NANOZYME-DRIVEN AMPEROMETRIC GLUCOSE BIOSENSOR

Aiste Krikstaponyte[1], Asta Kausaite-Minkstimiene[1]

[1]Vilnius University, Faculty of Chemistry and Geosciences, Institute of Chemistry, NanoTechnas - Center of Nanotechnology and Materials Science, Naugarduko St. 24, LT-03225 Vilnius, Lithuania.
aiste.krikstaponyte@chgf.vu.lt

A biosensor is a multicomponent analytical system designed to measure the concentration of a specific analyte. It consists of a biological recognition component selective for the analyte, a signal transducer, and a component responsible for signal processing and registration. Biosensors can be classified according to the biological recognition component employed, including enzymatic, immunological, or bacterial, as well as according to the analytical method used, such as optical, piezoelectric, or electrochemical techniques. Electrochemical biosensors are further divided into amperometric, potentiometric, conductometric, and other types. Among these, amperometric biosensors are considered one of the simplest types due to their straightforward operating principle. Amperometric enzymatic glucose biosensors based on glucose oxidase are widely used for monitoring blood glucose levels in patients with diabetes, as they are sensitive, exhibit a short response time, and do not require additional sample preparation. Nevertheless, they still exhibit some limitations, including interference effects and limited stability. To overcome these drawbacks and improve analytical performance, nanomaterials have attracted increasing attention. In particular, nanozymes, nanomaterials exhibiting enzyme-like catalytic activity, offer significant advantages over natural enzymes, as they are more stable, resistant to denaturation, less sensitive to environmental conditions, and easier to synthesize and modify.

In this work, metal nanoparticle-based peroxidase-like nanozyme was employed in the development of a nanozyme–enzyme-based glucose biosensor. The working electrode of the biosensor was fabricated by layer-by-layer modification of a graphite rod with trimetallic nickel–platinum–palladium nanoparticles, glucose oxidase, and an Aquivion® membrane. Furthermore, the electrode preparation and biosensor operating conditions were optimized, and the analytical performance of the developed biosensor was evaluated. The linear response range to glucose, as well as the limits of detection and quantification, were determined. The developed biosensor demonstrated good repeatability and reproducibility, high selectivity to glucose, and low interference from common electroactive substances. Moreover, sufficient storage stability and accurate glucose detection in real serum samples were achieved.

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