ε-MnO₂-modified graphite electrode as a novel electrochemical sensor for the ultrasensitive detection of the newly FDA approved Hepatitis C antiviral drug ledipasvir

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Abstract:

A novel, simple and sensitive electrochemical method for the determination of ledipasvir (LED), the newly FDA approved Hepatitis C antiviral drug was developed and validated using ε-MnO₂-modified graphite electrode. Two different MnO₂ polymorphs (g- and ε-MnO₂ nanoparticles) were synthesized and characterized using X-ray powder diffraction (XRD), Fourier transform infrared (FTIR), energy dispersive X-ray (EDX) and thermogravimetric analysis (TGA). Surface area measurements show that ε-MnO₂ NPs have large surface area of 345 m²/g, which is extremely high if compared to that of g-MnO₂ NPs (38 m²/g). In addition, a comprehensive study of the difference in the electrochemical behavior of LED while using pencil graphite electrode (PGE) modified with either g- or ε-MnO₂ NPs is carried out. It was found that surface area and percentage of surface hydroxyls of MnO₂ NPs are the key factors governing the sensitivity of the fabricated electrode toward the oxidation of the positively charged LED. Scanning electron microscopy (SEM) was employed to investigate the morphological shape of MnO₂ NPs and the surface of the bare and modified electrodes. Moreover, cyclic voltammetry and electrochemical impedance spectroscopy (EIS) were used for the surface analysis of the modified electrodes. Based on the obtained results, ε-MnO₂/PGE was applied as a selective and sensitive electrode for determination of LED. Under the optimized experimental conditions, ε-MnO₂/PGE provides a linear response over the concentration range of 0.025e3.60 mmol L⁻¹ LED with a low limit of detection, which was found to be 5.10 nmol L⁻¹ (4.50 ng mL⁻¹) for the 1st peak and 9.20 nmol L⁻¹ (8.10 ng mL⁻¹) for the 2nd one. In addition, the oxidation behavior of LED is discussed with a full investigation of the oxidized product using FT-

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