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Synthesis, luminescence properties and thermal stability of Eu^{3+} -activated $\text{Na}_2\text{Y}_2\text{B}_2\text{O}_7$ red phosphors excited by near-UV light for pc-WLEDs

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Abstract

In the present work, trivalent europium (Eu^{3+}) ion activated $\text{Na}_2\text{Y}_2\text{B}_2\text{O}_7$ red phosphors have been synthesized through high-temperature solid-state reaction. X-ray diffraction confirmed the successful formation of $\text{Na}_2\text{Y}_2\text{B}_2\text{O}_7:\text{Eu}^{3+}$ phosphors with monoclinic phase. Under near-UV light (395 nm) excitation, $\text{Na}_2\text{Y}_2\text{B}_2\text{O}_7:\text{Eu}^{3+}$ phosphors exhibited red emission around 619 nm due to the $^5\text{D}_0 \rightarrow ^7\text{F}_2$ transition. The intensity of the $^5\text{D}_0 \rightarrow ^7\text{F}_2$ transition increased with respect to Eu^{3+} ions concentration in $\text{Na}_2\text{Y}_{2(1-x)}\text{B}_2\text{O}_7:x\text{Eu}^{3+}$ ($0.05 \leq x \leq 0.5$) phosphors and the luminescence quenching was observed at $x = 0.35$. The critical distance (R_c) and θ were calculated to be 9.20 Å and 5.07, respectively, and thus the dipole-dipole interaction could play a significant role in concentration quenching. The lifetimes of the $\text{Na}_2\text{Y}_{2(1-x)}\text{B}_2\text{O}_7:x\text{Eu}^{3+}$ phosphors were calculated for various concentrations (x) of Eu^{3+} ions. In addition, the determined color purity of $\text{Na}_2\text{Y}_2\text{B}_2\text{O}_7:0.35\text{Eu}^{3+}$ phosphor was 98.2% and internal quantum efficiency was 36.6%. Temperature-dependent photoluminescence study showed that emission intensity at 423 K was 40.2% of its initial at room temperature. The calculated activation energy of the $\text{Na}_2\text{Y}_2\text{B}_2\text{O}_7:0.35\text{Eu}^{3+}$ phosphor was 0.16 eV. The above

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