Electronic Supplementary Material (ESI) for Dalton Transactions.

Supplementary Information

Narrow band red emitting phosphor with negligible concentration quenching for hybrid white LEDs and plant growth applications

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Table ST1 Lattice parameters for $Li_3BaSrLa_{3-x}Eu_x(MoO_4)_8$ where x = 0 – 3 (in steps of 0.3).

Concentration of Eu^{3+}(x)	a (Å)	b (Å)	c (Å)	β (Å)	V (Å^3)
0.3	5.2816	12.8192	19.9946	92.8875	1291.305
0.6	5.2681	12.8141	19.4057	92.7371	1283.666
0.9	5.2655	12.7407	19.2631	92.7071	1280.374
1.2	5.2554	12.7236	19.2176	92.1894	1279.561
1.5	5.2468	12.7156	19.2170	92.1589	1277.002
1.8	5.2320	12.7138	19.2080	91.4221	1272.372
2.1	5.2218	12.7129	19.1818	91.3841	1270.752
2.4	5.1915	12.7096	19.1419	91.3637	1269.197
2.7	5.1903	12.6723	18.9812	90.8082	1265.653
3	5.1766	12.6640	19.2170	91.2714	1266.653

Table ST2 The band gaps of $Li_3BaSrLa_{3-x}Eu_x(MoO_4)_8$ where x = 0.3 – 3

Composition in terms of x	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3
Band gap (E_g) in eV	3.75	3.48	3.41	3.38	3.37	3.35	3.34	3.32	3.29	3.48

