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Comparative Electrochemical Studies of Enzyme-Based and Enzyme-less Graphene Oxide-Based Nanocomposite as Glucose Biosensor

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Abstract : Graphene oxide provides a good host matrix for preparing nanocomposites due to the different functional groups attached to its edges and planes. Being biocompatible, it is used in therapeutic applications. As enzyme-based biosensor requires complicated enzyme purification procedure, high fabrication cost and special storage conditions, we need enzyme-less biosensors for use even in a harsh environment like high temperature, varying pH, etc. In this work, we have prepared both enzyme-based and enzyme-less graphene oxide-based biosensors for glucose detection using glucose-oxidase as enzyme and gold nanoparticles, respectively. These samples were characterized using X-ray diffraction, UV-visible spectroscopy, scanning electron microscopy, and transmission electron microscopy to confirm the successful synthesis of the working electrodes. Electrochemical measurements were performed for both the working electrodes using a 3-electrode electrochemical cell. Cyclic voltammetry curves showed the homogeneous transfer of electron on the electrodes in the scan range between -0.2V to 0.6V. The sensing measurements were performed using differential pulse voltammetry for the glucose concentration varying from 0.01 mM to 20 mM, and sensing was improved towards glucose in the presence of gold nanoparticles. Gold nanoparticles in graphene oxide nanocomposite played an important role in sensing glucose in the absence of enzyme, glucose oxidase, as evident from these measurements. The selectivity was tested by measuring the current response of the working electrode towards glucose in the presence of the other common interfering agents like cholesterol, ascorbic acid, citric acid, and urea. The enzyme-less working electrode also showed storage stability for up to 15 weeks, making it a suitable glucose biosensor.

Keywords : electrochemical, enzyme-less, glucose, gold nanoparticles, graphene oxide, nanocomposite
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