Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C
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# Supplementary Information

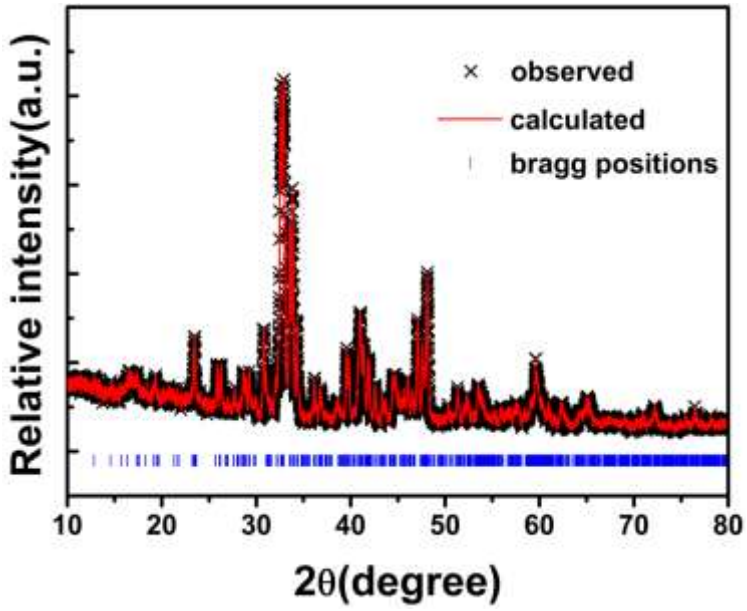


**Fig. S1** Observed (crosses) and calculated (solid line) synchrotron XRD profiles and their difference (bottom) for the Rietveld refinement of $Ca_{11}(SiO_4)_4(BO_3)_2$ at room temperature.

The room-temperature powder X-ray diffraction patterns for $Ca_{11}(SiO_4)_4(BO_3)_2$ are shown in Fig. S1. The XRD data could be indexed on the basis of known β-$Ca_{10}(SiO_4)_4(CO_3)_2$ crystal structure and refined by the Rietveld method ($R_{wp}$ = 12.89 %, $R_p$ = 9.11 %). The products crystallize in the orthorhombic system with space group $P2_1/a$ (No. 14).

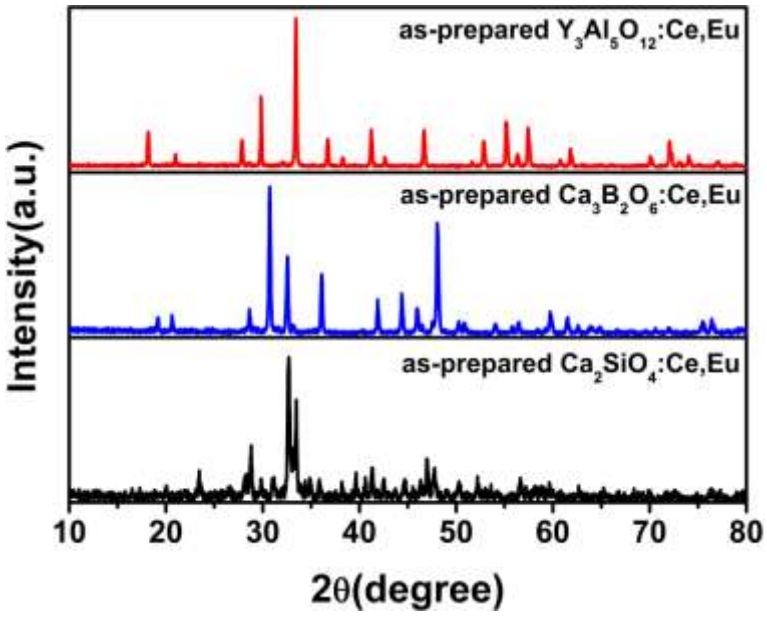


**Fig. S2** XRD patterns of as-prepared $Ca_2SiO_4$:0.02Ce,0.005Eu, $Ca_3B_2O_6$:0.01Ce,0.001Eu and

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YAG:0.02Ce,0.03Eu.

