Development of PPy-M Composites Materials for Sensor Application

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Abstract : The rapid growth of science and technology in energy and environmental fields has enlightened the substantial importance of the conducting polymer and metal composite materials engineered at nano-scale. In this study, polypyrrole-cobalt composites (PPy-Co Cs) and polypyrrole-nickel oxide composites (PPy-NiO Cs) were prepared by a simple and facile chemical polymerization method with an aqueous solution of pyrrole monomer in the presence of metal salt. These composites then fabricated into non-enzymatic hydrogen peroxide (H2O2) and glucose sensor. The morphology and composition of the composites are characterized by the Field Emission Scanning Electron Microscope, Fourier Transform Infrared Spectrum and X-ray Powder Diffraction. The obtained results were compared with the pure PPy and metal oxide particles. The structural and morphology properties of synthesized composites are different from those of pure PPy and metal oxide particles, which were attributed to the strong interaction between the PPy and the metal particles. Besides, a favorable micro-environment for the electrochemical oxidation of H2O2 and glucose was achieved on the modified glassy carbon electrode (GCE) coated with PPy-Co Cs and PPy-NiO Cs respectively, resulting in an enhanced amperometric response. Both PPy-Co/GCE and PPy-NiO/GCE give high response towards target analyte at optimum condition of 500 µl pyrrole monomer content. Furthermore, the presence of pyrrole monomer greatly increases the sensitivity of the respective modified electrode. The PPy-Co/GCE could detect H2O2 in a linear range of 20 µM to 80 mM with two linear segments (low and high concentration of H2O2) and the detection limit for both ranges is 2.05 µM and 19.64 µM, respectively. Besides, PPy-NiO/GCE exhibited good electrocatalytic behavior towards glucose oxidation in alkaline medium and could detect glucose in linear ranges of 0.01 mM to 0.50 mM and 1 mM to 20 mM with detection limit of 0.33 and 5.77 µM, respectively. The ease of modifying and the long-term stability of this sensor have made it superior to enzymatic sensors, which must kept in a critical environment.

Keywords : metal oxide, composite, non-enzymatic sensor, polypyrrole
Conference Title : ICAMST 2016 : International Conference on Advanced Materials Science and Technology
Conference Location : Venice, Italy
Conference Dates : April 11-12, 2016