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Eu³⁺ doped Al₂(WO₄)₃ for red-emitting phosphors applications

Since the discovery of the red light-emitting diode (R-LED) by Nick Holonyak in 1962, LEDs have become indispensable in many everyday applications, from lighting on display screens and smartphones, to laser diodes, even in specialized lighting in horticulture. In this direction, tungsten-based compounds are very attractive due to their high thermal stability greater than 800 °C and their high dopant solubility. Thus, in the present work reports the synthesis of Al₂(WO₄)₃ doped Eu³⁺ through a double substitution reaction by solvothermal evaporation technique. The Structural characterization by X-ray diffraction patterns presents well-defined high intensity peaks related to the orthorhombic phase of Al₂(WO₄)₃, according to chart PDF-70-4478, with a crystallite size of 29.0 nm calculated using the Scherrer equation. The Raman spectroscopy confirms that the main vibrational modes are located in 1052 cm⁻¹ related at WO₄²⁻ units. The excitation spectrum monitoring the emission at 613 nm (5D₀ → 7F₂) presents seven excitation bands, one related to O²⁻ → W⁶⁺ charge transfer and the other six to the characteristic excitation bands of Eu³⁺: 7F₀ → 5D₄, 5L₇, 5L₆, 5D₃, 5D₂, 5D₁ and 5D₀. On the other hand, the emission spectrum was measured under an excitation wavelength of 394 nm (7F₀ → 5L₆). The emission spectra present five bands emission related to Eu³⁺: 5D₀ → 7F₀, 7F₁, 7F₂, 7F₃ and 7F₄. The intensity between the different J levels relies on the symmetry of the local environment of Eu³⁺ ion and is evaluated as described in the literature. Finally, the color purity is evaluated through emission spectra in the CIE1931 protocol, obtaining color purities above 97%. The correlation results indicate that the Eu³⁺-doped Al₂(WO₄)₃ is suitable for LED applications.

Keywords

Luminescence, Phosphors, Europium, Tungstate, Aluminium

Reference

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