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STUDY OF THE LUMINESCENT AND STRUCTURAL PROPERTIES OF CsVO₃:Er³⁺ FOR INFRARED APPLICATIONS

Cesium metavanadate (CsVO₃) materials have recently received extensive attention due to their out-standing luminescent properties. In this study, the synthesis of CsVO₃ and CsVO₃:Er³⁺ was conducted using the solid-state reaction method. Through a thermal treatment at 400°C for 5 hours, the crystalline phase corresponding to PDF 00-70-0680 was obtained, achieving a phase purity of approximately 94% CsVO₃.

CsVO₃ was doped with erbium ions (Er³⁺) at varying concentrations ranging from 0.1 mol% to 6 mol%, and the structural and luminescent properties of CsVO₃:Er³⁺ were investigated. The incorporation of Er³⁺ ions induced microstrains within the crystalline structure, altering the position of vanadium tetrahedra and consequently reducing the purity of the crystalline phase.

Excitation spectra of CsVO₃:Er³⁺ were recorded from 200 nm to 400 nm, with emission monitored at 535 nm. The obtained spectra revealed a peak at 355 nm, corresponding to the 1A₁ → 1T₁ transition associated with (VO₄)₃⁻. Additionally, the emission spectra of CsVO₃:Er³⁺ excited at 365 nm exhibited a broad band centered at 536 nm, originating from the convolution of emission levels 3T₁ → 1A₁ and 3T₂ → 1A₁. Furthermore, sinks at 521 nm (4I_{15/2} → 2H_{11/2}) were observed in the emission spectra, indicating radiative energy transfer from [VO₄]₃⁻ to Er³⁺. Moreover, near-infrared emission under 980 nm excitation displayed a characteristic emission peak centered at 1534 nm, associated with the 4I_{13/2} → 4I_{15/2} transition.

Up-conversion emission peaks characteristic of Er³⁺, attributed to the levels Er³⁺: 2H_{11/2}, 4S_{3/2}, and 4F_{9/2} → 4I_{15/2}, are observed in UC emission spectra under λ_{ex}=980 nm diode laser excitation. The intensity of red emission is considerably higher than that of green. Integrated spectrum areas indicate an intensity growth with Er³⁺ content, with the 6.0% sample being the most intense. From UC emission spectra, color coordinates were evaluated using the CIE1931 protocol, observing a yellow hue with an average color purity of 98.7.

The optical properties of this material position it as an excellent candidate for enhancing the efficiency of solar cells.

Keywords

Luminescence-Phosphors-Erbium-Cesium-Vanadate

Reference

Espinosa-Cerón, M. Y., Meza-Rocha, A. N., Carmona-Téllez, S., Chacón, C., Soriano-Romero, O., Lozada-Morales, R. (2021). Effect of radiative energy transfer and direct excitation on the up-conversion and down-shifting emission properties of Er³⁺-doped Zn₃(VO₄)₂. *Journal of Luminescence*, 238, 118239

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Author approval

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