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Research Article

Optical and luminescence properties of Er^{3+} doped Sb_2O_3–Li_2O–MO (M=Mg, Ca and Sr) glasses

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ABSTRACT

Sb_2O_3–Li_2O–Er_2O_3glasses mixed with various modifier oxides *viz.*, MgO, CaO and SrO have been prepared by the melt quenching technique in this present work. Optical absorption, photoluminescence and decay characteristics were measured at room temperature. The Judd-Ofelt (JO) parameters Ω_2, Ω_4 and Ω_6 for Er_2O_3 mixed glasses were calculated using absorbance spectra. The emission spectra excited λ_{ex} = 380 nm exhibited emission transitions $^4F_{7/2}$, $^2H_{11/2}$, $^4S_{3/2}$, $^4F_{9/2} \rightarrow {}^4I_{15/2}$ (Vis region) and $^4I_{13/2} \rightarrow {}^4I_{15/2}$ (NIR region) of Er^{3+} doped glasses. Numerous characteristics of radiative parameters *viz.*, A_R, β_R, τ_R, and σ_p^e for Er_2O_3 enriched glasses were analyzed and reported, based on JO parameters and the emission spectra. Overall, the results indicated that Er^{3+} mixed glasses exhibited a substantial increase in the green emission ($^2H_{11/2}$, $^4S_{3/2} \rightarrow {}^4I_{15/2}$) intensity of all glass samples. When compared with the other two glasses, the SrO mixed glass having the highest quantum efficiency (η = 88.2%) of green emission. The structural modifications of Er^{3+} ions due to modifier oxides were identified by IR spectral studies.

1. Introduction

The trivalent rare earth (RE^{3+}) ions are well-established for the emission applications of glass materials. The 4f-5d and/or 4f–4f transitions of electrons in rare earth ions were ascribed for the emissions. In the RE^{3+} ions outer active 4f active valence electrons are adequately protected by fully occupied shells, $5s^2$ and $5p^6$. As a result, the RE^{3+} ions spectrum shifts are smaller in organized crystalline substances than in disordered ones like glasses [1–3]. The Er^{3+} doped glasses can give rich emission in the UV, NIR and visible regions, because Er^{3+} ground state produces a high number of absorption/emission transitions. Er^{3+} ions more prevalent owing to shifts viz., $^2H_{11/2}$, $^4S_{3/2} \rightarrow {}^4I_{15/2}$ - the green emission and even the transition $^4I_{13/2} \rightarrow {}^4I_{15/2}$ gives the NIR emission at 1.54 μm, that has been broadly applied as eye safe basis in the atmosphere as because the green laser finds a number of applications for instance in wind shear, printing, laser radar, applications in geodesy, surgery and medicine etc., [4–9].

Sb_2O_3 glasses possess high density, high refractive index, high dielectric constant (when compared with conventional borate and phosphate glasses), good photothermal properties and exhibit exceptionally good infrared transmission with low phonon losses. For these reasons this type of glasses were predicted to be highly suitable for hosting lasing ions that exhibit PL emission in the UV–VIS-NIR regions [10–13]. In absence of modifier oxides, antimony oxide acts as an incipient glass former and doesn't even form the glass. For this reason, the modifier oxide Li_2O is added to the studied glass system. Moreover, Sb_2O_3 glasses exhibit non-linear optical (NLO) properties, with the bond lengths of Sb–O ranging from 2.0 to 2.6 Å. Sb_2O_3 glass network consists

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