Preparation, morphological and electrochemical characterizations of poly(Toluidine blue)-deep eutectic solvent/gold nanoparticle modified screen-printed carbon electrode

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Abstract

Toluidine blue (TB) is a redox polymer which has electrocatalytic and fast charge transfer properties. Despite these excellent properties, polymers synthesized electrochemically in aqueous solution can be unstable and, leave from the electrode surface, reducing the sensing performance of the sensor. Despite these excellent properties, polymers synthesized electrochemically in aqueous solution can be unstable and detach from the electrode surface, thus the sensing performance of the sensor is decreases. To overcome the limitations in aqueous solutions, anhydrous systems such as deep eutectic solvents (DES) have been used in recent years [1]. In this study, screen-printed carbon electrodes (SPCEs) were modified with poly (toluidine blue)-deep eutectic solvent (PTB_{DES}) and gold nanoparticles (AuNP) for use as disposable electrochemical sensors, followed by morphological and electrochemical characterizations. First, electropolymerization of TB was performed on the working electrode (WE) of SPCEs. TB was prepared in DES ethalin (ethylene glycol: choline chloride 1:2) solution in 50 mM pH 8.0 phosphate buffer (PBS) in 0.1 M KCl and 0.1 M KNO_3. Electropolymerization of 1 mM TB in 90% DES etalin solution and 10% PBS (-0.6 V to +1.0 V, 100 $mV.s^{-1}$, 30 cycles) was applied by the cyclic voltammetry (CV) method. Then, AuNP was deposited on the WE of SPCE/PTB_{DES} by CV method (-1.3 V to -0.2 V, 50 mV.s-1, 10 cycles). The preparation steps of the electrode are shown in Figure 1. The morphological characterizations of the modified SPCEs were carried out by scanning electron microscope (SEM), and electrochemical characterizations were applied by CV, differential puls voltammetry (DPV) and electrochemical impedans spectroscopy (EIS) techniques in 5 mM $K_3Fe(CN)_6/K_4Fe(CN)_6$ (1 M KCl) solution. It was concluded that PTB_{DES} and AuNP showed a synergistic effect and increased electronic conductivity. The SPCE/PTB_{DES}/AuNP electrode can be used sensors and biosensors as transducer.

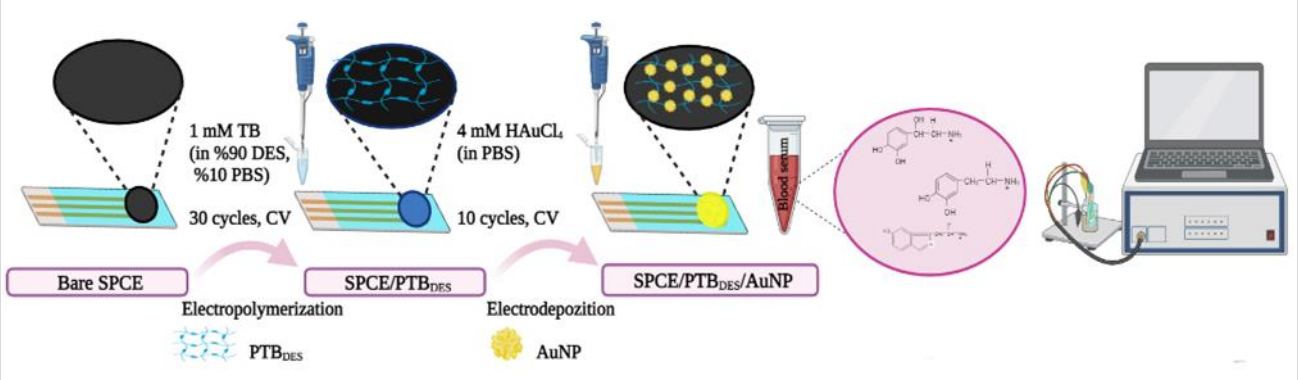

Figure 1. The preparation steps of the electrode

Keywords: *Screen printed electrode, deep eutectic solvents, poly(toluidine blue), gold nanoparticles*

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References

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