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Structural and optical behavior of Ag^+ and Gd^{3+} ions in CdWO_4

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Abstract

In this research, CdWO_4 (CWO), CWO: Gd, CWO: Ag, Ag and Gd-doped CWO (co-doped CWO) nanopowders were synthesized by a simple chemical method. Their microstructure and optical properties were characterized by different techniques. XRD patterns revealed the purity of the synthetic nanopowders. XPS results showed the characteristic peaks related to elements in the nanopowders. The SEM and TEM images showed that the size of nanoparticles was distributed from 24 to 63 nm. Ag^+ ions influenced the morphology of nanopowders. The co-doping affected nanopowders' morphology and size. UV-Vis spectra showed their bandgap energies varied from 5.3 to 5.55 eV. The PL and IBIL spectra exhibited light emission in the blue-green range at 468 and 495nm, respectively, at room temperature. The excited electrons in the $^1\text{T}_{1u}$ level of the WO_6^{6-} complex were trapped in the $^6\text{I}_J$ level of Gd^{3+} by cross-relaxation. The plasmonic effect of Ag^+ ions and fluorescence resonance energy transfer (FRET) to the energy level of $^3\text{T}_{1u}$ increased the total intensity in PL and IBIL spectra. The synthesized nanopowders are good substitutes for fluorescent single crystals and suitable candidates to produce flexible nanocomposite scintillators for detecting ionizing radiations.

Keywords: Ag and Gd-doped CWO, Energy transfer, Morphology, optical properties, Size, Cross-relaxation, Synthetic nanopowders.

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