

Preparation, morphologic and electrochemical characterization of TiO₂NP-Au NP-poly (Nile Blue)/deep eutectic solvent modified SPCE

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Abstract

In recent years, metal nanoparticles with extraordinary conductivity, large surface-to-volume ratio, and biocompatibility have been widely used to develop new electrochemical sensing platforms and improve their performance¹. The use of redox polymers such as poly(Nile blue) (PNB), and nanoparticles together create a synergistic effect and increase the performance of the sensor². In this study, screen-printed carbon electrodes (SPCEs) were modified with titanium (IV) oxide nanoparticles (TiO₂NP), gold nanoparticles (AuNP) and PNB-deep eutectic solvent (PNB_{DES}) and, for use as disposable electrochemical sensors, followed by morphological and electrochemical characterizations. A layer-by-layer method was applied for the modification of TiO₂NP on the working electrode (WE) of SPCE. AuNP was deposited on the WE of SPCE/ TiO₂NP by cyclic voltammetry (CV) method (-1.3 V to -0.2 V, 50 mV.s⁻¹, 10 cycles). 1 mM Nile blue was prepared in 50 mM pH 6 PBS and deep eutectic solvent DES (1:9 ratio). PNB films were electropolymerized on the SPCE/TiO₂NP/AuNP electrode by 15 cycling potential, in the potential range from -0.6 to +1.2 V at a scan rate of 50 mV s⁻¹. The preparation stage of the SPCE/TiO₂NP/AuNP/PNB_{DES} sensor is given in Figure 1. Morphological characterizations of the SPCE/TiO₂NP/AuNP sensor were performed with Scanning Electron Microscopy (SEM) and electrochemical characterizations were carried out with CV, differential pulse voltammetry (DPV) and electrochemical impedance spectroscopy (EIS) techniques in 5 mM K₃Fe(CN)₆/K₄Fe(CN)₆ (1 M KCl) solution. The charge transfer between TiO₂NP and AuNP, and the synergistic effect between PNB and nanoparticles were observed, therefore it was concluded that it increased electronic conductivity. The SPCE/TiO₂NP/AuNP/PNB_{DES} electrode can be used to detect electroactive substances.

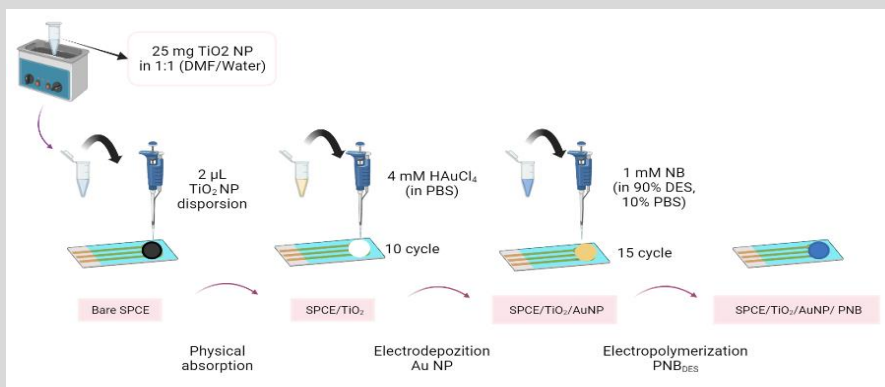


Figure 1. The preparation steps of the electrode

Keywords: titanium dioxide nanoparticles, poly(Nile blue), gold nanoparticles, deep eutectic solvents, screen-printed carbon electrode

References

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