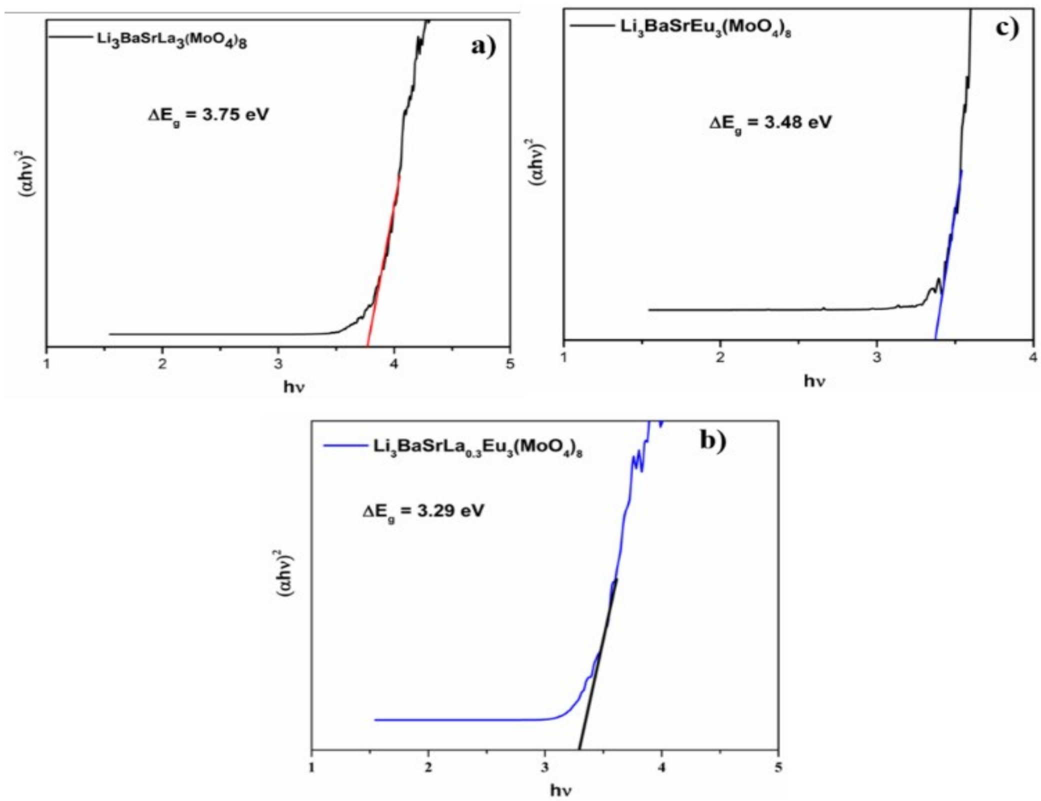


Fig.S1. The plot of $(\alpha h\nu)^2$ verses hν) host $Li_3BaSrLa_3(MoO_4)_8$, b) $0.3Eu^{3+}$: $Li_3BaSrLa_3(MoO_4)_8$ and c) $Li_3BaSrEu_3(MoO_4)_8$

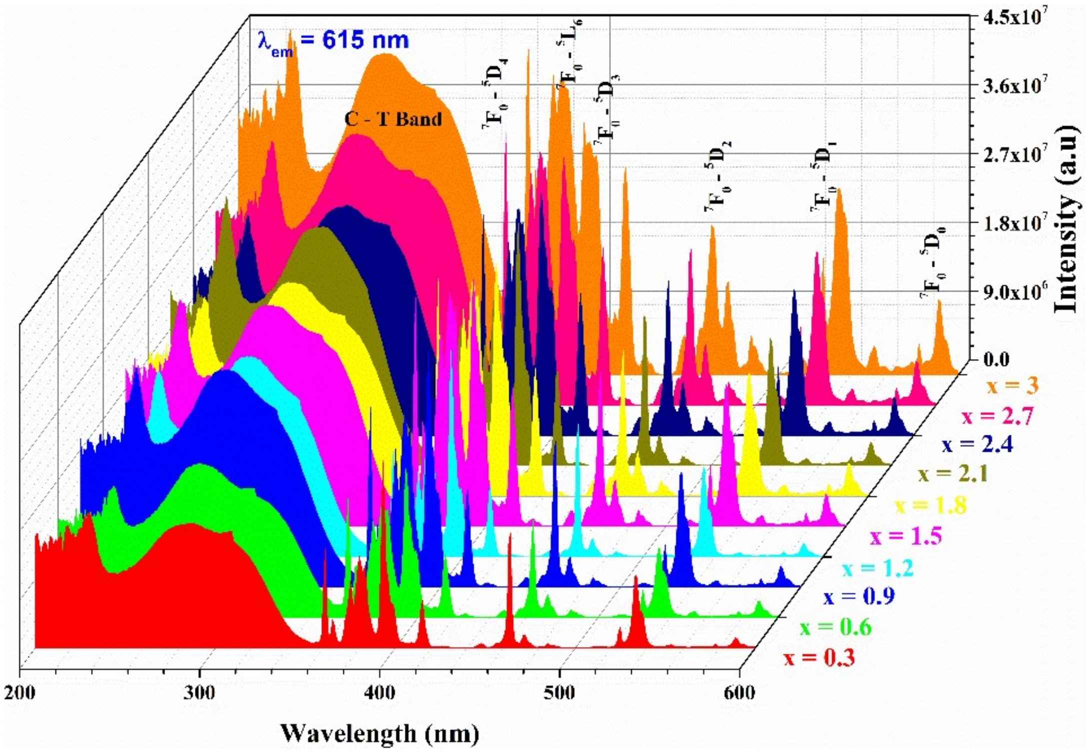


Fig.S2. PL excitation spectra of $Li_3BaSrLa_{3-x}Eu_x(MoO_4)_8$ where x = 0 – 3 at λ_{em} = 615 nm.

