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Solution-processed PEDOT: PSS/graphene composites as the electro-active paper for biosensor application

Saurabh Kumar[1], **Suveen Kumar**[1], **Shine Augustine**[1], **Birendra K Yadav**[2], **Jai G Sharma**[1], **Dinesh C Doval**[2] and **Bansi D Malhotra**[1]
[1]Delhi Technological University, India
[2]Rajiv Gandhi Cancer Institute and Research Centre, India

Composites of poly (3, 4-ethylenedioxythiophene): poly (styrenesulfonate) (PEDOT: PSS) and reduced graphene oxide (rGO) have been prepared by solution mixing and applied as electro-active paper. The effect of different solvent on conductivity was investigated; conductivity increased with treatment of electro-active paper with ethylene glycol by more than 250 times. Other solvents like methanol and H2SO4 were also used to treat the PEDOT: PSS/rGO based electro-active paper and showed inferior conductivity enhancement compared to ethylene glycol. The result provide direct evidence that the improvement in electric conductivity on paper substrate by ethylene glycol is mainly caused by conformational rearrangement in the polymer and ordering of PEDOT fibre over electro-active paper. Reduce graphene oxide increased the electrochemical properties of electro-active paper, probing by Fe(CN)63-/4- redox species using electrochemical impedance spectroscopy and chronoamperometry method. This electrochemical behavior makes the ethylene glycol-treated PEDOT: PSS/rGO paper electrode (electro-active paper) a promising platform for low cost electrochemical biosensor. The results of electrochemical response studies conducted onto anti-CEA (carcinoembryonic antigen) immobilized electro-active paper for human carcinoembryonic antigen (CEA) detection, reveals high sensitivity of 25.8 μA ml ng-1 in a physiological range, 1-10 ng ml-1.

sau2203@gmail.com

A rare earth metal oxide based electrochemical immunosensor for non-invasive oral cancer detection

Shweta Panwar, Suveen Kumar, Saurabh Kumar, Shine Augustine and **Bansi D Malhotra**
Delhi Technological University, India

We propose a label free, non-invasive and efficient immunosensing platform to investigate an oral cancer biomarker (CYFRA-21-1) that is secreted in saliva sample. For the fabrication of this immunosensor, Yttrium Oxide (Y_2O_3) was used as an interfacing material synthesized through hydrothermal process. Further, 3-aminopropyl triethoxy silane (APTES) was used to functionalize Y_2O_3 nanoparticles. Electrophoretic deposition technique was used to deposit functionalized Y_2O_3 (i.e., APTES/Y_2O_3) on indium tin oxide coated glass (ITO) electrode at 50 V for 60 sec. For efficient covalent immobilization of anti-CYFRA-21-1 on APTES/Y_2O_3/ITO, EDC/NHS chemistry was utilized. Synthesized nanostructured Y2O3 and immunoelectrode was characterized by X-ray diffraction (XRD), atomic force microscopy (AFM), fourier transform infrared spectroscopy (FT-IR), scanning electron microscopy (SEM) and cyclic voltammetry (CV) techniques. The electrochemical response studies reveal that the immunosensor can be used to estimate CYFRA-21-1 biomarker in a wide linear detection range (2 to 22 ng mL^{-1}), has high sensitivity (9.8×10^{-3} mA mL ng^{-1} cm^{-2}) and remarkable lower detection limit (0.218 ng mL^{-1}) with shelf life of up to 7 weeks. The results of these studies have been validated via enzyme linked immunosorbent assay (ELISA). The results of these studies reveal the efficacy of the BSA/anti-CYFRA-21-1/APTES/Y_2O_3/ITO platform as a high throughput compact biosensing device for investigating CYFRA-21-1 biomolecules.

shwetapanwar086@yahoo.com