Hematite nanostructures with well-defined facets and their electrochemical activity towards H_2O_2 and glucose

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Glucose biosensors are an essential tool in the fields of health care, chemical, and biological analysis. Classic measuring systems are based on the enzymes – glucose oxidase or glucose dehydrogenase. However, these biological catalysts are not sufficiently chemically and thermally stable. Thus, semiconductor materials for non-enzymatic glucose sensors are widely investigated. Hematite (α-Fe_2O_3) is an inexpensive and biologically inert n-type semiconductor which is chemically stable in aqueous solutions. The physicochemical properties of iron oxides are strongly dependent on their morphology. Thus, more and more attention is being paid to the shape-controlled synthesis of α-Fe_2O_3 nanomaterials. It has been reported that iron (III) oxide nanostructures with well-defined morphology show excellent catalytic activity towards glucose oxidation. Herein, α-Fe_2O_3 nanostructures with controlled shape have been investigated as electrode materials in non-enzymatic glucose and hydrogen peroxide sensors. Nanocubes and nanodiscs based on hematite were synthesized via metal-ion mediated hydrothermal route. The morphology of the obtained materials was analysed using scanning electron microscopy. The phase identification was performed by XRD, FTIR and Raman spectroscopy. The optical properties were determined by using UV–VIS–NIR diffuse reflectance spectroscopy. Moreover, zeta-potential measurements have been carried out to analyse the surface properties of the obtained nanomaterials. The detection of glucose and H_2O_2 in NaOH and PBS solutions was investigated by cyclic voltammetric measurements. Furthermore, the sensitivity and selectivity of the prepared sensors were investigated. The selectivity of the α-Fe_2O_3 electrodes towards glucose oxidation and hydrogen peroxide reduction was analyzed in the presence of interfering species which are present in the blood such as fructose or ascorbic acid.

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Biography

Kinga Michalec received her BSc in a field of Materials Science from AGH University of Science and Technology. She is currently an MSc student in a field of Materials Science with specialty Functional Materials at the same University. Her research includes the influence of the morphology of α-Fe_2O_3 and SnO_2 nanomaterials on their physicochemical properties for electrochemical and photoelectrochemical applications.

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