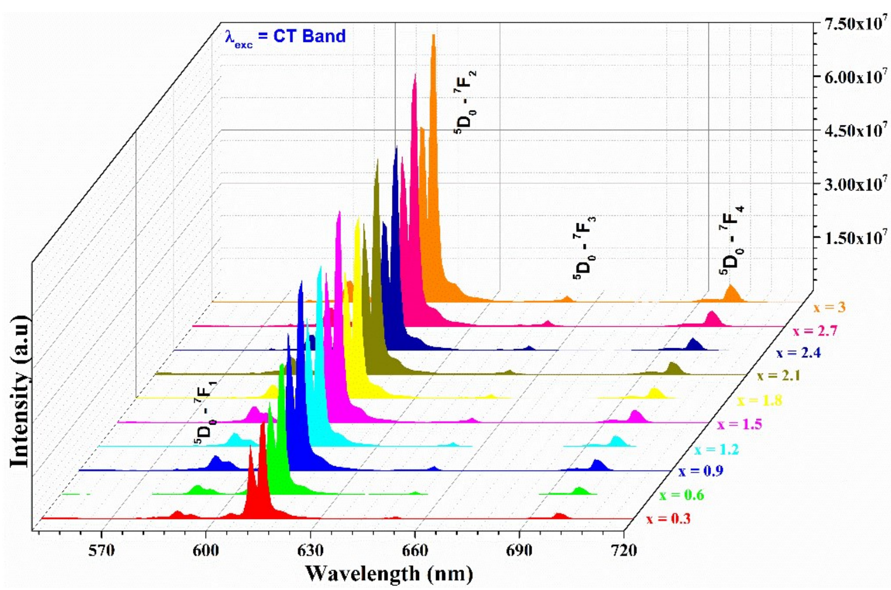


Fig. S3. PL emission spectra of $Li_3BaSrLa_{3-x}Eu_x(MoO_4)_8$ where x = 0.3 – 3 at λ_{exc} = CT band.

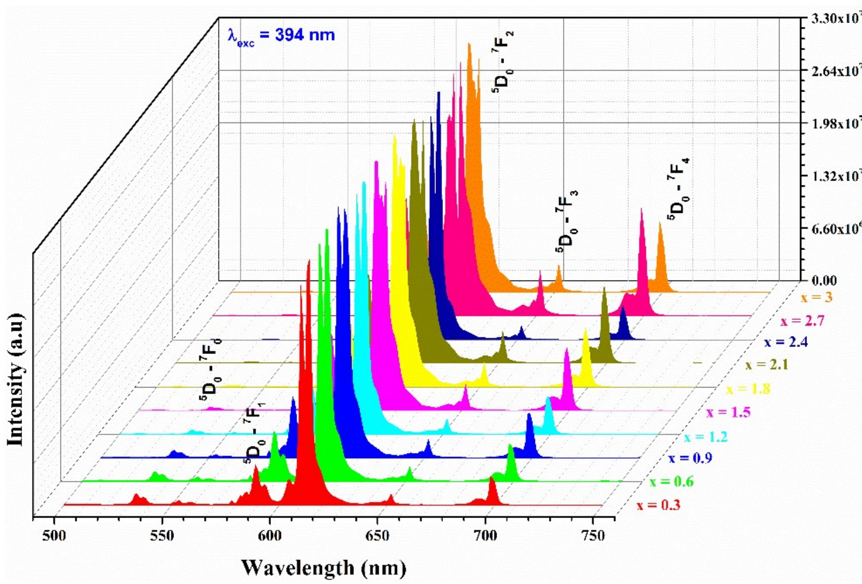


Fig. S4. PL emission spectra of $Li_3BaSrLa_{3-x}Eu_x(MoO_4)_8$ where x = 0.3 – 3 at λ_{exc} = 394 nm

