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Photoluminescence and Spectroscopic Studies of Tm3+ Ions Doped Lead Tungsten Tellurite Glasses for Visible Red and Near-Ir Laser Applications

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Abstract : Lead Tungsten Tellurite (LTT) glasses doped with different concentrations of Tm3+ ions were prepared by using melt quenching technique and characterized through optical absorption, photoluminescence and decay spectral studies to know the feasibility of using these glasses as luminescent devices in visible Red and NIR regions. By using optical absorption spectral data, the energy band gaps for all the glasses were evaluated and were found to be in the range of 2.34-2.59 eV; which is very useful for the construction of optical devices. Judd-Ofelt (J-O)theory has been applied to the optical absorption spectral profiles to calculate the J-O intensity parameters Ωλ (λ=2, 4 and 6) and consecutively used to evaluate various radiative properties such as radiative transition probability (AR), radiative lifetimes (τ_R) and branching ratios (β_R) for the prominent luminescent levels. The luminescence spectra for all the LTT glass samples have shown two intense peaks in bright red and Near Infrared regions at 650 nm (1G4→3F4) and 800 nm (3H4→3H6) respectively for which effective bandwidths (□Δλ□_P), experimental branching ratios (β_exp) and stimulated emission cross-sections (σ_se) are evaluated. The decay profiles for all the glasses were also recorded to measure the quantum efficiency of the prepared LTT glasses by coupling the radiative and experimental lifetimes. From the measured emission cross-sections, quantum efficiency and CIE chromaticity coordinates, it was found that 0.5 mol% of Tm3+ ions doped LTT glass is most suitable for generating bright visible red and NIR lasers to operate at 650 and 800 nm respectively.

Keywords : glasses, JO parameters, optical materials, thullium
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