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ZnO nanorods modified with copper nanoclusters for non-enzymatic glucose sensing applications

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Given the high chemical stability, ease of fabrication and favorable electrical and physical properties of ZnO, its nanostructures are being extensively investigated for non-enzymatic glucose sensing. In this work, thin films of ZnO nanorods (NR) were electrochemically deposited on ITO substrates and then Cu nanoclusters were added through co-electrochemical deposition by varying $CuCl_2$ concentration in an electrolyte containing 5 mM $ZnCl_2$ and 0.1 M KCl. Scanning electron microscopy confirmed that the fabricated thin films contained vertically aligned ZnO NRs having hexagonal facets with cross dimensions ~200 nm and height ~1 µm. The span of the deposited Cu NP clusters were shown to be around ~100 nm. Energy dispersive X-ray spectra further supported that no impurities were introduced to the films during Cu nanocluster deposition. Cyclic voltammetry measurements revealed that the glucose oxidation potential was ~+0.6 V with respect to the reference electrode (Ag/AgCl). Subsequent chronoamperometric measurements were performed at +0.6 V in a 0.1 M NaOH solution with successive addition of different glucose solutions having 200 nM, 1 mM, 5 mM and 10 mM. The optimum sensor performance was obtained for ZnO NR electrodes with Cu NP clusters obtained using 0.5 mM $CuCl_2$. The sensitivity, lower detection limit and the linear range were 142 µA mM^{-1} cm^{-2}, 130 nM and (130 nM - 5,968 µM) respectively. Additionally, electrodes showed good stability, faster response (~4 s) and favorable selectivity for glucose when tested in the presence of interfering agents such as ascorbic acid, uric acid, citric acid and NaCl making this material a novel candidate for non-enzymatic glucose sensing.

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