PhD position in Printed Organics Electronics

"Optimization of Source/Drain Contacts in Organic Thin-Film Transistors (OTFT) to Enhance Performance and Stability"

Context: Organic electronics offer a promising alternative to inorganic electronics for large-area applications, particularly in displays and flexible sensors. Among these devices, Organic Thin-Film Transistors (OTFTs) provide advantages in terms of low-cost fabrication and compatibility with flexible substrates. However, their commercial integration remains limited due to insufficient performance and stability issues, particularly in ambient conditions and over long periods. The Organic And Silicon System team of IETR (Institute of Electronic and Telecommunications of RENNES, France; *https://www.ietr.fr/*) aims to take part of this fascinating topic promoting a disruptive technology (1 patent pending technology). One of the major technological bottlenecks is the high contact resistance at the source and drain (S&D) electrodes, which negatively impacts charge injection efficiency and carrier mobility. These resistances, influenced by interface trap states and charge injection barriers, hinder device performance and long-term reliability. While various contact engineering strategies have been explored, further innovation is needed to enable the widespread adoption of OTFTs in commercial applications.

PhD Objectives: This PhD project aims to develop new strategies for improving S&D contacts in OTFTs, reducing contact resistance, and enhancing device stability. Two complementary approaches will be investigated:

1. Replacing heterojunction contacts with homojunctions
   The objective is to optimize charge injection by using an intrinsic polymer semiconductor (OIPSC), locally doped to create a conductive zone (ODPSC) acting as the electrode. This approach is expected to minimize energy discontinuities at the interfaces and reduce interface trap density.
2. Implementation of a transfer printing process for S&D electrode fabrication
   This method, linked to a patent filed in 2024 (FR2412688), aims to adapt materials and manufacturing processes to demonstrate the effectiveness of transfer printing in producing printed OTFTs. This technique is designed to optimize electrode topology and reduce access resistance.

Methodology and Project Framework:

This PhD project builds on the expertise of the OASiS department at IETR in inkjet-printed OTFT fabrication and is part of the ANR-funded SMOOTH (Stable Metal-free Organic transistOrs Thanks to Homojunction) project, which will start in February 2025 and run for four years. The project involves multiple partners:

- OTFT characterizations : L2n-URCA Reims (O. Simonetti)
- Polymer synthesis: ICPEES Strasbourg (N. Leclerc)
- Material deposition: ICS Strasbourg (M. Brinkmann)
- Ink formulation and printing process optimization: IETR Rennes (Maxime Harnois and Emanuel Jacques)

The research will focus on:

- Formulating and optimizing dopant inks for printed conductive regions,
- Investigating doping mechanisms and their stability,
- Electrical and morphological characterization of transistors,
- Evaluating device stability under real-world operating conditions.

Candidate: The PhD candidate will work in a multidisciplinary research environment (*NanoRennes* facilities) where engineering and materials science have to be combined to improve the development of highly efficient and reliable OTFT devices.
We are looking for a talented, curious, enthusiastic, and motivated life scientist for a three-year PhD position. As a PhD candidate, you are committed to conduct independent and original scientific research, to report on this research in international publications and conferences, and to assist in the supervision of research projects for both bachelor and master students.

Qualifications

Candidates should have a MSc degree with expertise/background in materials science and engineering. We would particularly welcome applications from candidates with background in engineering materials, chemical engineering, microelectronics and semiconductor devices.
The PhD candidate is expected to have an excellent academic record and should be able to work in a multidisciplinary environment in close cooperation with other experts. Excellent communication skills and good command of English (oral and written) are also required.

Information and Application

Questions regarding this position can be directed to: Dr. Maxime HARNOIS, email: maxime.harnois@univ-rennes1.fr and Dr. Emanuel JACQUES, email : emanuel.jacques@univ-rennes.fr
Applications, including a CV, a statement of your interest must be attached to your application form.