

Support Information

for

Constructing a single-white-light emission by finely modulating the occupancy of luminescence centers in europium doped $(\text{Ca}_{1-x}\text{Sr}_x)_9\text{Bi}(\text{PO}_4)_7$ for WLED

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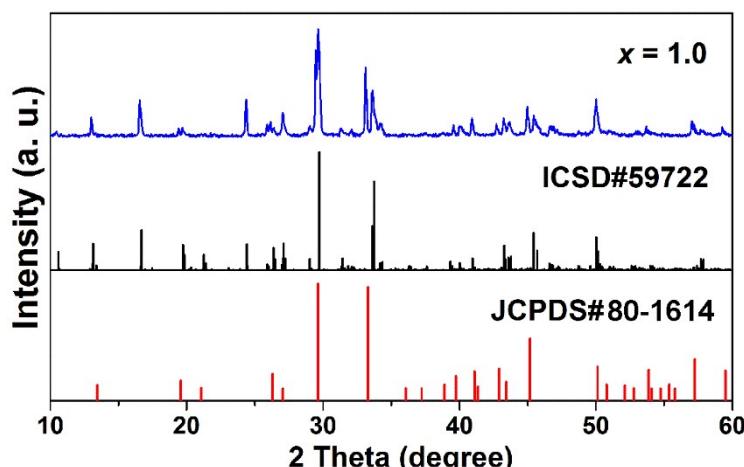


Figure S1. The XRD patterns of $x = 1.0$ sample and the standard patterns of $\text{Sr}_9\text{In}(\text{PO}_4)_7$ (ICSD # 59722) and $\text{Sr}_3(\text{PO}_4)_2$ (JCPDS# 80-1614).

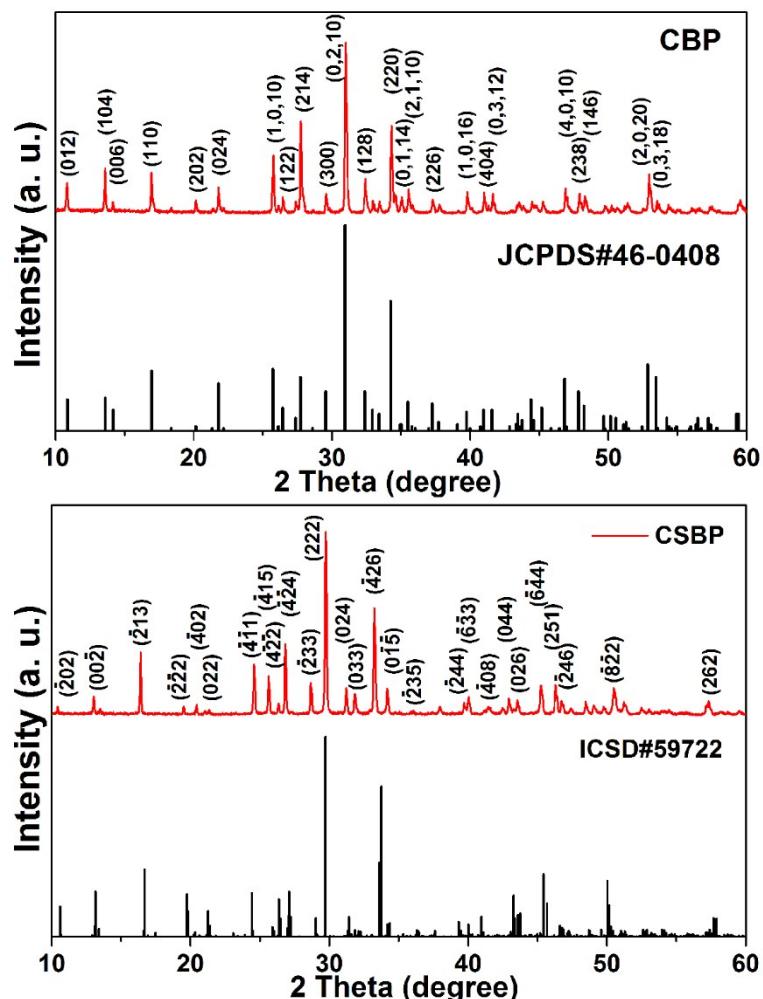


Figure S2. The XRD patterns indexing of CBP and CSBP.

