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Streszczenie pracy doktorskiej „Elektrody modyfikowane nanostrukturami węgla lub złota oraz ich zastosowanie w czujnikach i ogniwach"

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The goal of this thesis was to prepare new nanostructured electrodes based on carbon nanoparticles, gold nanoparticles, carbon nanotubes or silicate submicroparticles by applying simple methods of surface modification. These electrodes were then used to construct biocells and sensors.

The first, literature, part describes the current state of knowledge about applied nanomaterials, methods of electrode modification, enzymes (bilirubin oxidase and acetylcholinesterase) and manners of their immobilization. Electrochemical sensors and cells are presented in this section as well.

In the experimental part most attention was devoted to electrodes made by layer-by-layer methods exclusively from oppositely charged particles: gold; gold and silicate; and, primarily, silicate and carbon. Carbon nanostructures were also immobilized by entrapping them in silicate matrices by solvent evaporation or by electrophoretic deposition methods.

The surfaces of the obtained electrodes were imaged using microscopic techniques. For the electrodes consisting of gold nanoparticles the SPR effect in the UV-Vis spectrum was demonstrated as well. However, the main focus was dedicated to the electrochemical characteristics of the electrodes, like the ion accumulation ability, active surface area and electrocatalytic properties towards the reduction of oxygen or oxidation of glucose, cysteine, hydrazine, dopamine, ascorbic acid, uric acid, acetaminophen or thiocholine.

Based on the silicate-carbon electrode modified with bilirubin oxidase, new cathodes for two biocells, a hybrid zinc-oxygen and an ascorbic acid-oxygen fuel cell, were created. The same electrodes were used to prepare a sensor for dopamine which operate in the presence of interfering substances such as ascorbic acid, uric acid or acetaminophen. The obtained detection limit allows dopamine detection at levels occurring in healthy humans, which is enough for preliminary diagnostics.

The electrodes modified with carbon nanoparticles or nanotubes exhibited very good electrocatalytic properties toward tiocholine oxidation. Series of sensors were prepared and some of them were applied to construct an inhibition-based organophosphate pesticide biosensor. For this purpose the enzyme acetylcholinestrese was immobilized by entrapping it in a silicate matrix or in polyvinyl alcohol. The best results was obtained at screen printed carbon electrodes modified with carbon nanoparticles for detection of several pesticides. What's more, a new idea of pesticide sensor structure which includes separation of the electroactive and enzymatic parts biosensor was developed and tested.

The presented experimental results can contribute to develop the knowledge of biocells and sensors.