$Li_3Ba_2Gd_{3-x}(WO_4)_8$: Eu reddish orange phosphors for potential application in wLED

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Reddish orange $Li_3Ba_2Gd_{3-x}(WO_4)_8$:xEu^{3+} ($0.5 \leq x \leq 10$ at.%) phosphors were successfully synthesized by the conventional solid-state reaction method at high temperature in air atmosphere. The phosphors crystallized in the monoclinic system with C2/c space group and 2/m point group. The unit cell parameters are a= 5.2149(4) Å, b=12.7447(1) Å, c=19.2058(3) Å, α=γ=90°, β=a^c =91.9315(1)° and V_{calc} = 1275.748(2) $Å^3$. After excitation at 395 nm, the phosphors showed red emission with a peak centered at 614 nm which was attributed to the $^5D_0 \rightarrow {}^7F_2$ electric dipolar transition of Eu^{3+} ions. [1]At the same time, the influence of different Eu^{3+} ion concentration on the PL intensity are also discussed. The concentration quenching mechanism was attributed to the dipole-quadrupole interaction and the critical distance for energy transfer among Eu^{3+} ions was calculated to be 7.409 Å. The values of the asymmetry ratio [($^5D_0 \rightarrow {}^7F_2$)/($^5D_0 \rightarrow {}^7F_1$)] of the synthesized phosphors revealed that Eu^{3+} occupied the distorted cationic sites with a non-centrosymmetric position. The Judd–Ofelt theory was employed to evaluate the intensity parameters and radiative properties.The quantum efficiency showed the highest value for $Li_3Ba_2Gd_3(WO_4)_8$: 4 at.% Eu^{3+} being 26.35. The fluorescence decay times were also determined for the $Li_3Ba_2Gd_3(WO_4)_8$:Eu phosphors. Besides, the color coordinates of $Li_3Ba_2Gd_3(WO_4)_8$:3 at.%Eu were defined as (0.6302, 0.3648), close to those of standard red light (0.670, 0.330) and also showed high color purity (98.42%) under excitation at 395 nm. Furthermore, the $Li_3Ba_2Gd_3(WO_4)_8$: 3 at.% Eu phosphors showed good thermal stability with an activation energy of 0.428 eV. The above results revealed that the Eu^{3+}-doped $Li_3Ba_2Gd_3(WO_4)_8$ phosphors can serve as potential reddish orange emitting phosphors for near-UV pumped WLEDs.

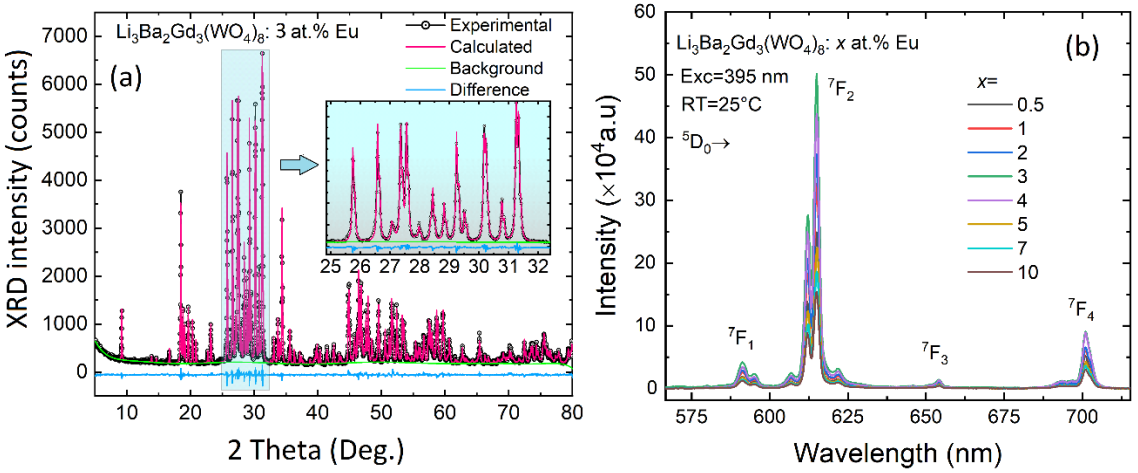

Fig 1 (a) Rietveld refinement plots for $Li_3Ba_2Gd_3(WO_4)_8$:3%Eu, the experimental profile-black dots ; the calculated pattern-red line; the difference plot-blue line and the background-green line; *Inset*: zoomed view in the range between 25 and 32°(b) Emission spectra of $Li_3Ba_2Gd_3(WO_4)_8$:x at.% Eu^{3+} ($0.5 \leq x \leq 10$) phosphors ; λ_{ex}=395 nm.

References

[1] X. Huang, Red phosphor converts white LEDs, Nat. Photonics. 8 (2014) 748–749.