GLUCOSE BIOSENSOR FOR THE DETERMINATION OF CADMIUM IONS VIA ENZYME ACTIVITY INHIBITION: EFFECT OF GOLD NANOSTRUCTURES ON THE ANALYTICAL SIGNAL

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Cadmium (Cd^{2+}) is a highly toxic heavy metal that poses serious risks to human health and the environment, making rapid and reliable detection essential [1]. Electrochemical glucose biosensors based on glucose oxidase (GOx) are a well-established analytical platform. In this study, the same concept was applied to Cd^{2+} detection by exploiting the inhibitory effect of cadmium on GOx activity. The Cd^{2+} sensing principle is based on monitoring the decrease in electrochemical response during glucose oxidation in the presence of the soluble redox mediator phenazine methosulfate (PMS).

To enhance sensitivity toward Cd^{2+} induced inhibition, graphite rod (GR) electrodes were modified with gold nanomaterials: dendritic gold nanostructures (DAuNSs) and 13 nm gold nanoparticles (AuNPs), following GOx immobilization on the surface. The performance of the biosensor based on GR/DAuNSs/GOx electrode was compared with GR/AuNPs/GOx and GR/GOx (no nanomaterials). In all cases, Cd^{2+} decreased GOx activity, as evidenced by a reduced electrochemical signal, with the strongest signal suppression observed with DAuNS-modified electrodes. These results demonstrate that DAuNSs significantly improve the response of GOx-based biosensors for monitoring Cd^{2+} contamination, with potential applicability to other toxic metal ions.

Keywords: glucose oxidase, electrochemical biosensor, cadmium, inhibition, gold nanoparticles, dendritic gold nanostructures, PMS

[1] L. Anchidin-Norocel, G. Gutt, E. Tataranu, and S. Amariei, “Electrochemical sensors and biosensors : effective tools for detecting heavy metals in water and food with possible implications for children ’ s health,” Int. J. Electrochem. Sci., vol. 19, no. February, 2024, doi: 10.1016/j.ijoes.2024.100643