Green Synthesis of Ag NPs/rGO Nanocomposite for Use as a Non-enzymatic Sensor of H_2O_2

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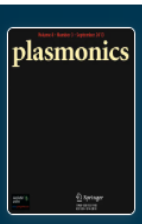

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Abstract

The detection and sensing of hydrogen peroxide (H_2O_2) by electrochemical nanocomposite-based sensors hold significant advantages over other common sensing materials due to their unique surface modification properties. Here, a nanocomposite is fabricated based on silver (Ag) nanoparticles (NPs) and reduced graphene oxide (rGO) using a green synthesis method from the extract of peppermint as a stabilizing and reducing agent. A pronounced surface plasmonic resonance (SPR) effect is observed in UV-visible spectrum of Ag NPs/rGO nanocomposite, indicating the plasmonic effect of Ag NPs around a wavelength of approximately 400 nm. This spectral signature serves as compelling evidence of the successful integration of Ag NPs into the rGO matrix, highlighting their robust anchoring within the intricate graphene structure. The resulting nanocomposite is then utilized to prepare a disposable electrochemical sensor on the basis of a glassy carbon electrode, contributing the specific features of both Ag NPs and graphene as well as the inherent high specific area and fast electron transfer of the nanohybrid structure. These features lead to an improvement in electrocatalytic efficiency of the nanocomposite compared to that of separate Ag NPs and rGO. The kinetic parameters and oxidation mechanism involved in the nanocomposite are investigated, achieving optimum reaction conditions. Accordingly, the non-enzymatic electrochemical sensor is capable of detecting H_2O_2 concentrations over the range of 20 to 1250 µM. The detection limit is found to be 13.55 µM at a signal-to-noise ratio of 3 along with a response time of 2 s. Alternatively, Ag NPs/rGO nanocomposite with SPR effect is tested against different bacterial species, and the results show its effective antibacterial performance.