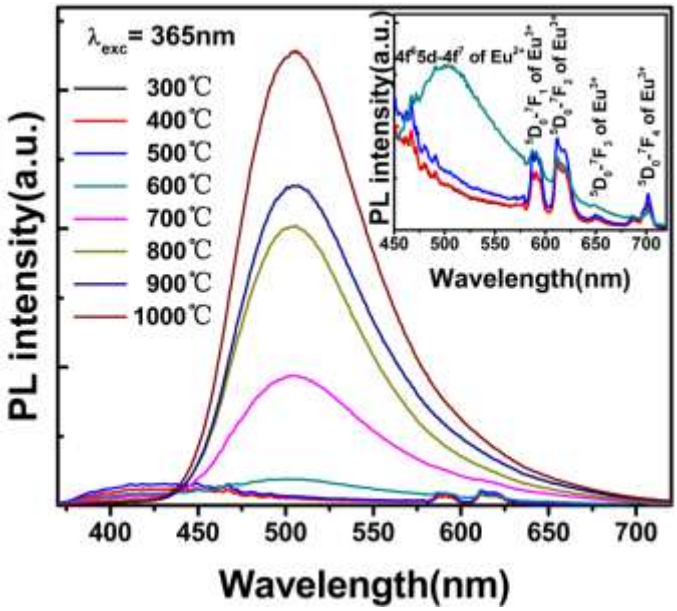


**Fig. S3** PL spectra of Al-reduced CSB:0.005Eu calcined at different temperature.

Fig. S3 shows the PL spectra of Al-reduced CSB:0.005Eu calcined at different temperature. The intense broad peaks of all samples are originated from 5d/4f transition of $Eu^{2+}$ ions due to the strong coupling of the 5d electron with host lattice. In the system of Al-reduced CSB:$Eu^{2+}$, PL intensity increase with increasing temperature. Signals of $Eu^{3+}$ emission were detected in the samples prepared blow 600 °C. As shown in Fig. S3, a few sharp emission peaks are observed at 587, 613, 623, 650, 702 nm. All these are characteristic emission peaks of $Eu^{3+}$ ions, indicating that the reduction temperature from $Eu^{3+}$ ions $Eu^{2+}$ in CSB host may occur at about 600 °C.

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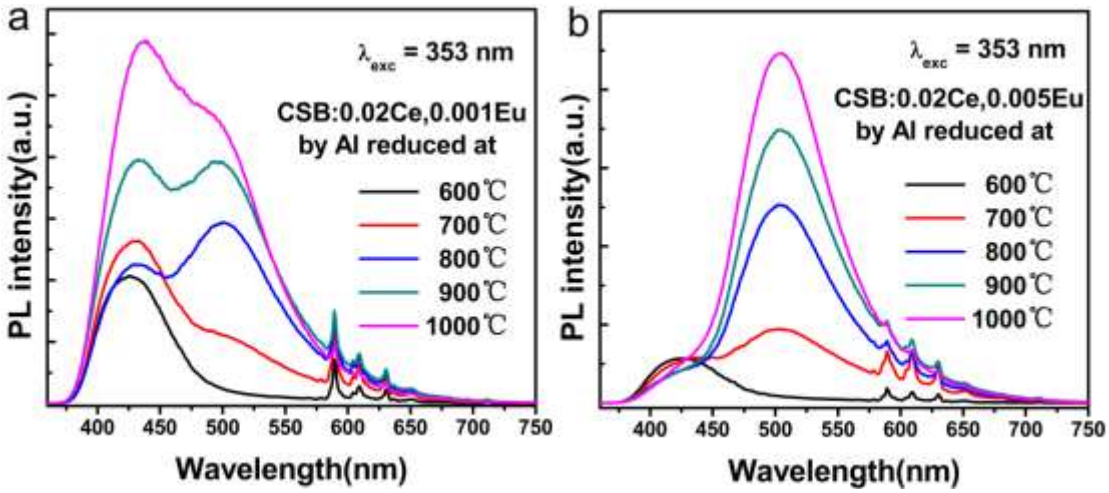


**Fig. S4** PL spectra of Al-reduced CSB:0.02Ce,0.001Eu and CSB:0.02Ce,0.005Eu calcined at different temperature.

Quantum efficiencies of selected samples were calculated according to the method described by de Mello *et al* [S1] and Palsson *et al* [S2]. Briefly, the method allows determining the sample quantum efficiency $\Phi_f$ by measuring the ratio between the number of photons emitted ($N_{em}$) and the number of those absorbed ($N_{abs}$) by the sample using the relation: $\Phi_f = N_{em}/N_{abs} = (E_c\text{-}E_a)/(L_a\text{-}L_c)$ where $E_c$ is the integrated luminescence of the sample caused by direct excitation, $E_a$ is the integrated luminescence from an empty integrating sphere (without the sample, only a blank), $L_a$ is the integrated excitation profile from an empty integrating sphere, and $L_c$ is the integrated excitation profile when the sample is directly excited by the incident beam.

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**Table S1** The chromaticity coordinates of phosphors CSB:0.02Ce,0.001Eu and CSB:0.02Ce,0.001Eu at different reduction temperature.

| reduction temperature (°C) | CIE (*x*, *y*) | |
|---|---|---|
| | CSB:0.02Ce,0.001Eu | CSB:0.02Ce,0.005Eu |
| 600 | (0.195, 0.090) | (0.208, 0.118) |
| 700 | (0.213, 0.193) | (0.267, 0.348) |
| 800 | (0.215, 0.306) | (0.241, 0.426) |
| 900 | (0.201, 0.266) | (0.243, 0.442) |
| 1000 | (0.179, 0.216) | (0.223, 0.436) |

**References:**

S1 J. C. De Mello, H. F. Wittmann, and R. H. Friend, *Adv. Mater*., 1997, **9**, 230-232.

S2 L. O. Palsson and A. P. Monkman, *Adv. Mater.*, 2002, **14**, 757-758.