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Full Paper

Electrochemical Measurement of B-Nicotinamide Adenine Dinucleotide by ZrO₂ Modified Carbon Paste Electrode

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Abstract- In this research, the electrochemical performance of carbon paste electrode modified with 4-(3,5-dimethyl-1,4,7,8-tetrahydrodipyrzolo[3,4-b: 4', 3'-e] pyridin-4-yl)benzene-1, 3-diol (DBC) and zirconium dioxide nanoparticles (ZrO₂) are investigated for the electrocatalytic oxidation of β -nicotinamide adenine dinucleotide (NADH). The kinetic parameters, transfer coefficient (α), and apparent charge transfer rate constant (k_s) were obtained 0.31 and 4.83 s⁻¹, respectively by the cyclic voltammetry (CV) technique. The anodic peak potential of the DBC modifier depends on pH and has a linear range with a slope of 0.047 V/pH. Also, the performance of the modified electrode in the electrocatalytic oxidation of NADH is investigated. It was observed that in the presence of the modifier, the overvoltage related to the oxidation of NADH decreases significantly and its oxidation potential decreases by about 300 mV. Also, the diffusion coefficient (D) between the species and the electrode surface was calculated ($D=1.93 \times 10^{-6}$ cm² s⁻¹) using the chronoamperometric method. Using the differential pulse voltammetry method (DPV), the detection limit of 5.8 nM was acquired. Two linear concentration ranges of 0.01-1.0 μ M and 1.0-350.0 μ M for NADH were obtained. The modified electrode was used to quantitatively analyze NADH in the blood serum sample. Also, this electrode can be acceptably utilized for the simultaneous measurement of NADH and ascorbic acid species.

Keywords- Ascorbic acid; β -nicotinamide adenine dinucleotide; Carbon paste electrode; ZrO₂