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Optical analysis of a novel color tunable $\text{Ba}_2\text{Y}_{(1-x)}\text{Eu}_x\text{AlO}_5$ nanophosphor in Judd-Ofelt framework for solid state lighting

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Abstract

Eu^{3+} doped Ba_2YAlO_5 nano-crystalline phosphor is synthesized for the first time using urea assisted solution combustion approach. X-ray diffraction analysis depicts that single phased $\text{Ba}_2\text{Y}_{(1-x)}\text{Eu}_x\text{AlO}_5$ sample obtained by post heat treatment for 4h at 1225°C crystallize in monoclinic lattice with $P2_1/(11)$ space group. Transmission electron microscopy (TEM) studies reveal semi-spherical shaped particles in nano dimension ranging 40-90 nm. Photoluminescent studies elicits that this nanophosphor can be efficiently excited by NUV light generating emission in the red region. $\text{Ba}_2\text{Y}_{0.95}\text{Eu}_{0.05}\text{AlO}_5$ is found to be the optimal composition for achieving the maximum luminescence. Concentration controlled luminescent behavior can be utilized to obtain the chromatic color tuning from blue to red region. Luminescent centres shows cross relaxation via quadrupole-quadrupole interactions beyond 5 mol% concentration of Eu^{3+} ion leading to concentration quenching. Judd-Ofelt intensity parameters and refractive index of host are also determined. Chromatic color tuning proclaim the possible utilization of this nano-crystalline phosphor in NUV excited solid state lighting devices.

Graphical abstract

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