

# Preparation, morphologic and electrochemical characterization of poly (methylene blue)-deep eutectic solvent / ZnONR-AuNP modified SPCE

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## Abstract

Methylene blue (MB) is a cationic phenazine dye that is also a good redox mediator. The presence of electron-rich sulfur and nitrogen atoms in the MB structure enables it to dissolve in water [1]. In this study, screen-printed carbon electrodes (SPCEs) were modified with zinc oxide nanorod (ZnONR), poly (methylene blue)-deep eutectic solvent (PMB<sub>DES</sub>) and gold nanoparticles (AuNP) for use as disposable electrochemical sensors, followed by morphological and electrochemical characterizations. Firstly, zinc oxide nanorods (-1.0 V, 60°, 80 rpm, 2400 sec, closed system) were modified on the working electrode (WE) of SPCEs by the amperometric method. Electropolymerization of MB was performed on the SPCE/ZnONR electrode. To this firstly, the solution of DES ethalin (ethylene glycol: choline chloride 1:2) and 50 mM pH 8.0 phosphate buffer (PBS), in 0.1 M KCl and 0.1 M KNO<sub>3</sub>, was prepared. Then, the solution of 1 mM MB was prepared blue in 90% DES ethalin and 10% PBS and, was electrochemically polymerized by the cyclic voltammetry (CV) method (-0.6 V to +1.0 V, 100 mV.s<sup>-1</sup>, 30 cycles). Finally, AuNP was deposited on the WE of SPCE/ZnONR/PMB<sub>DES</sub> by CV method (-1.3 V to -0.2 V, 50 mV.s<sup>-1</sup>, 10 cycles). The preparation stage of the SPCE/ZnONR/PMB<sub>DES</sub>/AuNP sensor is given 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 pulse voltammetry (DPV) and electrochemical impedance spectroscopy (EIS) techniques in 5 mM K<sub>3</sub>Fe(CN)<sub>6</sub>/K<sub>4</sub>Fe(CN)<sub>6</sub> (1 M KCl) solution. It was concluded that ZnONR, PMB<sub>DES</sub>, and AuNP showed a synergistic effect and increased electronic conductivity. The SPCE/ZnONR/PMB<sub>DES</sub>/AuNP electrode can be used to detect electroactive substances such as serotonin, dopamine, ascorbic acid, NADH, and uric acid.



**Figure 1.** The preparation stage of the SPCE/ZnONR/PMB<sub>DES</sub>/AuNP sensor

**Keywords:** ZnO-nanorod, deep eutectic solvents, methylene blue, gold nanoparticles, screen-printed carbon electrode

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## References

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