High-Molecular-Mass Organic Semiconductors Obtained by *In Situ* Electropolymerization: Synthesis, Spectroscopic, Electrochemical Studies and Application in Organic Electrochemical Transistors

One of the fastest-growing areas of science is the field of integrating electronic devices with living organisms. The use of artificial intelligence to process and analyse vast amounts of data opens new possibilities for innovative applications of bioelectronic devices. Among the most intriguing are "electronic neurons" which could create systems similar to the human brain, or sensors implanted under the skin capable of determining the concentration of specific compounds, such as glucose. The ability to analyse information from the direct connection between biological systems and integrated circuits indicates a high demand for new devices that could facilitate such data transfer. One of the fundamental electronic components enabling this communication is the transistor. This device allows for the amplification of weak electrical signals, signal filtering, stimulation, and the execution of specific logical operations. To date, the most widely used transistors have been those based on inorganic semiconductors. Despite their excellent electrical properties and low production costs, these transistors exhibit limited biocompatibility, restricting their use in physiological conditions. Consequently, recent years have seen significant focus on developing Organic Electrochemical Transistors (OECT), which have the ability to operate in aqueous environments.

In this project, we aim to produce a series of polymer organic semiconductors to be used as active layers in OECTs. Due to the specially designed structure of the monomers, the resulting polymers will be capable of conducting both electrons and electron holes. This will enable the creation of ambipolar transistors, which are highly desirable elements in electronic circuits. We will employ an unconventional method of *in situ* electropolymerization in the production of OECTs. This process involves the polymerization of the monomer under the influence of an electric current directly in the transistor channel. This approach will allow us to bypass the time-consuming and material-intensive traditional polymer purification methods. Our research will utilize various investigative methods, including electrochemical, spectroscopic, impedance, and computational chemistry techniques. The project's goal is to understand the influence between the chemical structures of the monomers and the parameters of the electropolymerization process on the transistor performance. We will also evaluate the competitiveness of our devices against those available on the market.