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Glucose biosensors based on poly (*o*-aminophenol)

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Introduction

Poly(*o*-aminophenol) (POAP) synthesized in acid medium is a ladder polymer whose redox reaction was considered as an internal conversion between oxidized and reduced units.[1] The redox conversion of POAP must be accompanied by the proton exchange between the polymer and the solution. Despite a great number of studies reported in the literature about POAP synthesized in acidic media,[1] there is relatively little work that has been reported about the electrochemistry of POAP in neutral and alkaline solutions.[2] POAP formed in neutral media leads to a non conducting film that exhibits some advantages over the conducting film formed in acidic media. These characteristic properties of POAP synthesized in neutral media (thickness uniformity and compactness, and low permeability) have practical applicability. POAP has usefully been employed in the development of different types of sensors, mainly biosensors based on immobilized enzymes.[3] The development of glucose biosensors has received considerable attention because the determination of glucose concentration is very important in clinical applications. Most glucose measurements are based on the immobilization of glucose oxidase (GOx) for detecting hydrogen peroxide concentration, which is produced from the GOx enzyme reaction. Several glucose biosensors based on POAP are reported in the literature.[4–9] In most cases, hydrogen peroxide liberated by the enzymatic reaction is detected by measuring its oxidation current on the base electrode material (platinum, gold, glassy carbon, carbon paste, etc.). The amperometric response characteristics of the enzyme electrodes based on POAP are affected by the polymerization cycle number, the *pH* of the detection solution, applied potential used in the determination, and the presence of electroactive (interfering) compounds. The maximum value of the response current for POAP was obtained for a polymerization cycle number about 15. The compactness of POAP synthesized at a small number of potential cycles prevents the diffusive penetration of dissolved oxygen.[9] However, thick films show a long response time and low sensitivity, but result in a wider linear response range. It has been suggested that when the number of cycles is lower than 15, then the amount of enzyme entrapped in the POAP film gradually increases with the increase of the polymerization cycle number. However, when the number of cycles is higher than 15, the amount of GOx incorporated into POAP films decreases. In respect to *pH*, the response current of the sensors[5] increases with the increase of the *pH* value, and the maximum response was observed at *pH* 7.0.

The maximum current at *pH* 7.0 was attributed to the entrapment of GOx in the POAP film, which made GOx more active in neutral solution. The response current of most glucose biosensors based on POAP[4–6,] increases rapidly with the increase of the applied potential up to 0.75 V (*vs*. SCE), and then, the response current remains constant. This effect was explained by the rate-limiting process of enzyme kinetics and substrate diffusion. With regard to the effects of interferents, the magnitude of the interferent current (I_{G+I}) relative to the analytical signal (I_G) produced by the analyte (glucose) was considered in different biosensors.[4–6] The interferences of electroactive compounds in the glucose response were examined in the presence of their physiological normal levels (0.1mM ascorbic acid (AA), 0.5mM uric acid (UA) and 0.1mM acetaminophen (AMP)) with a glucose concentration of 5.6mM. It was observed that the influence of AA, UA and AMP on the glucose response was always small under the testing conditions. With regard to stability under storage conditions (phosphate buffer of *pH* 7 at low temperature), it was analyzed for most of the glucose biosensors based on POAP. After 7 days, an 8% loss of the response signal was observed for every day of use.[5] However, 80% response current was retained after 20 days. In respect to reproducibility, the results revealed that the sensors exhibit satisfactory reproducibility with a mean change of the response current of 12.6nA and a relative standard deviation of 4.32%. Most of biosensors[5] showed good characteristics, such as high sensitivity (171.2 nA mM^{-1}), low detection limit (3.6 µM), wide linear range (up to 8mM) and short response time (within 6 s). The stability of the sensors[7] was evaluated by repetitive (200 times) measurements of its response to 1mM glucose within a period of 10 h. The sensor sensitivity loss was only 14.3% after the 200 measurements. Human plasma samples were assayed to demonstrate the practical use of biosensor based on POAP.[5] The results obtained agreed closely (relative error between 1% and 3%) with those obtained employing other biochemical methods.

Acknowledgments

None.

Conflicts of interest

Author declares that there is no conflicts of interest.

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