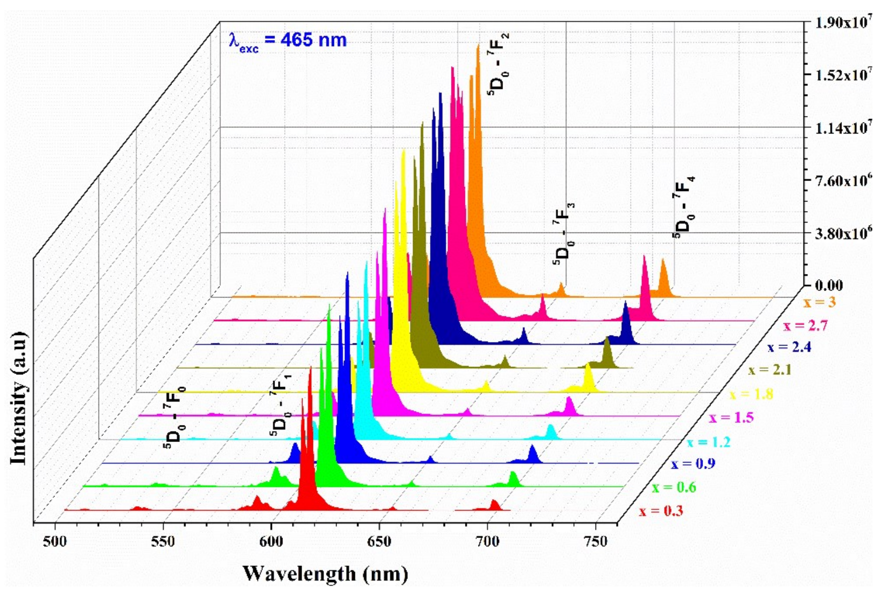


Fig. S5. PL emission spectra of $Li_3BaSrLa_{3-x}Eu_x(MoO_4)_8$ where x = 0.3 – 3 at λ_{exc} = 465 nm]

