

Conducting polymer materials are uniquely poised to make biocompatible interfaces between electronic devices and living matter. This is because of the hybrid electronic-ionic conductivity these materials possess, which allows transduction between biological signals, which are ionic, and electronics. This feature is particularly desirable in organic electrochemical transistors (OECTs) applications. The unique ionic-electronic properties of OECTs and their large capacitance and operation at low voltage make these kinds of organic devices ideal candidates for biosensors. Moreover, OECTs introduce many advantages over traditional electrode-based sensors and conventional silicon transistors. However, further OECT development depends on advances in the design and synthesis of suitable polymeric materials. This should mainly be characterized by high electron and hole charge carrier mobility, high ionic conductivity, processability from solutions, long-term working stability OECT, and biocompatibility.

This project aims to synthesize new semiconducting polymers of the donor-acceptor type that can be ambipolar, i.e., easily electrochemically reducible and oxidizable in water. The comprehensive characterization will involve spectroscopic, electrochemical, spectroelectrochemical, and structural methods, as well as the fabrication of organic electrochemical transistors based on the synthesized polymers with subsequent testing. The envisioned collaboration with groups working on in vitro and in vivo bioelectronics is crucial for the successful application of the newly synthesized materials.

The long-term perspective of the research proposal is to understand the nature of electrochemical and electronic processes occurring during OECT operation, as it is a necessary step preceding the work leading to its optimized preparation.