Glucose Biosensor Based on Glucose Oxidase Immobilized on Multi-Vacancy TiO₂ Nanotube Arrays

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TiO₂ nanotube arrays (TNAs) are promising low-cost biosensor materials due to their large specific surface area and catalytic activity. Nevertheless, the detection efficiency of TNAs enzymatic glucose biosensors is affected by the amount of glucose oxidase adsorbed and the rate of electron transport. Here, we reveal that the adsorption capacity and electron transport rate of TNAs can introduce more active sites by annealing under an argon atmosphere to form oxygen vacancies, resulting in the generation of highly active surfaces and a significant improvement in the adsorption and conductivity properties. These manufactured highly active TNAs enzymatic glucose biosensors exhibit good electrochemical performance for the oxidation of glucose with a sensitivity of 8.5 $\mu\text{A}\cdot\text{mM}^{-1}\cdot\text{cm}^{-2}$, and a detection limit as low as 3.2 μM . Our study represents a simple method for the preparation of highly stable and selective TNAs enzymatic glucose biosensors by defect engineering, providing a novel concept for the manufacture of other enzyme biosensors.

Keywords: TiO₂ nanotube arrays, defect engineering, biosensor, electrochemical determination

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