ORIGINAL ARTICLE   **OPEN ACCESS**

OPTIMIZATION AND KINETIC PARAMETERS OF METAL OXIDE NANOCOMPOSITE UREASE BASED BIOSENSOR PANI/ZnO/Urease FOR THE DETECTION OF HEAVY METAL IONS IN DRINKING WATER

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Abstract

Out of all the environmental issues, water pollution by heavy metal ion such as Mercury, Lead Arsenic, Cadmium, Chromium etc most important to be solved. Biosensors present an efficient alternative technique which can lead to the low-cost heavy metal ion detector along with the features such as no need of special training for an operator, easily disposable, quick detection and less time consumption. In the present work, we have developed electrochemical amperometric biosensor by immobilizing Urease, to Stainless steel transducer. The stainless-steel electrode was modified with PANI/ZnO nanocomposite by the method of electro polymerization. The electrochemical response of the constructed biosensors was studied in the phosphate buffer solution. Operational, storage, pH and temperature stabilities were determined by cyclic voltammetry with application of -0.3 V to 0.6 V at a scan rate of 50mV/s with respect to Ag/AgCl electrode. From the calibration curve it was observed that the biosensor shows good linearity in the range of 10 - 50 mM of Urea concentration. The minimum detection limit was found to be 4.953 mM/l. Thus the constructed biosensor shows low detection limit for urea which may be attributed to incorporation of nanostructured ZnO for immobilizing urease, which provides larger surface to volume ratio. The linear regression equation was $I(mA) = 0.599 \times [Urea\ Conc.] + 7.235$ with correlation coefficient (R^2) of 0.989. The sensitivity was found to be 0.599 mA/mM. The value of Michaelis–Menten constant ($K'm$) for Urease was obtained as $K'm = 0.018$ mM and maximum current (I_{MAX}) was found to be 83.33 mA. This $K'm$ value is lower than that for free enzyme (1.30 mM) indicating increased affinity of enzyme toward Urea after immobilization, which might be due to enhanced diffusion of Urea through PANI/ZnO/Urease surface.

Keywords: Biosensor, Metal oxide nanocomposites, Heavy Metal Ions, Calibration of biosensor