Paper ID: A207

Improved glucose biosensor based on Glucose oxidase-horseradish peroxidase/multiporous Tin oxide modified-electrode

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EXTENDED ABSTRACT

The fabrication of a crosslinked network of glucose oxidase-horseradish peroxidase/tin oxide (GOx-HRP/SnO_2), immobilized on glassy carbon electrode (GCE) and its utilization as a sensor for glucose detection has been reported. The 3-D network established with GOx-HRP/SnO_2 has possessed high sensitivity and stability by performing the electrocatalytic features in sensing of glucose. The turbidity of fabrication has been scanned and analyzed using UV-Vis Spectroscopy. The morphology and composition of the fabricated GOx-HRP modified multi-nanoporous SnO_2 nanofibers were characterized by scanning electron microscopy (SEM). Cyclic voltammetry and amperometry were used to study the proposed electrochemical biosensor. The effect of applied electrode potential, pH and the concentration of glucose on the sensitivity of the biosensor have been systemically investigated which indicates that these systems should be very useful for other sensing applications.

Nanostructured materials with different characteristics have been used for developing biosensors. However, among them SnO_2 nanomaterial is one of the very recently applied and a very few study has been conducted with that nanomaterial [1]. Nanostructured materials of SnO_2 exhibited great performance in solar cells because of its high electron mobility. Different types of SnO_2 nanomaterials have been used in solar cell as electron mobility enhancer and in different biosensors. Therefore, SnO_2 nanomaterial can be a great potential for the advancement of biosensor by increasing the electron transport.

In this work, we have presented a comparatively simple, rapid and inexpensive method for fabricating a uniform glucose oxidase (GOx)-horseradish peroxidase (HRP)/multi-porous tin oxide (SnO2) nanofibre modified glassy carbon electrode (GCE). The highly sensitive SnO2-GOx-HRP/GCE electrode was used to detect wide range of glucose by amperometry technique. In this scheme, glucose has been detected by cathodic reduction of hydrogen peroxide (H2O2) Horseradish peroxidase at lower overpotential in the range of −0.2V (versus Ag/AgCl). Based on this system, hydrogen peroxide produced from the glucose oxidation step by oxygen in presence of glucose oxidase is subsequently reduced by peroxidase. The generic reaction can be illustrated as the following reaction schemes:

$$\text{Glucose} + O_2 \quad (\text{GOD}) \quad \text{Gluconic acid} + H_2O_2$$

$$H_2O_2 + \text{HRP(red)} \rightarrow H_2O + \text{HRP(ox)}$$

The amperometric result showed that the fabricated sensor was performing well at regular interval. These results indicate that low detection limits for glucose were obtained due to the high electro-catalytic properties of the SnO2-GOD-HRP/GCE electrode.

Keywords: Multiporous SnO_2 nanofibre; Redox enzyme; Glucose Oxidase; Biosensor.

Acknowledgment
This study was supported by University Malaysia Pahang local research grant (RDU 1703176).

References
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