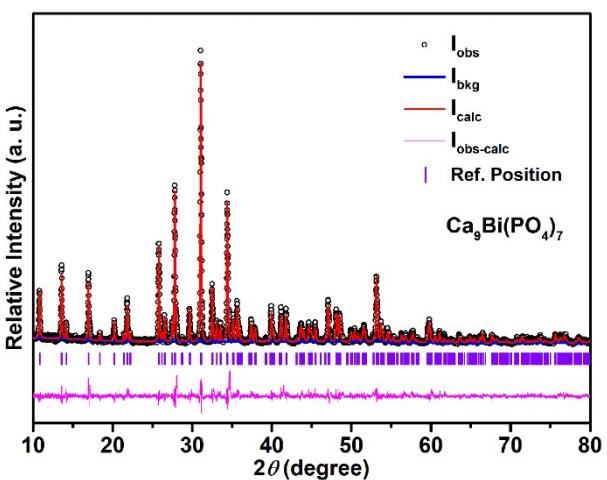


Figure S3. The Rietveld refinement XRD patterns of CBP.

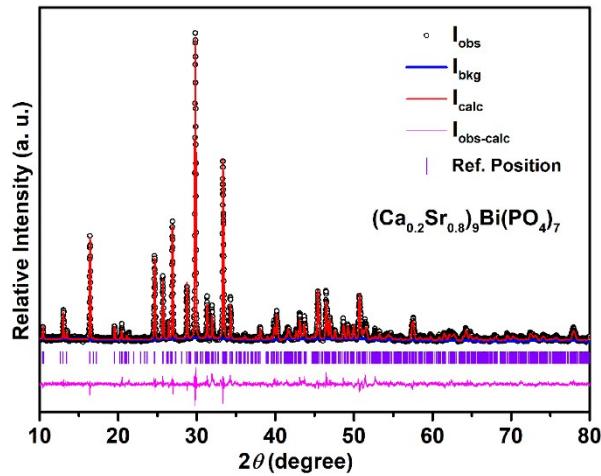


Figure S4. The Rietveld refinement XRD patterns of CSBP.

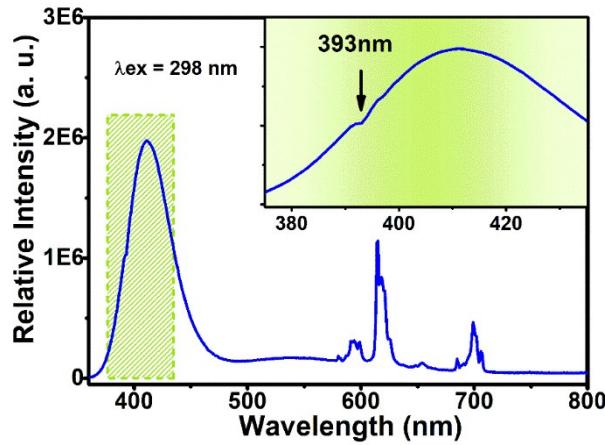


Figure S5. The spectral decline at around 393 nm occurs in the PL spectrum of CBP:Eu.

