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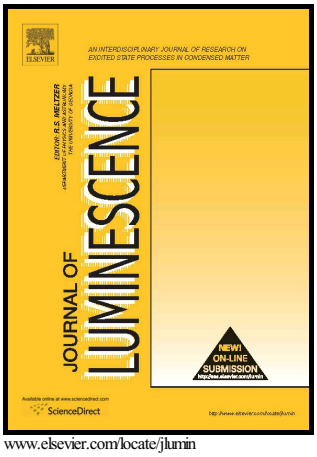

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Fluorescence characteristics of Nd^{3+} doped multicomponent fluoro-phosphate glasses for potential solid-state laser applications

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Abstract

The multicomponent fluoro-phosphate glasses of the type, $49.5P_2O_5$ -$10AlF_3$-$10BaF_2$-$10SrF_2$-10PbO-10M (M= Li_2O, Na_2O, K_2O, ZnO and Bi_2O_3) doped with 0.5 mol % neodymium were prepared by melt quenching technique. Their structures were characterized by the X-ray diffraction with SEM analysis, Fourier transform infrared (FTIR), Raman spectroscopy and ^{31}P and ^{27}Al magic angle spinning (MAS) nuclear magnetic resonance (NMR) techniques. XPS spectra were studied to know the bridging and non-bridging oxygen groups. X-ray absorption near edge spectroscopy (XANES) was used to study the electronic structure of neodymium in the host glass matrices. The Judd–Ofelt parameters (J-O) (Ω_2, Ω_4 and Ω_6) were evaluated from the intensities of the absorption bands through optical absorption spectra. Further, J-O parameters have been used to calculate various radiative properties like probabilities of radiative transitions, radiative lifetimes and branching ratios for different fluoro-phosphate glasses. The luminescence kinetics from the excited neodymium levels have been studied upon selective excitation through photoluminescence measurements. Neodymium ion emits two near infrared laser emissions: $^4F_{3/2} \rightarrow {}^4I_{11/2}$ at 1.06 μm and another one $^4F_{3/2} \rightarrow {}^4I_{13/2}$ at 1.32 μm. The major intensity is observed for 1.06 μm for the prepared fluoro-phosphate glasses. The lifetimes of these levels have been experimentally determined through decay profile studies. The above results suggest that the prepared lithium fluoro-phosphate glass system could be a suitable candidate for using it as 1.06 μm laser source in the near infrared region of spectrum.