Fabrication of graphene/gold-modified screen-printed electrode for detection of carcinoembryonic antigen

ABSTRACT

Immunosensors based on gold nanoparticles and reduced graphene oxide (AuNPs/rGO)-modified screen-printed electrodes (SPEs) were successfully synthesized using an electrochemical deposition method. The modified SPEs were characterized using a field emission scanning electron microscope (FESEM) and Raman spectroscopy to analyze the morphology and composition of AuNPs and rGO. Both the FESEM and Raman spectroscopy revealed that the AuNPs were successfully anchored on the thin film of rGO deposited on the surface of the SPEs. Characterization with a ferri–ferrocyanide couple [$Fe(CN)_6^{3-/4-}$] showed that the electron transfer kinetic between the analyte and electrode was enhanced after the modification with the AuNPs/rGO composite on the electrode surface, in addition to increasing the effective surface area of the electrode. The modified SPE was immobilized with a sandwich type immunosensor to mimic the ELISA (enzyme-linked immunosorbent assay) immunoassay. The modified SPE that was fortified with the sandwich type immunosensor exhibited double electrochemical responses in the detection of carcinoembryonic antigen (CEA), with linear ranges of 0.5–50 ng/mL and 250–2000 ng/mL and limits of detection of 0.28 ng/mL and 181.5 ng/mL, respectively.

Keyword: Biosensor; Electrochemistry; Gold nanoparticles; Graphene; Screen-printed electrode