World Academy of Science, Engineering and Technology
International Journal of Physical and Mathematical Sciences
Vol:19, No:05, 2025

Nickel Substituted Cobalt Ferrites via Ceramic Rout Approach: Exploration of Structural, Optical, Dielectric and Electrochemical Behavior for Pseudo-Capacitors

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Abstract : Nickel doped cobalt ferrites □(Co□_(1-x) Ni_x Fe_2 O_4) has been synthesized with the variation of Ni dopant (x=0.0, 0.25, 0.50, 0.75) by ball milling route at 150 RPM for 3hrs. The impact of nickel on Co ferrites has been investigated by using various approaches of characterization such as XRD (X-Ray diffraction), SEM (Scanning electron microscopy, FTIR (Fourier transform infrared spectroscopy), UV-Vis spectroscopy, LCR meter and CV (Cyclic voltammetry). The cubic structure of the nanoparticles confirmed by the XRD data, the increase in Ni dopant reduces the crystallite size. FTIR spectroscopy has been employed in order to analyze various functional groups. The agglomerated morphology of the particles has been observed by SEM images.. UV-Vis analysis reveals that the optical energy bandgap progressively rises with nickel doping, from 1.50 eV to 2.02 eV. The frequency range of 20 Hz to 20 MHz has been used for dielectric evaluation, where dielectric parameters such as AC conductivity, tan loss, and dielectric constant are examined. When the frequency of the applied AC field rises the AC conductivity increases, while the dielectric constant and tan loss constantly decrease. The pseudocapacitive behavior revealed by the CV curve showed that at high scan rates, specific capacitance values (Cs) are low, whereas at low scan rates, they are high. At the low scan rate of 10 mVs-1, the maximum specific capacitance of 244.4 Fg-1 has been attained at x = 0.75. Nickel doped cobalt ferrites electrodes have incredible electrochemical characteristics that make them a promising option for pseudo capacitor applications.

Keywords : lattice parameters, crystallite size, pseudo capacitor, band gap: magnetic material, energy band gap
Conference Title : ICP 2025 : International Conference on Physics
Conference Location : Bucharest, Romania
Conference Dates : May 17-18, 2025