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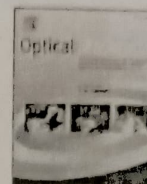
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Research Article

Optical and luminescence properties of Er³⁺ doped Sb₂O₃-Li₂O-MO (M=Mg, Ca and Sr) glasses

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ABSTRACT

Sb₂O₃-Li₂O-Er₂O₃ glasses 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 Ω₂, Ω₄ and Ω₆ for Er₂O₃ mixed glasses were calculated using absorbance spectra. The emission spectra excited λ_{exc} = 380 nm exhibited emission transitions ⁴F_{7/2}, ²H_{11/2}, ⁴S_{3/2}, ⁴F_{9/2} → ⁴I_{15/2} (Vis region) and ⁴I_{13/2} → ⁴I_{15/2} (NIR region) of Er³⁺ doped glasses. Numerous characteristics of radiative parameters viz., A_R, β_R, τ_R, and σ_R^{sp} for Er₂O₃ enriched glasses were analyzed and reported, based on JO parameters and the emission spectra. Overall, the results indicated that Er³⁺ mixed glasses exhibited a substantial increase in the green emission (²H_{11/2}, ⁴S_{3/2} → 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 Er³⁺ ions due to modifier oxides were identified by IR spectral studies.

1. Introduction

The trivalent rare earth (RE³⁺) 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 RE³⁺ ions outer active 4f active valence electrons are adequately protected by fully occupied shells, 5s² and 5p⁶. As a result, the RE³⁺ ions spectrum shifts are smaller in organized crystalline substances than in disordered ones like glasses [1–3]. The Er³⁺ doped glasses can give rich emission in the UV, NIR and visible regions, because Er³⁺ ground state produces a high number of absorption/emission transitions. Er³⁺ ions more prevalent owing to shifts viz., ²H_{11/2}, ⁴S_{3/2} → ⁴I_{15/2} - the green emission and even the transition ⁴I_{13/2} → 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].

Sb₂O₃ 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 Li₂O is added to the studied glass system. Moreover, Sb₂O₃ glasses exhibit non-linear optical (NLO) properties, with the bond lengths of Sb-O ranging from 2.0 to 2.6 Å. Sb₂O₃ glass network contains

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