

# Structural, Morphological and Optical Tuning of 5CB Liquid Crystal Doped CoFe<sub>2</sub>O<sub>4</sub> Nanocomposites Synthesized via Two-Step Sol–Gel Auto-Combustion Route

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This study presents a straightforward two-step procedure for synthesizing cobalt ferrite (CoFe<sub>2</sub>O<sub>4</sub>)/liquid crystal (LC) (5CB) nanocomposite. CoFe<sub>2</sub>O<sub>4</sub> nanoparticles were initially synthesized using the sol-gel auto-combustion process. Subsequently, LC was incorporated at 3 wt%, 6 wt%, 9 wt%, and 12 wt% into the resulting CoFe<sub>2</sub>O<sub>4</sub> nanoparticles. Characterization techniques included X-ray diffraction (XRD), scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX), atomic force microscopy (AFM), and UV-visible spectroscopy. XRD analysis confirmed the formation of a single-phase spinel ferrite in the Fd-3m space group. Increasing the LC concentration reduced the crystallite size from 32.62 nm to 12.62 nm, indicating effective dopant incorporation. SEM analysis revealed an average particle size distribution of 1.60-1.99 μm, as determined using ImageJ software. The EDX spectrum of LC/ CoFe<sub>2</sub>O<sub>4</sub> confirmed the presence of all principal elements, including Fe, Co, C, and O, within the nanocomposite. AFM was employed to evaluate the surface roughness of CoFe<sub>2</sub>O<sub>4</sub>/LC samples. Increasing the LC concentration decreased the band gap from 2.56 eV to 2.03 eV, attributed to particle size expansion and lattice contraction. These findings suggest that the synthesized liquid crystal-doped cobalt ferrite nanocomposites are promising candidates for optoelectronic liquid-crystal-based device applications.

## References:

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