Mesoporous Graphene Oxide for High-Performance Supercapacitor Electrodes

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This study focuses on the development of a high-performance supercapacitor electrode material with the specific emphasis on synthesizing mesoporous activated graphene oxide (AGO) derived from Sri Lankan vein graphite. A simple and cost-effective chemical synthesis route is employed to synthesize the mesoporous AGO, resulting in a material with a notable specific surface area over 700 m^2g^{-1}, as determined by Brunauer-Emmett-Teller (BET) analysis. The AGO-based electrode is fabricated using a slurry-coating method, incorporating Carbon black as the conductive additive and PTFE as the binder. Optimization of the electrode's performance is carried out with careful consideration of the maximum AGO loading. The electrochemical evaluation of the fabricated electrodes is conducted utilizing a three-electrode configuration using a Ag-AgCl reference electrode and a Pt counter electrode. Remarkably, an enhanced specific capacitance over 500 Fg^{-1} is achieved in a 1M HCl electrolyte, representing one of the highest reported values for AGO-based electrodes to date. The observed high capacitance is attributed to the unique combination of a high specific surface area, a three-dimensional mesoporous structure characterized by well-connected pores, and efficient ion and electron transport within the electrode, as confirmed by Electrochemical Impedance Spectroscopy analysis. AGO's outstanding performance positions it as a promising material for future energy storage applications, including electric vehicles and renewable energy systems.

Keywords: Activated Graphene Oxide, Supercapacitor, Sri Lankan Graphite.