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Green Synthesis of Graphene *via* Electrochemical Exfoliation

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Abstract

Synthesis of graphene is one of the best ways to value-add graphite. Electrochemical exfoliation for graphene synthesis attracts interest due to its simplicity, cost-effectiveness, and green approach compared to other methods. The limitation of electrochemical exfoliation is restacking nature. One of the effective strategies to overcome this limitation is the optimization of solvent parameters that critically affect the electrochemical exfoliation. Therefore, this study aims to optimize the electrochemical exfoliation for graphene synthesis considering the Hansen solubility parameter of solvents to overcome restacking of graphene layers. After optimizing the electrochemical exfoliation parameters, it was applied for water and 5% N, N-dimethylformamide (DMF). Synthesized graphene was characterized structurally and electrochemically in the presence of potassium ferricyanide. Fourier transform infrared spectroscopy, Raman spectroscopy, and X-ray diffraction data confirmed the formation of few-layer graphene. Scanning electron microscopic images confirm the mean lateral size of graphene is in the nano-range. UV-visible data confirm the characteristic peak for graphene is around 268 - 274 nm, and the graphene dispersibility is high in DMF. Cyclic voltammetry data illustrate the peak currents for graphene/Nafion-modified glassy carbon (GC) electrodes, graphene-DMF, and graphene-water, are 46.3 and 30.4 μA respectively compared to Nafion-modified GC electrode which was 0.99 μA. Moreover, electrochemical impedance spectroscopy confirms the high ion diffusion behavior of graphene-DMF-modified GC electrodes compared to other electrodes. These characterization data confirm the favorable effect of solvents with compatible Hansen solubility parameters such as DMF on the electrochemical exfoliation and the potential of the novel strategy to easily synthesize graphene by manipulating solvent properties.

Keywords: *Graphene, Electrochemical exfoliation, Restacking, Solvents*