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Spectroscopic Studies of Dy^{3+} Ions in Alkaline-Earth Boro Tellurite Glasses for Optoelectronic Devices

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Abstract : A Series of Alkali-Earth Boro Tellurite (AEBT) glasses doped with different concentrations of Dy^{3+} ions have been prepared by using melt quenching technique and characterized through spectroscopic techniques such as optical absorption, excitation, emission and photoluminescence decay to understand their utility in optoelectronic devices such as lasers and white light emitting diodes (w-LEDs). Raman spectrum recorded for an undoped glass is used to measure the phonon energy of the host glass and various functional groups present in the host glass (AEBT). The intensities of the electronic transitions and the ligand environment around the Dy^{3+} ions were studied by applying Judd-Ofelt (J-O) theory to the recorded absorption spectra of the glasses. The evaluated J-O parameters are subsequently used to measure various radiative parameters such as transition probability (AR), radiative branching ratio (βR) and radiative lifetimes (τR) for the prominent fluorescent levels of Dy^{3+} ions in the as-prepared glasses. The luminescence spectra recorded at 387 nm excitation show three emission transitions ($^4F9/2 \rightarrow {}^6H15/2$ (blue), $^4F9/2 \rightarrow {}^6H13/2$ (yellow) and $^4F9/2 \rightarrow {}^6H11/2$ (red)) of which the yellow transition observed at 575 nm is found to be highly intense. The experimental branching ratio (βexp) and stimulated emission crosssection (σse) were measured from luminescence spectra. The experimental lifetimes (τexp) measured from the decay spectral profiles are combined with radiative lifetimes to measure quantum efficiencies of the as-prepared glasses. The yellow to blue intensity ratios and chromaticity color coordinates are found to vary with Dy^{3+} ion concentrations. The aforementioned results reveal that these glasses are aptly suitable for w-LEDs and laser devices.

Keywords : glasses, J-O parameters, photoluminescence, I-H model
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