Direct ethanol fuel cells (DEFC) are one of the most promising sources of green, renewable energy. DEFC convert chemical energy from the fuel, which is ethanol, to electrical energy, which could power mobile devices or even vehicles. Electrical energy is generated during the ethanol oxidation reaction (EOR) on the anode of the DEFC, due to the presence of catalysts. These catalysts are typically based on platinum-containing spherical nanoparticles, therefore the cost of fuel cells are relatively high. Moreover, platinum is poisoned by byproducts of ethanol oxidation reaction, such as acetic acid or acetaldehyde. Therefore, attention of the researchers is focused to find the novel, low Pt-content and thus cheaper but efficient catalysts for EOR. It can be achieved by combining platinum with cheaper elements, which not only lowers the price of the nanocatalysts, but it also may increases catalytic activity toward ethanol oxidation reaction.

The aim of this research project is to design and to study the physical and electrochemical properties of novel anodic nanocatalysts, which will improve the DEFC performance. In these catalysts platinum nanoparticles will be doped with cheaper ruthenium which will reduce the production cost of DEFC. Also, the catalytic nanoparticles will be in form of so-called hollow nanoframes, which will be decorated by small SnO_2 nanoparticles. It is anticipated that nanoframes will show greater activity in ethanol oxidation due to their open three-dimensional structure, high surface to volume ratio and the presence of many catalytically active sites on the surface. Additionally, it is expected that nanoframes morphology combined with proper chemical composition enhance the catalytic performance of the obtained catalysts toward EOR. Moreover, it is planned to obtain PtRu-nanoframes with three shapes, i.e. rhombicdodecahedral, tetrahexahedral and octahedral, to prove that ethanol oxidation reaction efficiency depends on the shape of the catalysts.

The nanocatalysts will be obtained as a result of a series of chemical processes, which will include syntheses, galvanic replacement reaction and connection of nanoframes with SnO_2 nanoparticles in solution with different pH. The obtained catalysts will be characterized by electron microscopy (transmission and scanning electron microscopy), diffraction (X-ray and electron diffraction) methods. Electrochemical properties of the obtained catalysts will also be examined. For this purpose, cyclic voltammetry and chronoamperometric measurements will be used.