PHYSICAL CHEMISTRY

Study of electrocatalytic activity of heterogeneous catalysts based on transition metals nanoparticles for applications in water electrolysis and fuel cells
supervisor: prof. RNDr. Renáta Oriňaková, DrSc. (renata.orinakova@upjs.sk)
Study form: full time
Annotation: The aim of this work is to study the effect of method and conditions of the heterogenous catalyst based on transition metals nanoparticles production on its structure, morphology, and stability and subsequently on its electrocatalytic activity toward hydrogen evolution reaction and oxygen oxidation reaction.

Development and study of hybrid electrodes for electrochemical detection of viruses
supervisor: prof. RNDr. Renáta Oriňaková, DrSc. (renata.orinakova@upjs.sk)
consultant: RNDr. Ladislav Galdun, PhD.
study form: full time
Annotation: The aim of this work is to study the suitable electrode materials for the electrochemical sensors development that would be able not only qualitatively but also quantitatively to determine the amount of virus particles in a sample. It will be primarily the SARS-CoV-2 virus and influenza virus. Next aim is to study the effective immobilisation of nucleic acid aptamers on the electrode surface for the specific detection of viral particles.

Bioactive coatings for degradable metallic biomaterials with controlled drug release
supervisor: prof. RNDr. Renáta Oriňaková, DrSc. (renata.orinakova@upjs.sk)
study form: full time
Annotation: The aim of the work is to prepare and characterize a smart-biomaterial consisting of a metal matrix and bioactive coatings. The function of the prepared degradable biomaterial will be to provide adequate mechanical support at the site of tissue damage and to prevent the development of bacterial infection after surgery by releasing drugs at the same time. Next aim is to study the degradation mechanisms and processes related to the drug and the dissolution of the metal matrix and bioactive coatings itself as well as the mechanical properties, in vitro, and in vivo biocompatibility of the prepared materials.

Study of the influence of polysulfides on the lifetime and stability of Li-S batteries
supervisor: doc. RNDr. Andrea Straková Fedorková, PhD.
(andrea.fedorkova@upjs.sk)
study form: full time
Annotation: The aim of this work is the preparation and characterization of sulfur-based cathode materials and the study of the influence of polysulfide migration on the degradation processes inf Li-S batteries. Another goal will be to propose a strategy for the treatment of cathode materials and separators in order to reduce the mobility of the resulting lower polysulfides. Reducing the mobility of lower polysulfides can significantly improve the stability, cyclability, and overall lifetime of Li-S batteries.

Development of new high energy cathode materials and polymer electrolytes for Li-S batteries

supervisor: doc. RNDr. Andrea Straková Fedorková, PhD.
(andrea.fedorkova@upjs.sk)
study form: full time

Annotation: The aim of the work is the preparation and characterization of new high-energy cathode materials based on sulfur and at the same time new compatible polymer electrolytes with higher conductivity. Combination of these tailored materials compatible with each other and resistant to polysulfides can effectively increase the stability and energy efficiency of the new Li-S batteries.

The catalysts for synthesis of acetic acid from mixture of metane and carbon dioxide.

supervisor: prof. RNDr. Andrej Oriňak, PhD. (andrej.orinak@upjs.sk)
study form: full time

Annotation: Novel catalysts of Zn and Cu base will be studied on conversion of mixture of metane and carbon dioxide to acetic acid. I tis of interest due to enormous production of carbon dioxide. Studied will be also kinetics of conversion process and activation CH_4 and CO_2 by catalysis of different structure.Differencies in oxidation states of catalysts effect adsoprtion metane and carbon dioxide and may change activation barrier disoc C-H bonds of metane a C-C coupling reaction.

Computer simulation of relationship of zeolite channel on ion- exchange capacity and next characteristics.

supervisor: prof. RNDr. Andrej Oriňak, PhD. (andrej.orinak@upjs.sk)
study form: full time

Annotation: Ion exchange capacity and others characteristics of zeolites play important effect on commercial application. By simulation process of zeolite channel diameter od function we can get information how a chemical modification of zeolite can be made. Modelled will be also core-shell structure of crystals for their novel application in catalysis.