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Quenching behavior in Nd^{3+} doped zinc phosphate glasses for near infrared laser applications

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Abstract : With interest in the luminescence properties, neodymium doped six series of zinc phosphate glass composition with different concentrations (0.1, 0.3, 0.5, 1.0, 1.5 and 2.0 mol%) were prepared by melt quenching method, and their luminescence has been investigated. Structural properties were accomplished from XRD (X-Ray Diffractometer) and Raman spectrum. Spectroscopic properties were investigated by measuring optical absorption spectrum, emission spectra and decay profiles. Neodymium environment in zinc phosphate host glass matrix can be accessed by Judd-Ofelt (J-O) theoretical approach. This theory gives three important parameters such as Ω_2, Ω_4 and Ω_6 parameters. In turn these parameters were further used to calculate emission properties of Nd^{3+} ions. Luminescence parameters such as effective bandwidth ($\Delta\lambda_{eff}$), stimulated emission cross-sections (σ_p) and branching ratios (β_{exp}) have been studied through photoluminescence spectra. By adjusting the doping concentration in glass system, the concentration quenching phenomenon occurs. The photoluminescence spectra exhibit three prominent transitions. Of which, the near infrared transition located at 1.06 μm has high emission intensity. Further, decay time constants have been estimated from the decay profiles of Nd^{3+} doped different zinc phosphate glasses. This approach shows the present prepared zinc phosphate glasses significant for NIR lasing action.

Key words : Rare earth doped glasses; Zinc phosphate glasses; Neodymium; Judd-Ofelt theory; Absorption; Decay profiles.

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