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SYNTHESIS, STRUCTURAL CHARACTERIZATION, AND ELECTROCHEMICAL ANALYSIS OF La–Sr DOPED NiO_3 PEROVSIKTE FOR ENERGY STORAGE APPLICATIONS

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Abstract

The increasing demand for efficient energy storage systems has accelerated research into advanced electrode materials that can balance high energy and power densities. In contrast, supercapacitors offer ultrafast charge–discharge cycles, high power density, and excellent cycle life, but their low energy density hinders large-scale applications. To address this challenge, La–Sr co-doped NiO_3 Perovsikte was synthesized via a controlled co-precipitation route, followed by thermal treatment to achieve optimized crystallinity and morphology. The co-doping strategy improves electrical conductivity, redox activity, and structural stability, thereby enhancing electrochemical performance. Structural analysis using X-ray diffraction (XRD) confirmed the formation of a well-crystallized tetragonal Perovsikte phase, with principal reflections indexed to JCPDS No. 34-1028. Additional characterization through FTIR, SEM, TEM, and XPS is underway to validate functional groups, morphology, and elemental states. Electrochemical performance was assessed in alkaline electrolyte using cyclic voltammetry (CV), galvanostatic charge–discharge (GCD), electrochemical impedance spectroscopy (EIS), and chronopotentiometry (CP). The optimized La–Sr NiO_3 electrode demonstrated high specific capacitance, excellent rate capability, and superior cycling stability, retaining over 90% of capacitance after 10,000 cycles. Reduced charge-transfer resistance and enhanced ion transport highlight the synergistic role of La–Sr substitution in improving conductivity and electrochemical kinetics.

Keywords: Ternary Nanocomposities, Structural Studies, Electrochemical Analysis, Energy Storage