

## Synthesis and Characterisation of Co<sup>2+</sup>-Incorporated ZnO Nanoparticles Prepared through a Sol-gel Method

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**Abstract:** The properties of ZnO nanoparticles were modified by doping them with cobalt ions (Co<sup>2+</sup>) in various compositions through a sol-gel route. The Co<sup>2+</sup>-doped ZnO nanoparticles were characterised using X-ray diffraction (XRD), UV/Vis spectroscopy, scanning electron microscopy (SEM), transmission electron microscopy (TEM) and zeta potential measurements. A hexagonal wurtzite-phase structure of Co<sup>2+</sup>-doped ZnO was observed, with a slight decrease in particle size as the Co<sup>2+</sup> doping concentration increased. Absorption by Co<sup>2+</sup>-doped ZnO was found to shift to longer wavelengths, towards the visible region, which was also confirmed by photoluminescence analysis. The band gap of the Co<sup>2+</sup>-doped ZnO samples decreased from 3.19 to 2.66 eV as the content of dopant Co<sup>2+</sup> increased from 0.0 to 1.0 wt.%. The zeta potential results showed slight effects of Co<sup>2+</sup> doping compared with undoped ZnO, indicating that Co<sup>2+</sup> doping influences the optical properties and morphology of pure ZnO nanoparticles. The photocatalytic activity of the Co<sup>2+</sup>-doped ZnO samples was evaluated for the removal of Congo red dye from aqueous solution under solar radiation. The Co<sup>2+</sup>-doped ZnO samples showed higher effective removal of the dye using the optimal doping of 0.50 wt%, which produced higher efficiency (about 96%, compared with 80% for pure ZnO).

**Keywords:**

ZnO, nanoparticles, sol-gel, Co<sup>2+</sup> ions.

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