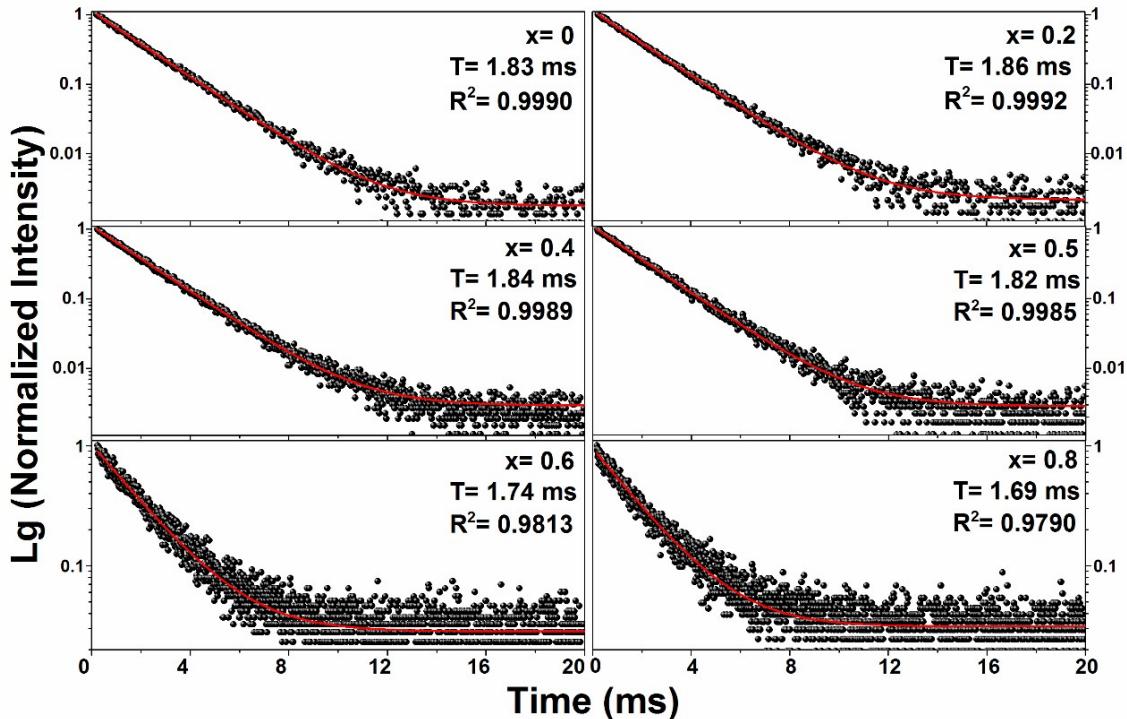


Figure S6. The lifetime decrease of Eu^{3+} monitored at 617 nm under the excitation of 393 nm with x .

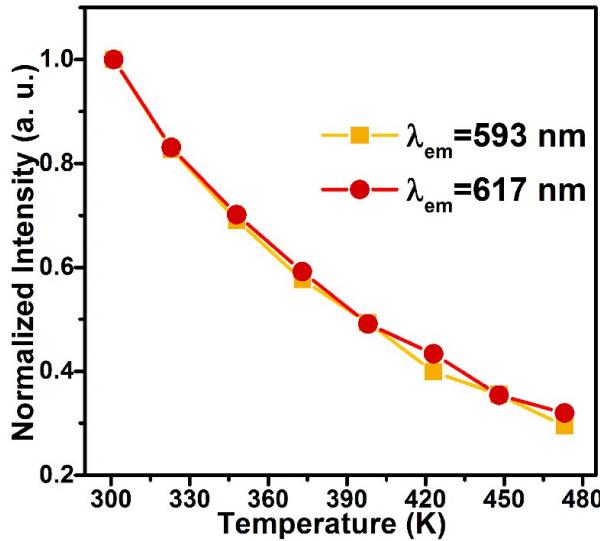


Figure S7. The temperature-dependent emission intensity of Eu²⁺ ($\lambda_{\text{em}} = 593 \text{ nm}$) and Eu³⁺ ($\lambda_{\text{em}} = 617 \text{ nm}$) in CSBP.

Table S1. Reitveld Refinement Data of CBP.

Ca₉Bi(PO₄)₇						
Space-group	R 3 c (161) - trigonal a=10.4001(3) Å c=37.2548(1) Å					
Cell	c/a=3.5822 V=3489.71(1) Å ³ Z=6					
Refinement results	$R_{\text{wp}} = 14.68\%$; $R_{\text{p}} = 11.93\%$; $\chi^2 = 1.154$					
Atomic parameters						
Atom	Wyck.	S.O.F.	x/a	y/b	z/c	U [Å ²]
Ca1/Bi1	18b	1	0.7276(2)	0.8560(2)	0.1685(1)	0.032(8)
Ca2/Bi2	18b	1	0.6196(8)	0.8247(1)	-0.0309(9)	0.024(0)
Ca3/Bi3	18b	1	0.7279(6)	0.8518(8)	0.0637(2)	0.020(1)
Ca4	-	-	-	-	-	-
Ca5	6a	1	0	0	0.7336(0)	0.012(1)
P1	6a	1	0	0	0	0.20(3)
P2	18b	1	0.6820(0)	0.8510(8)	0.8662(5)	0.019(6)
P3	18b	1	0.6510(9)	0.8446(3)	0.7687(7)	0.039(6)
O1	18b	1	0.7283(7)	-0.1057(5)	-0.0894(0)	0.044(6)
O2	18b	1	0.7680(0)	0.7856(7)	0.8631(7)	0.125(9)
O3	18b	1	0.7298(0)	0.0088(0)	0.8486(0)	0.016(7)
O4	18b	1	0.5348(8)	0.7667(2)	0.8633(3)	0.054(0)
O5	18b	1	0.6177(2)	-0.0588(6)	0.7865(3)	0.077(3)
O6	18b	1	0.5654(9)	0.6947(3)	0.7904(8)	0.017(8)
O7	18b	1	0.0844(6)	0.9051(7)	0.7735(9)	0.009(5)
O8	18b	1	0.6411(4)	0.8312(8)	0.7302(9)	0.008(8)
O9	18b	1	0.0057(0)	0.8624(0)	-0.0154(2)	0.029(6)
O10	6a	1	0	0	0.0421(0)	0.019(6)

