

Dy³⁺ Ions Doped Single and Mixed Alkali Fluoro Tungstate Tellurite Glasses for Laser and White LED Applications

Authors : Allam Srinivasa Rao, Ch. Annapurna Devi, G. Vijaya Prakash

Abstract : A new-fangled series of white light emitting 1 mol% of Dy³⁺ ions doped Single-Alkali and Mixed-Alkali fluoro tungstate tellurite glasses have been prepared using melt quenching technique and their spectroscopic behaviour was investigated by studying XRD, optical absorption, photoluminescence and lifetime measurements. The bonding parameter studies reveal the ionic nature of the Dy-O bond in the present glasses. From the absorption spectra, the Judd-Ofelt (J-O) intensity parameters have been determined which are used to explore the nature of bonding and symmetry orientation of the Dy-ligand field environment. The evaluated J-O parameters ($\Omega_4 > \Omega_2 > \Omega_6$) for all the glasses are following the same trend. The photoluminescence spectra of all the glasses exhibit two intensified peaks in blue and Yellow regions corresponding to the transitions 4F_{9/2}→6H_{15/2} (483 nm) and 4F_{9/2}→6H_{13/2} (575 nm) respectively. From the photoluminescence spectra, it is observed that the luminescence intensity is maximum for Dy³⁺ ion doped potassium combination of fluoro tungstate tellurite glass (TeWK: 1Dy). The J-O intensity parameters have been used to determine the various radiative properties for the different emission transitions from the 4F_{9/2} fluorescent level. The highest emission cross-section and branching ratio values observed for the 4F_{9/2}→6H_{15/2} and 4F_{9/2}→6H_{13/2} transitions suggest the possible laser action in the visible region from these glasses. By using the experimental lifetimes (τ_{exp}) measured from the decay spectral features and radiative lifetimes (τ_R), the quantum efficiencies (η) for all the glasses have been evaluated. Among all the glasses, the potassium combined fluoro tungstate tellurite (TeWK:1Dy) glass has the highest quantum efficiency (94.6%). The CIE colour chromaticity coordinates (x, y), (u, v), colour correlated temperature (CCT) and Y/B ratio were also estimated from the photoluminescence spectra for different compositions of glasses. The (x, y) and (u, v) chromaticity colour coordinates fall within the white light region and the white light can be tuned by varying the composition of the glass. From all these studies, we are suggesting that the 1 mol% of Dy³⁺ ions doped TeWK glass is more suitable for lasing and White-LED applications.

Keywords : dysprosium, Judd-Ofelt parameters, photo luminescence, tellurite glasses

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