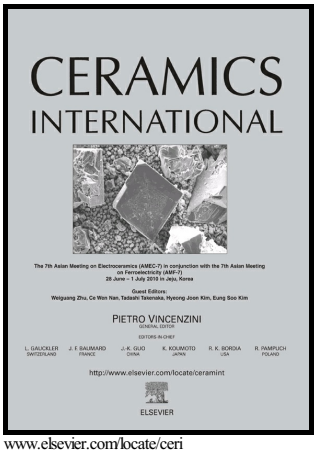

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Luminescence properties of Dy^{3+}-doped alkali lead alumino borosilicate glasses

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Abstract

A new series of Dy^{3+}-doped sodium lead alumino borosilicate glasses are prepared by the melt quenching technique with the chemical composition $20Na_2O$- $10PbO$-$(5-x)Al_2O_3$-$40B_2O_3$-$25SiO_2$-xDy2O3 (where x = 0, 0.5, 1.0 and 1.5 mol %) and are characterized by various spectroscopic techniques such as XRD, FT-IR, Optical absorption spectra, Fluorescence spectra and Decay measurements. Optical and Luminescence spectra of all the glasses are recorded at room temperature. From the optical absorption spectra, optical band gap and Urbach energies of Dy^{3+}-doped titled glasses have been evaluated. The oscillator strengths and the intensity parameters, Ω_λ (λ = 2, 4 and 6) are calculated using Judd-Ofelt analysis. The various lasing parameters like transition probability (A_T), branching ratio (β_R), stimulated emission cross-section (σ_e) and the radiative lifetime (τ_{rad}) for different emission levels of Dy^{3+} ions have been evaluated. Fluorescence spectra show sharp emission peaks are observed at 482 nm (blue), 575 nm (yellow) and 665 (red) under 385 nm excitation, which are attributed to $^4F_{9/2} \rightarrow {}^6H_{15/2}$, $^6H_{13/2}$ and $^6H_{11/2}$ transitions respectively. The yellow-to-blue intensity ratio (Y/B) increase up to 1.0 mol% Dy^{3+} ion content and beyond it decreases because of concentration quenching which occurs due to the energy transfer between Dy^{3+} and Dy^{3+} ions. The x, y coordinates of the prepared glasses pass through the white light region in the CIE 1931 chromaticity diagram. The results reveal that these glasses emit quality white light which is suitable for the development of W-LEDs. The color purity and the correlated color temperature (CCT) are also calculated for the present work. Various physical parameters such as density, refractive index, and ion concentration etc., are calculated. Among the prepared glasses, NPABSDy10 glass exhibits higher σ_e, β_R, $\sigma_e x \tau_R$, and $\sigma_e x \Delta\lambda_{eff}$ values corresponding to the $^4F_{9/2} \rightarrow {}^6H_{13/2}$ emission band and these are in turn specifies its suitability for W-LEDs and visible laser applications.

Keywords: Nephelauxetic effect, Judd-Ofelt theory, Stimulated emission cross-section, Y/B intensity ratio and Luminescence studies.

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