Table S2. Reitveld Refinement Data of CSBP.

(Ca_{0.2}Sr_{0.8})₉Bi(PO₄)₇						
Space-group	I 1 2/a 1 (15) - monoclinic					
Cell	a=17.9160(8) Å b=10.6963(4) Å c=18.5235(6) Å β=133.58(0)° V=2571.37(4) Å ³ Z=4					
Refinement results	R _{wp} = 11.08%; R _p = 8.96%; χ ² = 2.156					
Atomic parameters						
Atom	Wyck.	S.O.F.	x/a	y/b	z/c	U [Å²]
Sr1/Ca1	8f	1	0.1984(2)	-0.0034(0)	0.2777(8)	0.034(4)
Sr2/Ca2	8f	1	0.3089(7)	0.7203(3)	0.4437(0)	0.000(2)
Sr3/Ca3	8f	1	0.8044(7)	0.7162(8)	0.4415(5)	0.007(3)
Sr4/Ca4	8f	0.5	0.0251(7)	0.4971(7)	-0.0085(2)	0.023(8)
Sr5/Ca5	8f	1	-0.0178(9)	0.7306(2)	0.2387(3)	0.154(0)
Bi	4a	1	0	0	0	0.452(7)
P1	4e	1	1/4	0.4783(4)	0	0.076(3)
P2	8f	1	0.3938(2)	-0.0034(0)	0.1112(6)	0.068(0)
P3	8f	1	0.1220(1)	0.2798(9)	0.1838(2)	0.300(8)
P4	8f	1	0.5961(4)	0.2541(7)	0.1584(0)	0.095(6)
O1	8f	1	0.8094(3)	0.6055(9)	0.0769(8)	0.140(6)
O2	8f	1	0.2196(5)	0.9348(2)	0.5322(2)	0.205(0)
O3	8f	1	0.4910(8)	-0.0027(3)	0.7862(0)	0.002(7)
O4	8f	1	0.3432(8)	0.8736(7)	0.0977(1)	0.090(0)
O5	8f	1	0.8540(4)	0.8916(7)	0.1048(3)	0.090(0)
O6	8f	1	0.3866(9)	-0.0015(1)	0.0236(2)	0.073(9)
O7	8f	1	0.3503(0)	0.2552(0)	0.2419(0)	0.800(0)
O8	8f	1	0.8526(6)	0.8541(1)	0.3725(3)	0.785(9)
O9	8f	1	0.6265(4)	0.6409(2)	0.6283(4)	0.084(2)
O10	8f	1	0.5381(2)	0.2071(3)	0.4187(9)	0.020(4)
O11	8f	1	0.0245(4)	0.2064(2)	0.4286(6)	0.082(9)
O12	8f	1	0.3095(8)	0.8577(6)	0.3278(5)	0.212(6)
O13	8f	1	0.8563(9)	0.2810(1)	0.2076(9)	0.800(0)
O14	8f	1	0.1122(3)	0.6352(8)	0.6216(9)	0.021(5)

Table S3. The mean bond lengths of Ca/Bi - O in CBP.

The Ca/Bi - O bond lengths in CBP	
Bonds	Mean bond length (Å)
Ca1/Bi1 - O	2.437
Ca2/Bi2 - O	2.464
Ca3/Bi3 - O	2.513
Ca5 - O	2.295
Total average	2.432