Highly sensitive and selective label free immunosensor based on GO/PEDOT-PSS decorated with AuNPs for precise detection of Mycotoxin

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ABSTRACT

We have explored spherical AuNPs anchored GO modified PEDOT-PSS based bioelectrode for sensing mycotoxin (especially, Aflatoxin B_1). Synthesis of PEDOT-PSS over ITO electrode was carried out by adapting simple electrochemical polymerization technique in presence of GO as dopant. Further, uniform distribution of AuNPs on the surface of GO/PEDOT-PSS/ITO electrode was achieved by electrochemical layer-by-layer deposition method. Using glutaraldehyde as a covalent linker, the mouse IgG antibody was covalently immobilized over the surface of the prepared electrode. Structural and morphological characterization of the synthesized electrodes were carried out through XRD and FESEM; respectively. Electrochemical characterization, namely Cyclic Voltammetry and Impedance spectroscopy were employed to investigate electroactive properties after each process steps of sensor fabrication. Using single frequency capacitance transient measurements at 77 Hz and 1 kHz, different concentrations of analyte (anti-Aflatoxin B_1 derived from mouse) interaction with antibody were monitored. The proposed immunosensor exhibited high selectivity with a response of 8.3125 nF ng^{-1}mL within the concentration range of 18.18 to 300 ng mL^{-1} at 77 Hz and 1.2038 nF ng^{-1}mL within the range 18.18-291.42 ng mL^{-1} at 1 kHz towards detection of Aflatoxin B_1. The respective LODs were estimated to be, 67.8 ng mL^{-1} (452 pM), and 62.5 ng mL^{-1} (416 pM) at 77 Hz and 1 kHz. Adoption of electrochemical sensor design can offer a fast, reliable, and efficient strategy for sensing mycotoxins in specific food items (peanut, maize, mushroom etc.) prior human consumption.

Keywords: Electrochemical polymerization, composite electrode, transient capacitance, Aflatoxin B_1, Immunosensor