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Investigations on the Spectroscopic properties of Dy^{3+} ions doped Zinc calcium tellurofluoroborate glasses

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Abstract

A new series of Dy^{3+} doped $(30–x)B_2O_3+30TeO_2+20CaCO_3+10ZnO+10ZnF_2+xDy_2O_3$ (x=0.01, 0.1, 0.5, 1, 2 and 3 in wt%) Zinc calcium tellurofluoroborate glasses were prepared and their structural, luminescence and excited state dynamics have been studied and reported. The structural properties have been characterized through XRD and FTIR studies to confirm the amorphous nature and to explore the presence of fundamental stretching vibrations. The bonding parameters (δ and β), optical band gap, Urbach's energy, oscillator strengths and Judd-Ofelt (JO) intensity parameters were calculated from the absorption spectra. The JO intensity parameters and the Y/B intensity ratio values have been used to explore the nature of the bonding and asymmetry around the Dy-ligand field environment. The luminescence properties of the present Dy^{3+} doped glasses have been analyzed through luminescence excited state dynamics and radiative properties such as transition probability (A), stimulated emission cross-section (σ_P^E) branching ratio (β) and radiative lifetime (τ_R) values. The combination of dominant blue ($^4F_{9/2}\rightarrow {}^6H_{15/2}$) and yellow ($^4F_{9/2}\rightarrow {}^6H_{13/2}$) emissions generate white light emission in the CIE chromaticity diagram thus suggest that the present Dy^{3+} doped glasses are suitable for white light applications. The lifetime of the $^4F_{9/2}$ excited state is found to decrease with the increase in Dy^{3+} ion content and the concentration quenching of the Dy^{3+} ions emission could be ascribed due to the resonant energy transfer and cross-relaxation processes. The non-exponential behavior of the decay curves have