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Exploring the Potential of Reduced Graphene Oxide/Polyaniline (rGo/PANI) Nanocomposites for High-Performance Supercapacitor Application

Authors : Ahmad Umar, Ahmed A. Ibrahim, Mohsen A. Alhamami

Abstract : This study introduces a facile synthesis method for synthesizing reduced graphene oxide (rGO) nanosheets with surface decoration of polyaniline (PANI). The resultant rGO@PANI nanocomposite (NC) exhibit substantial potential as advanced electrode materials for high-performance supercapacitors. The strategic integration of PANI onto the rGO surface serves dual purposes, effectively mitigating the agglomeration of rGO films and augmenting their utility in supercapacitor applications. The PANI coating manifests a highly porous and nanosized morphology, fostering increased surface area and optimized mass transport by reducing diffusion kinetics. The nanosized structure of PANI contributes to the maximization of active sites, thereby bolstering the efficacy of the nanocomposites for diverse applications. The inherent conductive nature of the rGO surface significantly expedites electron transport, thereby amplifying the overall electrochemical performance of the nanocomposites. To systematically evaluate the influence of PANI concentration on the electrode performance, varying concentrations of PANI were incorporated. Notably, an elevated PANI concentration was found to enhance the response owing to the unique morphology of PANI. Remarkably, the 5% rGO@PANI NC emerged as the most promising candidate, demonstrating exceptional response characteristics with a specific capacitance of 314.2 F/g at a current density of 1 A/g. Furthermore, this catalyst exhibits outstanding long-term stability, retaining approximately 92% of its capacitance even after enduring 4000 cycles. This research underscores the significance of the synergistic integration of rGO and PANI in the design of high-performance supercapacitors. The elucidation of the underlying mechanisms governing the improved electrochemical properties contributes to the fundamental understanding of nanocomposite behavior, thereby paving the way for the rational design of next-generation energy storage materials.

Keywords : reduced graphene oxide, polyaniline, nanocomposites, supercapacitors, energy storage
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