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Nanostructured ZnO-based biosensor: DNA immobilization and hybridization

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Abstract

An electrochemical DNA biosensor was successfully fabricated by using (3-aminopropyl) triethoxysilane (APTES) with zinc oxide (ZnO) nanorods synthesized using microwave-assisted chemical bath deposition method on thermally oxidized SiO_2 thin films. The structural quality and morphology of the ZnO nanorods were determined by employing scanning electron microscopy (SEM) and X-ray diffraction (XRD), which show a hexagonal wurtzite structure with a preferred orientation along the (101) direction. The surface of the SiO_2 thin films was chemically modified with ZnO. Label-free detection DNA immobilization and hybridization were performed using potassium hexacyanoferrate with cyclic voltammetry (CV) measurements. The capacitance, permittivity, and conductivity profiles of the fabricated sensor clearly indicate DNA immobilization and hybridization. Results show that the capacitance values of bare, ZnO- modified surface immobilization, and target DNA hybridization were 46×10^{-12} F, 47×10^{-8} F, 27 μF, and 17 μF, respectively, at 1 Hz. The permittivity measurement increased from 3.94×10^3 to 251×10^3 and 165×10^3 at the frequency

range of approximately 200 to 1 Hz for bare and DNA immobilization and hybridization, respectively. The measured conductivity values for the bare, ZnO, immobilized, and hybridization device were 2.4×10^{-9}, 10×10^{-8}, 1.6×10^{-7}, and 1.3×10^{-7} S cm^{-1}, respectively.

Keywords

Zinc oxide, Biosensor, Capacitance, Permittivity, Conductivity