

Development of Eu^{3+} doped $\text{Li}_2\text{O-BaO-GdF}_3\text{-SiO}_2$ oxyfluoride glass for efficient energy transfer from Gd^{3+} to Eu^{3+} in red emission solid state device application

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PII: S0022-2313(18)30456-3
DOI: <https://doi.org/10.1016/j.jlumin.2018.07.009>
Reference: LUMIN15756

To appear in: *Journal of Luminescence*

Received date: 13 March 2018
Revised date: 2 July 2018
Accepted date: 4 July 2018

Cite this article as: I. Khan, G. Rooh, R. Rajaramakrishna, N. Sirsittipokakun, H.J. Kim, C. Wongdeeying and J. Kaewkhao, Development of Eu^{3+} doped $\text{Li}_2\text{O-BaO-GdF}_3\text{-SiO}_2$ oxyfluoride glass for efficient energy transfer from Gd^{3+} to Eu^{3+} in red emission solid state device application, *Journal of Luminescence*, <https://doi.org/10.1016/j.jlumin.2018.07.009>

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Abstract:

The Eu^{3+} -doped $\text{Li}_2\text{O}-\text{BaO}-\text{GdF}_3-\text{SiO}_2$ glasses were fabricated by conventional melt quenching technique to study its spectroscopic and luminescence properties for lasing potential. The density and molar volume of the glass had been increased with Eu_2O_3 concentration. An FTIR spectrum is used to study the structural properties of the developed glasses. Two intense peaks were observed in UV-Vis-NIR spectra at 2206nm ($^7\text{F}_6$) and 2085nm ($^7\text{F}_1$) in NIR region. Under 394nm excitation LBGFS display five regular emission peaks at (578nm) $^7\text{F}_0$, (590nm) $^7\text{F}_1$, (613nm) $^7\text{F}_2$, (651nm) $^7\text{F}_3$ and (701nm) $^7\text{F}_4$ from $^5\text{D}_0$ state, the most intense red emission was found at 613nm. The characteristic intense red emission peak at 613 nm corresponding to the $^5\text{D}_0 \rightarrow ^7\text{F}_2$ transition of Eu^{3+} ions has been observed for oxy-fluoride glass samples. Efficient energy transfer phenomena from $\text{Gd}^{3+} \rightarrow \text{Eu}^{3+}$ were observed under 275nm excitation in these glasses. FTIR measurements reveal that these glasses show non-bridging oxygen stretching of $\text{Si}-\text{O}^-$ at $\sim 929 \text{ cm}^{-1}$. Phonon sideband spectrum confirms the phonon energy $\sim 920 \text{ cm}^{-1}$ for these glasses arising from $\text{Si}-\text{O}^-$. Increasing trend of $I_{\text{R/O}}$ with increasing concentration of Eu_2O_3 indicates the asymmetric environment around Eu^{3+} in LBGFS. Higher value of stimulated cross section ($\sigma(\lambda_p)$) branching ratio (β_R) for transition to $^7\text{F}_0$ from $^5\text{D}_0$ were observed for LBGFS glasses. Decay time decrease with increasing concentration of Eu_2O_3 .

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