ID 703

Graphene Derivatives for Supercapacitor Applications

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Graphene has superior properties which are enormously advantageous in energy applications. Despite graphene's superior properties, it has limitations such as the utilization of complicated synthesis methods and restacking. One of the effective strategies to overcome these limitations is the synthesis of graphene derivatives. This study reports the synthesis of porous graphene (PG) *via* a novel one-step/one-pot electrochemical exfoliation approach. Electrochemical exfoliation was carried out using a graphite rod and a stainless-steel electrode as the anode and cathode. The electrolyte used was 0.1 M $(NH_4)_2SO_4$ in 1 M H_2SO_4 and contained 0.03 M Phytic acid (PA). As-synthesized PG was characterized using scanning electron microscopy (SEM), X-ray diffraction (XRD), and Fourier transform infrared (FT-IR) spectroscopy. SEM, FT-IR, and XRD confirmed the formation of a porous structure, the formation of new bonds in PG, and the formation of graphene derivatives respectively. The electrochemical characterization of materials for supercapacitor applications was carried out using electrochemical impedance spectroscopy (EIS), cyclic voltammetry (CV), and galvanostatic charge-discharge (GCD). EIS showed that in PG, the resistance decreased, capacitance increased, and diffusion improved. CV confirmed that PG produced the highest specific capacitance (SC) compared to activated carbon (AC), graphite, and graphene. The percentage increments SC of graphene and PG compared to graphite are 42280.7 % and 93346.5 % respectively. GCD confirmed PG has low potential drop, resistance, and good charging time. These results collectively provide strong evidence of easy synthesis of PG *via* one-step/one-pot electrochemical exfoliation.

Keywords: *graphene derivative, supercapacitors, electrochemical exfoliation, specific capacitance, porous graphene*