

## Author's Accepted Manuscript

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PII: S0022-2313(18)31158-X  
DOI: <https://doi.org/10.1016/j.jlumin.2018.09.010>  
Reference: LUMIN15893

To appear in: *Journal of Luminescence*

Received date: 28 June 2018  
Revised date: 30 August 2018  
Accepted date: 4 September 2018

Cite this article as: Heng Guo, Liangling Sun, Jia Liang, Bin Li and Xiaoyong Huang, High-efficiency and thermal-stable  $\text{Eu}^{3+}$ -activated  $\text{Ca}_3\text{Y}(\text{AlO})_3(\text{BO}_3)_4$  red-emitting phosphors for near-UV-excited white LEDs, *Journal of Luminescence*, <https://doi.org/10.1016/j.jlumin.2018.09.010>

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# High-efficiency and thermal-stable $\text{Eu}^{3+}$ -activated $\text{Ca}_3\text{Y}(\text{AlO})_3(\text{BO}_3)_4$ red-emitting phosphors for near-UV-excited white LEDs

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## Abstract

Red-emitting  $\text{Ca}_3\text{Y}(\text{AlO})_3(\text{BO}_3)_4:\text{Eu}^{3+}$  (abbreviated as CYAB: $\text{Eu}^{3+}$ ) phosphors with different  $\text{Eu}^{3+}$  doping concentrations were synthesized by a conventional solid-state method and their crystal structure, morphology, luminescence properties, decay curves and quantum efficiency were investigated in detail. The CYAB: $\text{Eu}^{3+}$  phosphors can emit red light peaking at  $\sim 621$  nm under 397 nm excitation and the most intense red emission was obtained at the  $\text{Eu}^{3+}$  concentration of 50 mol%. From the concentration-dependent photoluminescence studies of CYAB: $\text{Eu}^{3+}$  phosphors, the concentration quenching mechanism was dominated by dipole-dipole interaction. The as-prepared CYAB:0.5 $\text{Eu}^{3+}$  sample possessed good color coordinates of (0.653, 0.342) with high color purity of 90%. More importantly, the internal quantum efficiency of CYAB:0.5 $\text{Eu}^{3+}$  sample reached up to 88%. Furthermore, CYAB: $\text{Eu}^{3+}$  exhibited good thermal stability and its emission intensity at 150 °C was still up to 76.3% of that at room-temperature. In addition, a prototype LED device was fabricated by coating a phosphor blend of  $\text{BaMgAl}_{10}\text{O}_7:\text{Eu}^{2+}$  blue phosphors,  $(\text{Ba,Sr})_2\text{SiO}_4:\text{Eu}^{2+}$  green phosphors and CYAB:0.5 $\text{Eu}^{3+}$  red phosphors on the surface of 395 nm-emitting InGaN chip, which exhibited bright white light under 120 mA driven current. These good results indicate that the CYAB: $\text{Eu}^{3+}$  phosphors are very appropriate red-emitting phosphors for applications in near-ultraviolet-excited white light-emitting diodes.

Graphical Abstract

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