Self-Powered biosensor towards glucose diagnostic in Point-of-Care

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ABSTRACT

Monitoring blood glucose levels is of great importance, especially for people at high risk of developing diabetes. To this end, an innovative biosensor device has been developed that uses a miniaturized and membraneless enzymatic fuel cell (EFC) as an electrical reader box for diabetes diagnosis at the point-of-care. Gold screen-printed electrodes (Au-SPE) were modified with the enzyme glucose oxidase (GOx), which is used as a glucose-consuming biocatalyst at both the anode and the cathode of the EFC. The enzyme was immobilized in a cathode based on graphene oxide/prussian blue nanocubes (GO/PBNCs) and in an anode based on a biographene layer. Hydrogen peroxide, a product of the enzymatic conversion of glucose, was electrocatalytically reduced by using PBNCs at the cathode. In parallel, glucose oxidation catalyzed by oxygen-mediated glucose oxidase took place at the anode.

The analytical performance was evaluated separately for both electrode systems. The combination of the two electrodes resulted in an EFC with an output power for glucose of 5 mM (close to physiological conditions) of approximately (1.8 μW/ cm^{-2}).

This proposed self-powered biosensor opens the door for a fully autonomous biosensor device that can be used for any target analyte at room temperature and using the oxygen present in the air, thus enabling diagnosis anywhere.

Keywords:

Enzymatic Fuel Cell, Glucose oxidase, glucose, biographene, Prussian blue Nanocubes.