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Development of Enzymatic Amperometric Biosensors with Carbon Nanotubes Decorated with Iron Oxide Nanoparticles

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Abstract : Carbon nanotubes (CNTs) and other graphitic nanostructures are materials with extraordinary physical, physicochemical and electrochemical properties which are being aggressively investigated for a variety of sensing applications. Thus, sensing of biological molecules such as proteins, DNA, glucose and other enzymes using either single wall or multiwall carbon nanotubes (MWCNTs) has been widely reported. Despite the current progress in this area, the electrochemical response of CNTs used in a variety of sensing arrangements still needs to be improved. An alternative towards the enhancement of this CNTs' electrochemical response is to chemically (or physically) modify its surface. The influence of the decoration with iron oxide nanoparticles in different types of MWCNTs on the amperometric sensing of glucose, urea, and cholesterol in solution is investigated. Commercial MWCNTs were oxidized in acid media and subsequently decorated with iron oxide nanoparticles; finally, the enzymes glucose oxidase, urease, and cholesterol oxidase are chemically immobilized to oxidized and decorated MWCNTs for glucose, urease, and cholesterol electrochemical sensing. The results of the electrochemical characterizations consistently show that the presence of iron oxide nanoparticles decorating the surface of MWCNTs enhance the amperometric response and the sensitivity to increments in glucose, urease, and cholesterol concentration when compared to non-decorated MWCNTs.

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