

Zinc Nanoparticles Modified Electrode as an Insulin Sensor

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Abstract : Diabetes mellitus (DM) is a serious metabolic disease characterized by chronic hyperglycemia. Often, the symptoms are not sufficiently observable at early stages, and so hyperglycemia causes pathological and functional changes before the diagnosis of the DM. Therefore, the development of an electrochemical sensor that will be fast, accurate, and instrumentally undemanding is currently needful. Screen-printed carbon electrodes (SPCEs) can be considered as the most suitable matrix material for insulin sensors because of the small size of the working electrode. It leads to the analyst's volume reduction to only 50 μ l for each measurement. The surface of bare SPCE was modified by a combination of chitosan, multi-walled carbon nanotubes (MWCNTs), and zinc nanoparticles (ZnNPs) to obtain better electrocatalytic activity towards insulin oxidation. ZnNPs were electrochemically deposited on the chitosan-MWCNTs/SPCE surface using the pulse deposition method. Thereafter, insulin was determined on the prepared electrode using chronoamperometry and electrochemical impedance spectroscopy (EIS). The chronoamperometric measurement was performed by adding a constant amount of insulin in 0.1 M NaOH and PBS (2 μ l) with the concentration of 2 μ M, and the current response of the system was monitored after a gradual increase in concentration. Subsequently, the limit of detection (LOD) of the prepared electrode was determined via the Randles-Ševčík equation. The LOD was 0.47 μ M. Prepared electrodes were studied also as the impedimetric sensors for insulin determination. Therefore, various insulin concentrations were determined via EIS. Based on the performed measurements, the ZnNPs/chitosan-MWCNTs/SPCE can be considered as a potential candidate for novel electrochemical sensor for insulin determination. Acknowledgments: This work has been supported by the projects Visegradfund project number 22020140, VEGA 1/0095/21 of the Slovak Scientific Grant Agency, and APVV-PP-COVID-20-0036 of the Slovak Research and Development Agency.

Keywords : zinc nanoparticles, insulin, chronoamperometry, electrochemical impedance spectroscopy

Conference Title : ICNB 2021 : International Conference on Nanotechnology and Biosensors

Conference Location : Rome, Italy

Conference Dates : May 03-04, 2021