Project 3.5 Nanoscale detection of redox-active molecules and enzymes

Supervisor: prof. dr hab. Marcin Opałło / dr inż. Wojciech Nogala
Institute: Institute of Physics Chemistry PAS
Unit: Research group No. 6. Nanoelectrochemistry - dr inż. Wojciech Nogala
www: http://groups.ichf.edu.pl/nogala

Background:

Electrochemical processes are well understood at the macroscopic level, where many species react in a very short time. However, little is known about these processes at the molecular level. In this project, we will focus on detecting a low number of faradaic electrons (ultimately individual). This will ultimately enable electrochemical studies of individual molecules. We will try to solve fundamental unknown areas of electrochemistry concerning activity distribution among enzyme molecules, the mechanism of deactivation of enzyme molecules, the kinetics of electron transfer to and from individual molecules, and the dynamics of electrode processes at equilibrium. This will be done by converting Faradaic currents below the detection limit to electrogenerated fluorescence. We will focus on model electrode processes of electroactive molecules immobilized at nanoelectrodes and processes catalyzed by enzymes positioned near nanoelectrodes.

Aim:

This project aims to develop a flexible and general strategy for the electroanalysis of single molecules. We aim to detect a low number of faradaic electrons. This will allow for the electrochemical characterization of a small number of redox-active molecules and enzyme molecules that will be pushed toward the ultimate analysis of individual molecules.

Requirements:

- Master degree in chemistry, physics, or materials science,
- experience in laboratory work in the field of electrochemistry,
- knowledge of electroanalytical methods and spectroscopic methods,
- independence to design and execute experiments and sample characterizations,
- analytical mindset for interpreting measured data,
- ability to solve problems and troubleshoot independently