

Bioelectrocatalysis is a interdisciplinary field of study focused on exploring the mechanism of reaction and application of biological catalysts: enzymes, organellas, microbials in electrochemical devices. In our researches we work on electrode design consisted of enzymes and nanostructural material enabling efficient electric contact between catalyst active site and support with e.g. gold nanoparticles.

Gold nanoparticles and their applications in bioelectrocatalysis have raised significant interest in the last decade. They are used a support material for glucose amperometric biosensors or enzymatic fuel cells for implantable devices. Adsorbed on electrode surface they cause significant expansion of electrode surface area and electronic conductivity. However, many authors except those merits claim that gold nanoparticles influence the kinetics of electrode reaction without much experimental data in favor of this thesis.

That is why aim of this project is to investigate influence of gold nanoparticles present in film size (in meaning of metallic core diameter, from 5 to 1 nm) on kinetic and thermodynamic of bioelectrocatalytic reactions carried by oxidoreductases. Nanoparticles of diameter lower than 2 nm, called more often clusters, contrary to common (app. 10 nm) exhibit unique chemical and physical properties: lack of surface plasmon resonance and quantized electrochemical activity. We claim that redox activity of clusters, manifested as ability to exchange single electrons in wide range of potential might be utilized to mediate charge transfer between enzyme active site and electrode surface and therefore affect the observed kinetic of catalytic proces, due to change of reaction mechanism.

Results of our study may bring insight in understanding of interactions between quantum sized metallic nanostructure and enzymes and mechanism of electron transfer in such systems. Additionally, in long perspective our work can be utilized to design new applicable bioelectronics devices, such as third generation glucose biosensors or biological fuel cells with enhanced kinetics (sensitivity of sensor or maximum power output of fuel cell) and thermodynamics (decreased overpotential of electrode reaction).