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Impact of Scan Rates on the Redox Behavior of Paracetamol at NiO/GrE

Authors : S. Moussaoui, F. Smaili, S. E. Berrabah, S. Kaizra

Abstract : Paracetamol (acetaminophen, N-acetyl p-aminophenol) is a commonly used antipyretic and analgesic drug, effective in reducing fever, alleviating coughs, colds, and various types of pain, such as muscle aches, chronic pain, migraines, backaches, and toothaches. A nickel oxide-based electrochemical sensor NiO/GrE has been proposed for the efficient detection of paracetamol. The initial stage of this work involves the electrochemical deposition of a metallic nickel film on a graphite electrode at a potential of −1.05 V vs. SCE for 120 seconds via chronoamperometry. Subsequently, the metallic nickel layer is transformed into nickel oxide (NiO) in an alkaline medium over a duration of 300 seconds. In the following step, the surface of the resulting oxide film is analyzed using several electrochemical and physicochemical techniques such as open circuit potential (OCP) measurements, electrochemical impedance spectroscopy (EIS), X-ray photoelectron spectroscopy (XPS) and X-ray diffraction (XRD). The sensor shows a good repeatability capability with an RSD of 1.47% after six measurements and excellent stability, where it retains 99.5% of its original capacity after 40 measurements. The electrochemical behavior of paracetamol on the NiO/GrE and a bare GrE was studied using cyclic voltammetry in a buffer solution composed of KH_2PO_4 and Na_2HPO_4 (pH=7) at a scan rate of 50 mV/s. Additionally, the influence of different scan rates on the redox behavior of paracetamol at NiO/GrE was analyzed. The modified electrode exhibited a significant improvement in electrocatalytic activity for paracetamol oxidation compared to the bare graphite electrode. The paracetamol exhibited a pair of well-defined redox waves on the modified graphite electrode, with anodic peak potential (Epa) at 0,367 V and cathodic peak potential (Epc) at 0,312 V. The redox peak currents at the modified graphite electrode in the paracetamol solution increased linearly with the scan rate in the range from 25 to 200 mV/s. This behavior indicates that the reaction at the modified electrode involving paracetamol is a surface-confined process.

Keywords : anodic oxidation, cyclic voltammetry, detection, electrodeposition, paracetamol
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