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Single-use nonenzymatic glucose biosensor based on CuO nanoparticles ink printed on thin film gold electrode by micro-plotter technology

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Abstract

We reported a single-use non-enzymatic glucose biosensor based on a printed CuO nanoparticles film on thin gold film electrode. This three-electrode configuration biosensor consisted of a thin gold film (10 nm) working and counter electrodes and a thick-film printed Ag/AgCl reference electrode. The biosensor was fabricated on a polyethylene terephthalate (PET) substrate. CuO nanoparticles with an average particle size of ~7 nm were synthesized by a one-step precipitation approach, formulating an aqueous-based nanoparticles ink. A CuO nanoparticles square area of 0.9x0.9 mm^2 was printed on thin film Au working electrode (φ=1.4 mm) of the biosensor by micro-plotter technology. The remarkable resolution and dimensional accuracy of micro-plotter printing technology resulted in a better development of nano-catalyst biosensors compared to conventional ink-jet printing or other techniques. X-ray Photoelectron Spectroscopy (XPS) and Transmission Electron Microscopy (TEM) were used to characterize the printed biosensor. Field Emission Scanning Electron Microscopy (FESEM) characterizations of the copper oxide printed features showed a nano-porous morphology together with high printing resolution. Cyclic Voltammetry (CV) and chronoamperometry (CA) measurements revealed the considerable electro-catalytic performance of the printed biosensor having high sensitivity (2419.8 μA $mM^{-1}cm^{-2}$), acceptable stability and excellent interference rejection against ascorbic acid (AA), uric acid (UA), dopamine (DA), lactose, mannose and maltose. Interference rejection studies were performed in undiluted human serum to verify the functionality of the sensor for real samples. The developed biosensor showed a linear response toward glucose in the range of 0.1 to 6.5 mM. The lower detection limit of the biosensor was measured as 0.5 μM glucose. This study suggested a high performance robust glucose biosensor not only suitable for biomedical single-use *in-vitro* application but also for long-term glucose monitoring in industrial processes.

Keywords: glucose; printed sensor; copper oxide; flexible electrode