

DEVELOPMENT OF VANADIUM AND NICKEL BASED COMPOSITE MATERIALS FOR HIGH PERFORMANCE SUPERCAPACITOR

INTRODUCTION:

The development of next-generation super capacitors has increased due to the growing need for environmentally friendly and efficient energy storage devices. Supercapacitors have longer cycle lives, faster charge/discharge rates, and better power densities than traditional batteries. Transition metal oxides, especially those based on nickel (Ni) and vanadium (V), have shown promising electro chemical qualities among the different electrode materials investigated because of their structural diversity, high theoretical capacitance, and diverse oxidation states.

Despite these benefits, when employed separately, Ni and V-based materials frequently have low conductivity and cyclic stability. In order to improve the overall performance of super capacitor electrodes, this study suggests investigating nickel-vanadium nano composites and hybrid architectures.

RESEARCH OBJECTIVE:

to create nano structured electrode materials based on Ni and V by employing sol-gel, hydrothermal, or electro chemical deposition methods.

to create Ni-V composite electrodes, such as stacked double hydroxides, Ni-V sulfides, or oxides.

to improve their morphological and structural characteristics in order to increase cycling stability and capacitance.

to assess the electro chemical performance through the use of electro chemical impedance spectroscopy (EIS), galvanostatic charge-discharge (GCD), and cyclic voltammetry (CV).

to comprehend the charge storage mechanism by means of in-depth modeling and analysis.

METHODOLOGY:

Material Synthesis: Hydrothermal, co-precipitation, and electro chemical deposition techniques will be studied to generate Ni, V, and Ni-V nano structures.

Characterization: For structural and surface investigation, methods like XRD, FESEM, TEM, BET, and FTIR will be employed.

Electro chemical Testing: Using aqueous and/or ionic liquid electrolytes, CV, GCD, and EIS will be carried out in both three-electrode and two-electrode systems.

Optimization: We'll look at how the synthesis factors (pH, temperature, and precursor ratio) affect output.

SIGNIFICANCE OF THE STUDY:

The goal of this research is to create high-performance, scalable, and reasonably priced electrode materials for supercapacitors. By providing insights into the synergistic effects of bimetallic systems, the discoveries will advance the field of sustainable energy storage and may pave the way for the development of high-performance, eco-friendly supercapacitors.

TIME LINE:

Review of the literature, initial synthesis experiments, and fundamental characterization

Synthesis optimization and thorough electrochemical testing

Scalability testing, mechanism analysis, and results publication

Writing a thesis, publishing it, and possibly demonstrating a prototype

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