DOCTORAL THESIS

Amperometric biosensors utilizing carbon nanotubes and metal deposits on glassy carbon electrode with poly(phenylenediamine) coatings

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Amperometric Biosensors Utilizing Carbon Nanotubes and Metal Deposits on Glassy Carbon Electrode with Poly(phenylenediamine) Coatings

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Abstract

This work focuses on the application of metal deposits and carbon nanotubes in the research of biosensors with non-conducting poly(phenylenediamine) (PPD) coatings. Different PPD films, namely P*o*PD, P*m*PD, and P*p*PD, have been utilized for enzyme immobilization on various electrode materials including metal deposit, glassy carbon, and carbon nanotubes.

Electrooxidation of different isomers of phenylenediamine (*ortho*-, *para*-, and *meta*-) on a palladium electrode and the permeability characteristics of the electrochemically formed PPD films have been investigated. The permeability and permselectivity of various analytes on PPD films, including H_2O_2, ascorbic acid, uric acid, acetaminophen, and cysteine, have been compared. The results suggest that the electropolymerization techniques (cyclic voltammetric and potentiostatic) would affect the permeability of PPD films. Other experimental conditions, such as electropolymerization potential, electropolymerization time, have also been studied.

Palladium and platinum black layers have been deposited on glassy carbon electrode for construction of glucose biosensor. The porous metal deposit layers have large surface area, which is beneficial for enzyme loading and H_2O_2 electrooxidation. Good anti-interference performance towards ascorbic acid, uric acid, acetaminophen, and L-dopamine is observed due to the utilization of PPD film. Experimental conditions for biosensor preparation and detection, such as metal deposition time, concentration of monomer and enzyme, electropolymerization potential, operation potential, etc., have been investigated.

Enhanced electrocatalytic reduction of dissolved oxygen at multi-walled carbon nanotube (MWCNT) in neutral media has been reported. The catalytic

behavior makes it eligible to serve as an oxygen-sensitive electrode for the construction of oxidase-based biosensors. Glucose oxidase and lactate oxidase have been immobilized onto MWCNT modified glassy carbon with electropolymerized PPD film. The determination of glucose and L-lactic acid can be carried out by monitoring H_2O_2 production and oxygen consumption. Better determination performance, such as higher sensitivity and better anti-interference ability, can be obtained when the oxygen consumption approach is employed.

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