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Biosensing of catechol via amperometry using laccase immobilized nickel oxide/graphite modified screen-printed electrodes

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Abstract

In the present work, we have developed a modified screen-printed carbon electrode (SPE) based biosensor to detect catechol using nickel oxide/graphite (NiO/G) immobilized with laccase as bio-nanocomposite coating. The laccase immobilized NiO/G composite increased the effective Randles-Sevcik surface area from 0.034 cm^2 to 0.083 cm^2 compared to bare SPE, resulting in improved electrochemical activity and enhanced reversible catechol oxidation process. Impedance spectroscopic data for the modified SPE (MSPE) showed faster electron transfer than the bare counterpart suggesting the successful immobilization of the bio-nanocomposite onto the electrode surface. Consequently, the cyclic-voltammograms of laccase MSPE exhibited a sharp decrease in the peak-to-peak separation potential and an increase in the current responsiveness. We further, utilized the chronoamperometric method to quantify the catechol detection under optimal conditions, and found a linear biosensor response over the concentration region of 1–100 μM. The sensor's lower detection limit, response time, and sensitivity towards catechol were found to be 65 nM, 3 s, and 1.51 $\mu A \mu M^{-1} cm^{-2}$, respectively. These results suggest that the laccase immobilized NiO/G MSPE as one of the most promising customized electrodes for catechol biosensing.

Keywords

Biosensors; Modified Screen- Printed electrode; NiO nanocrystals; Amperometric sensing; Laccase enzyme

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