Characterization of a Biosensor for Biomedical Applications

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A biosensor is an analytical device that consists of a physical element and a biological element on a solid state surface. The biological element is a layer of biological molecules responsible for biological recognition, such as receptors, enzymes, peptides, single stranded DNA or even living cells. Enzymes can be immobilized at the surface of the transducer by adsorption, covalent attachment, entrapment in a gel or electrochemically generated polymer, in bi-lipid membranes or in solution behind a selective membrane. Enzymatic biosensors are fabricated by immobilization of different types of enzymes onto the surface of the biocompatible sensing material, which is selected according to the target molecule. Glucose oxidase (GOD) is the most commonly employed enzyme in glucose biosensors because of its high selectivity to glucose molecules. This project concentrates on the fabrication and characterization of a zinc oxide (ZnO) thin film based enzymatic biosensor for glucose concentration detection.

Fabrication of the biosensor:

For the biosensor fabrication, first a GOD stock solution was prepared. 10 mg/mL GOD was dissolved in phosphate buffered saline (PBS) at pH 7.4 and kept stirring for 24 h.

Fresh glucose oxidase solution was prepared by using PBS at pH 7. In order to immobilize glucose oxidase on ZnO substrate, about 8 µl of glucose oxidase (optimized concentration) was drop casted and allowed to dry at room temperature.

Characterization of the biosensor:

Six samples with different thickness of the ZnO thin film were fabricated. Test solutions of glucose with glucose/DD water ratios of 1:10 and 1:20 were prepared and used with the samples to study the response of the sensor. I-V curves of the six samples with and without glucose were investigated using cyclic voltammetry for the oxidation and reduction current with the applied voltage. The sensors showed a very good variation in the current for varying concentrations of glucose. The sensors were subjected to varying voltages and their current responses were recorded. The samples showed variation in their current measurements with changing concentrations of glucose indicating sensitivity towards glucose.

Current-voltage variations of the sensor sample 6, with and without glucose: