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High-Performance Supercapacitors with Activated Carbon and Nickel Sulfide Composite

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Abstract : The growing demand for efficient energy storage in applications such as portable electronics, electric vehicles, and renewable energy systems has emphasized the need for advanced energy storage materials. This study addresses the pressing need for efficient energy storage materials by exploring the synthesis and application of a composite of activated carbon (AC) and nickel sulfide (NiS) for supercapacitors. Activated carbon, possessing high surface area and excellent electrochemical stability, was combined with nickel sulfide, a transition metal sulfide with high theoretical capacitance, to enhance the electrochemical performance of the composite material. Characterization techniques, including scanning electron microscopy (SEM), X-ray diffraction (XRD), and Fourier-transform infrared spectroscopy (FTIR), were employed to analyze the morphology, crystalline structure, and bonding characteristics, confirming the successful formation of a uniformly distributed AC/NiS composite. Electrochemical evaluations revealed that the AC/NiS composite exhibited superior capacitance, excellent rate capability, and enhanced cycling stability compared to pure AC and NiS. The synergistic effect of the large surface area from activated carbon and redox-active sites of nickel sulfide provided an improved energy storage capacity, making this composite a promising electrode material for high-performance supercapacitors.

Keywords : activated carbon, energy storage, sulfide, surface area
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