Fabrication of Graphene-Fe3O4@Carbon Nanocomposites for next-generation green Li-ion battery technology

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Abstract

Today there is an urgent need globally to substitute fossil fuel (FF) uses with sustainable alternatives. With a global population exceeding 7 billion, the electricity crisis is one of the world's most critical issues. In power generation industries FF is the most extensively utilized energy source. The FF supply is steadily reducing every day because it is a non-renewable resource. Furthermore, total FF-related CO_2 emissions rose, with the power sector accounting for roughly two-thirds of the rise. Rechargeable batteries and fuel cells (FCs) can be used to solve both problems because of low emissions. As society focuses on green energy systems researchers have been investigating the qualities of nanocomposites utilized to produce green energy since they could serve as a replacement for FFs and potentially become the standard materials.

Graphene's (G) exceptional mechanical and electrical attributes, along with magnetite's (Fe_3O_4) large theoretical capacity, make these composites promising materials for flexible energy storage devices. Besides, biomass is a low-priced carbon source that is easily accessible, extensively disseminated, ecologically favorable, and renewable. Carbons have long been employed in electronic devices as adsorbents, catalysts, and electrodes. Biomass from Macadamia nuts shell (MNS) is one probable raw material highly suitable for the synthesis of highly porous carbon (C) for battery electrodes.

The goal of this research is to fabricate and look at the properties of the G-Fe_3O_4@C composite to enhance the performance of Li-ion batteries. In this study novel, G-Fe_3O_4@C nanocomposites with a multilayer sandwich structure will be made using a simple approach. The obtained nanocomposites will be characterized by X-ray diffraction (XRD), Scanning electron microscopy (SEM), Fourier transform Infrared spectroscopy (FT-IR), Thermogravimetric analysis (TGA), transmission electron microscopy (TEM), X-Ray photoelectron spectroscopy (XPS).

Furthermore, the electrochemical evaluation will also be carried out using a three-electrode system that included the synthesized active material as the working electrode, Hg/HgO as the reference electrode, and Pt as the counter electrode. In a 6 M KOH aqueous solution, cyclic voltammetry (CV), Galvanostatic charge/discharge (GCD), and electrochemical impedance spectroscopy (EIS) studies will be performed. Using a CHI660D workstation, all electrochemical tests will be carried out at ambient temperature (CHI660D, Shanghai Chenhua Instrument Co., Ltd.). This innovative approach can be used in the fabrication of other sandwich-structured nanocomposites for high-performance lithium-ion batteries (LIBs) and other electrochemical appliances. It is expected that due to the inherent nanoporous architecture of the MNS and its robustness, this material will be highly suited to the Green Li-ion battery Industry.

References

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