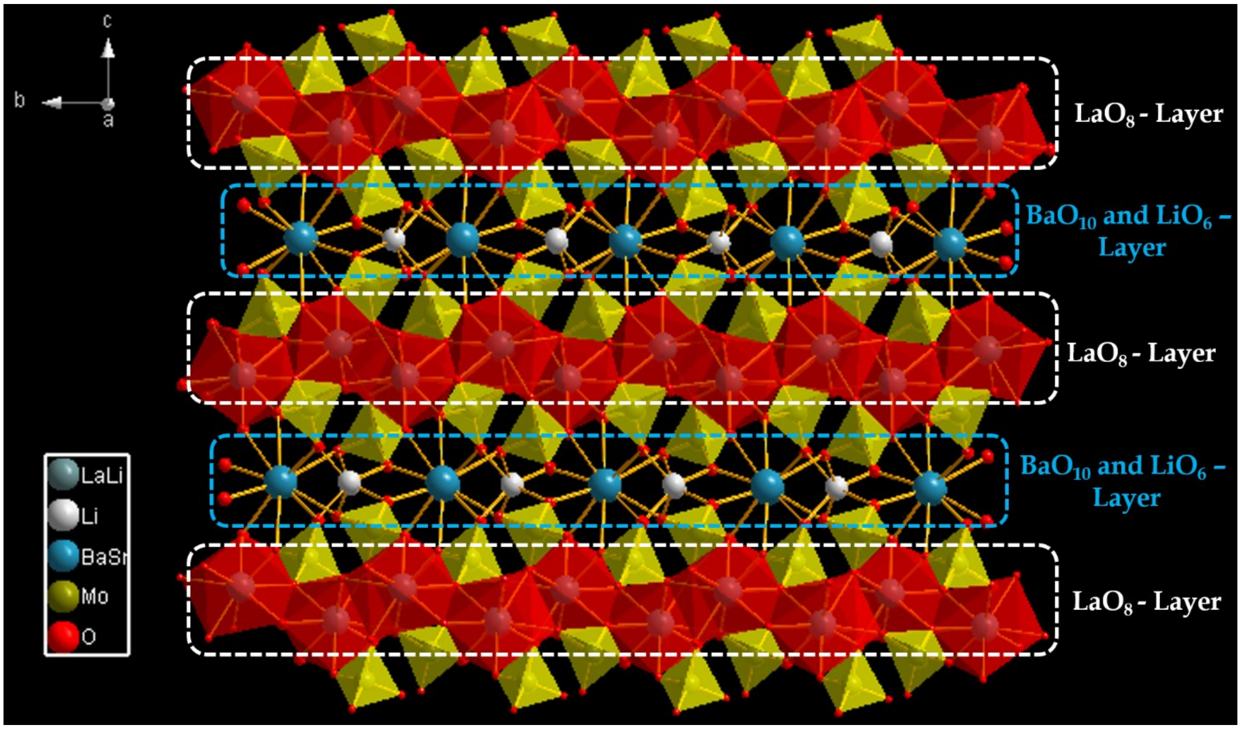


Fig S6. Layered structure of $Li_3BaSrLa_3(MoO_4)_8$

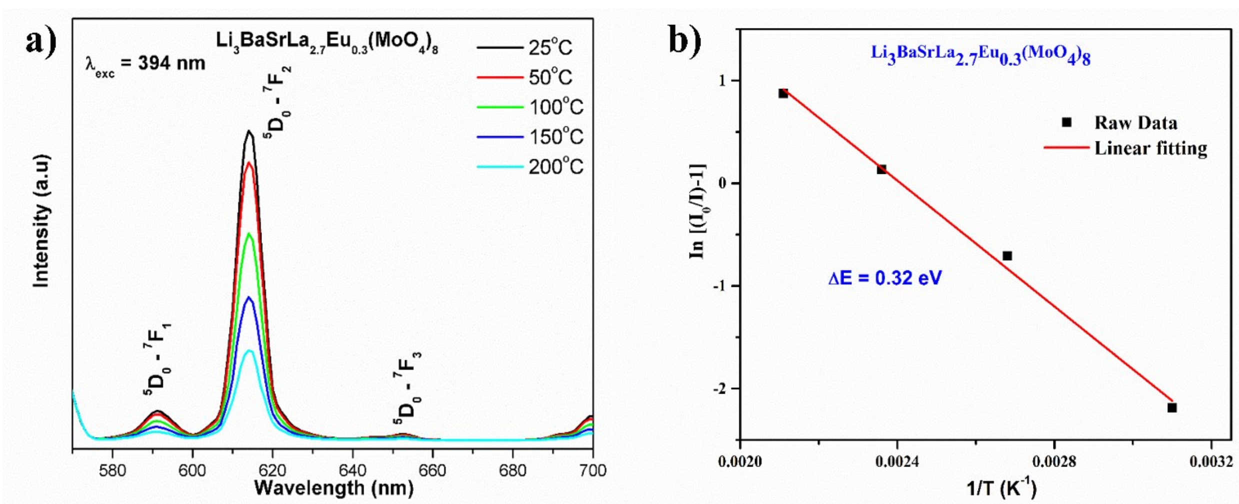


Fig. S7. a) Temperature dependence profile of emission intensity at λ_{exc} = 394 nm from 25º C to 200º C, b) Plot of $\ln(I/I_0) - 1$ verses 1/KT for $Li_3BaSrLa_{2.7}Eu_{0.3}(MoO_4)_8$ phosphor.

