution to be applied)
Keywords: printed electronics, organic electronics, flexible electronics, thermoelectricity
Essential skills and qualifications: the ideal candidate graduated with an MSc in Chemistry, Physical Chemistry or Physics; he/she is naturally curious and meticulous, possesses a taste for careful experimental work and data analysis, and is ready to join a multidisciplinary and international team project. He/she has a good command of English (at least a B2 level). Previous experience in printed and/or organic electronics would be a plus but it is not a strict requirement.
All enquiries shall be addressed by email to: Prof. Benoît PIRO (piro@u-paris.fr) and Dr. Giorgio MATTANA (giorgio.mattana@u-paris.fr).

The deadline for application is 1st of June 2022.

*Applications must include a motivation letter, a full C.V. and the name and contact details of **two persons** acquainted with the academic or research proficiency of the candidate.*