

Project 3.8 Synthesis of core-shell nanoparticles for chemosensing and electrosynthesis

Supervisor: Piyush Sindhu Sharma, PhD Dsc.

Institute: Physical Chemistry PAS

Research group: Research group No. 18. Functional Polymers – dr hab. Piyush Sharma

www: <https://ichf.edu.pl/en/groups/functional-polymers>

Background:

Nanoscale materials provide unique and tailorable properties, giving rise to their use in chemical sensing and catalysis applications. Mostly, inorganic/organic core/shell nanoparticles are made of metal, metal oxide, or a silica core with a polymer shell or a shell of any other high-density organic material. Because of their excellent performance, such nanomaterials are becoming powerful competitors and potential substitutes for natural enzymes. Applications such as catalysis and sensing depend heavily on the nanoscale's composition, size, shape, and architecture. Furthermore, nanoparticles prepared with electroactive conducting polymers allow excellent electrical stimulus control.

Although significant progress has been achieved, developing polymers with enzyme-like properties still faces several difficulties, including poor selectivity and a low density of active sites. In conclusion, one crucial challenge often faced by researchers in catalysis and sensing is developing a selective, robust, and economic system. The proposed project will address these issues by developing core-shell nanoparticles containing functionalized shells featuring molecular recognition and electrocatalysis sites. In addition, we plan to prepare polymers in the form of 3D materials. Active centers in such 3D polymers will be easily accessible because of non-restricted diffusion in pores and the high surface of materials.

Aim:

The core of the proposed research is the implementation of novel core-shell nanoparticle preparation procedures to synthesize nanomaterials with in-built active centers and recognition sites. We plan to synthesize nanostructured polymers with tailorable functionalities for chemical sensing of antibiotics and electrosynthesis of value-added products.

Requirements:

- Master of Science (or equivalent) degree, preferably in chemistry or physics, awarded not earlier than five years before the deadline of the current recruitment;
- the average grade obtained in the course of study is not less than 4.5;
- ability to work independently as well as in a group;
- experience in working in the field of electrochemistry;
- knowledge of spectroscopic (UV-vis, XPS), microscopic (AFM, SEM, SECM etc.) and nano/micro-electrochemistry will be appreciated;
- proficiency in English speaking and writing.