Structural and Optical Properties of Co₃O₄ Nanoparticles Prepared by Sol-gel Technique for Photocatalytic Application

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doi: 10.20964/2019.04.40

Received: 16 October 2018 / Accepted: 11 February 2019 / Published: 10 March 2019

Co₃O₄ (Cobalt Oxide) nanoparticles (NPs) were synthesized via sol-gel method by taking cobalt acetate (Co(OAc)) as a precursor material at four different concentrations like 0.06, 0.07, 0.08, and 0.09 M. The obtained Co₃O₄ was used as the photocatalyst for the degradation of methylene blue dye. The phase pure cubic spinel cobalt oxide formation was confirmed by powder X-ray diffraction (PXRD). The surface morphology and elemental analysis were studied by FESEM and EDAX. The SEM image showed that the particle size ranged from 200 nm to 1 μm with respect to the concentration of the cobalt acetate precursor. Surface defects, vibrational and rotational modes of Co₃O₄ were determined by Raman studies. The functional groups of the cubic spinel Co₃O₄ were determined by the Fourier Transform Infrared Spectroscopic (FTIR) analysis. The optical behavior of the prepared material was investigated by UV-Vis and PL spectroscopic studies. The band gap of Co₃O₄ varied as 1.29 eV and 3.34 eV for Co₃O₄-006, 1.39 eV and 3.53 eV for Co₃O₄-007, 1.59 eV and 3.58 eV for Co₃O₄-008 and 1.63 eV and 3.65 eV for Co₃O₄-009 is due to the quantum confinement effect. The Co₃O₄-006 showed 93.8% degradation of methylene blue dye under visible light irradiation.

Keywords: Co₃O₄ Nanoparticle, Sol-gel method, Structural, Optical property, Photocatalytic activity

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