Enhanced chemical stability and electrochemical sensing properties of glucose sensors hybridized with titania

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Abstract

Recently, much interest in the micro-scale and high-performance biosensors for the rapid and precise glucose sensing has been raised due to the increase in diabetes incidences. Effective immobilization of glucose oxidase (GOD) using a polymer is one of the key issues in the biosensor industry. Among conducting polymers, pyrrole is a suitable one for the micro-biosensor fabrication since it can be selectively polymerized onto a micro-electrode in a mild condition using electropolymerization. However, due to swelling problem during application this system shows weak immobilization of glucose oxidase, resulting in short-term stability and decreasing sensitivity. In this study glucose oxidase was entrapped in titania-pyrrole hybrid during electropolymerization and sensor fabrication was performed in a near neutral condition to prevent degradation of the enzyme. Scanning electron microscopy (SEM) and energy dispersive x-ray spectroscopy (EDS) analyses showed that glucose oxidase and titania were homogeniously dispersed in the hybrid matrix. The hybridized pyrrole-titania matrix was highly effective in the prevention of enzyme from leaking out of the electrode surface for long-term use. The composition of titania, pyrrole, and glucose oxidase was varied to obtain high chemical stability and appropriate sensor properties. Amperometirc experiments were carried out with variation in temperature and pH, and various sensor properties were evaluated.