



Preparation and optoelectronic properties of zinc dicobalt tetraoxide nanostructures for optical and photocatalysis applications

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Received: 4 December 2025

Accepted: 24 May 2026

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ABSTRACT

Carbinol-water, ethyl hydroxide-water, ethyl carbinol-water, and water-mediated zinc dicobalt tetraoxide (ZnCo_2O_4) nanostructures were synthesized via microwave treatment followed by a calcination process. Powder XRD, SEM, optical absorption spectra, PL emission, and chromaticity studies were employed to analyze their crystalline size, morphological shape, and optical property changes under the impact of solvents. A cubic spinel structure as well as Zn–O and Co–O molecule vibrations was noticed in the XRD patterns of all synthesized compounds. Spherical, aggregated sheet, spherical/rod, and rock-like aggregated particles were observed for the carbinol-water, ethyl hydroxide-water, ethyl carbinol-water, and water-mediated nanostructured ZnCo_2O_4 in the HR-SEM studies. Using recorded optical absorption spectral data, the bandgap energy values were identified to be 3.21 eV (carbinol-water), 3.16 eV (ethyl hydroxide-water), 3.12 eV (ethyl carbinol-water), and 3.08 eV (water) for ZnCo_2O_4 samples. The PL emission spectra of all synthesized ZnCo_2O_4 samples showed a red emission band at 641 nm, meanwhile the PL full-width half-maximum peak showed a notable variation, which was due to the crystallite size effect. Positions of color coordinates (x, y) were found to be pinkish red for all synthesized ZnCo_2O_4 samples. Under a tungsten lamp source, the Phenol Red (PR) dye photodegradation efficiency of carbinol-water-mediated ZnCo_2O_4 was computed to be ~ 94.83% over 110 min.

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