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Photoluminescence and Judd-Ofelt analysis of Er3+ doped CdO-V2O5-ZnO-B2O3 inverted glasses.

Er-doped CdO-V2O5-ZnO-B2O3 inverted glasses were synthetized by the melt-quenching method, using proportions of 80-5.0-2.5-12.5 mol% of CdO-V2O5-ZnO-B2O3, respectively, which were doped with different mol% of Er. The structural analysis, carried out by X-Ray diffraction patterns recording, showed an amorphous structure in all Er doping range. This fact was also verified by the line shape of Raman spectra, which revealed vibrational modes associated with borate, Zn2V2O7 and Cd2V2O7 in amorphous phases. By using optical absorption and the Tauc model, the direct optical band gap (E_g^d) values were found around 2.74 eV, without tendency with Er mol% concentrations. The down-shifting emission spectra recorded under laser excitation at 980 nm exhibited the featured near infrared Er emission band centered at 1534 nm, which grows up to 2 mol% and remained oscillate for larger Er doping contents. The upconverting (UC) emission spectra registered under laser excitation of 980 nm, displayed the well-known green and red emission bands, related to relaxations of 2H11/2, 4S3/2 and 4F9/2 excited states to the 4I15/2 ground state, respectively. Such process is dominated by a linear decay mechanism, as revealed the dependence of the intensity versus the excitation laser power. The Judd-Ofelt (JO) parameters obtained by least-square method from the experimental and theoretical oscillator strengths, were found as Ω_2 = 6.43×10-20, Ω_4 = 0.96×10-20 and Ω_6 = 1.53×10-20 cm2 for the CVZB glass activated with 2.8 mol% of Er. Moreover, the emissions arisen by transitions from 4I13/2, 4I11/2 ,4F9/2, 4S3/2, 2H11/2, 4F7/2 states to 4I15/2 ground state, present radiative branching ratio (β_R) values higher than 0.6, and total radiative transfer probabilities A_T (4I13/2⟶4I15/2) = 782.46 s-1 and A_T (4S3/2⟶4I15/2) = 10248.56 s-1. Finally, for the 1533 nm emission, the stimulated emission cross section had a value of σem(λ) = 1.57×10-20 cm^2, and an effective bandwidth Δλem = 60.52 nm.

Keywords

Luminescence, Inverted glasses, Judd-Ofelt, Laser, Upconversion

Reference

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Author approval

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