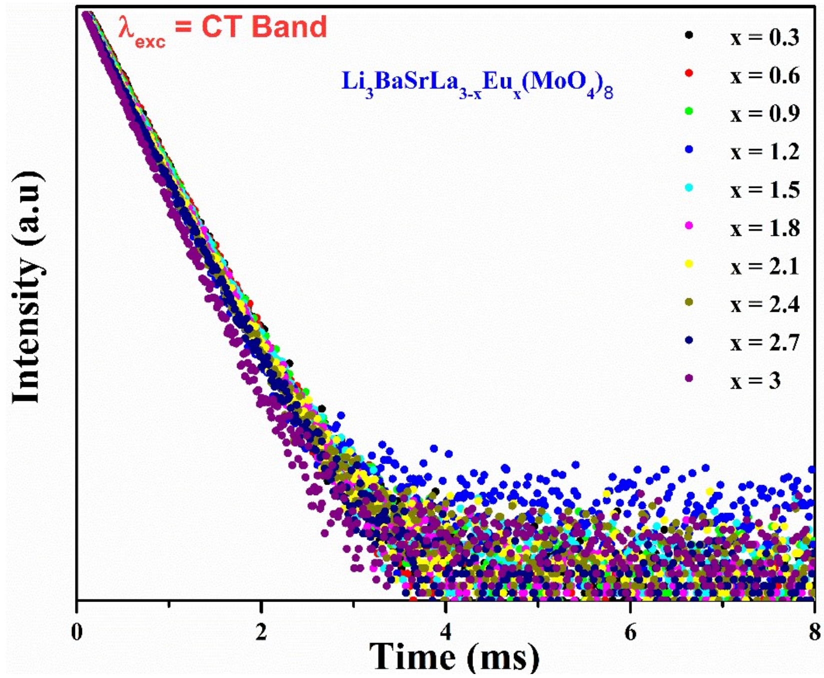


Fig. S8. PL lifetime for $Li_3BaSrLa_{3-x}Eu_x(MoO_4)_8$phosphors with different concentration under CT band nm excitation

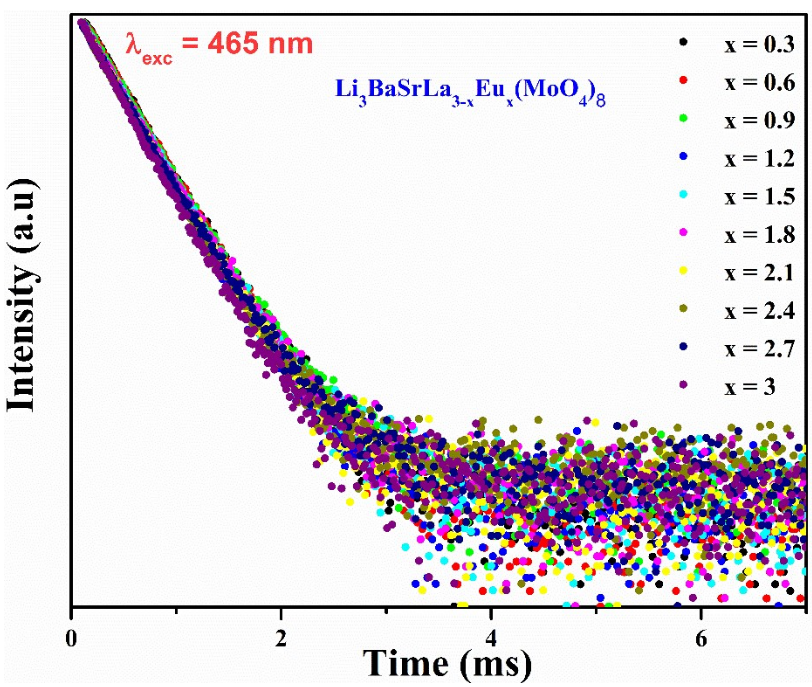


Fig. S9.PL lifetime for $Li_3BaSrLa_{3-x}Eu_x(MoO_4)_8$phosphors with different concentration under under 465 nm excitation

Table ST3 lifetime of $Li_3BaSrLa_{3-x}Eu_x(MoO_4)_8$ in different excitation CT band, 394 and 465 nm

Composition in terms of concentration (x)	Lifetime in ms		
	λ_{exc} = CT Band	λ_{exc} = 394 nm	λ_{exc} = 465 nm
0.3	0.489	0.474	0.472
0.6	0.487	0.473	0.469
0.9	0.485	0.472	0.468
1.2	0.483	0.472	0.466
1.5	0.481	0.470	0.466
1.8	0.474	0.465	0.458
2.1	0.463	0.460	0.452
2.4	0.462	0.457	0.442
2.7	0.450	0.435	0.438
3	0.412	0.419	0.420

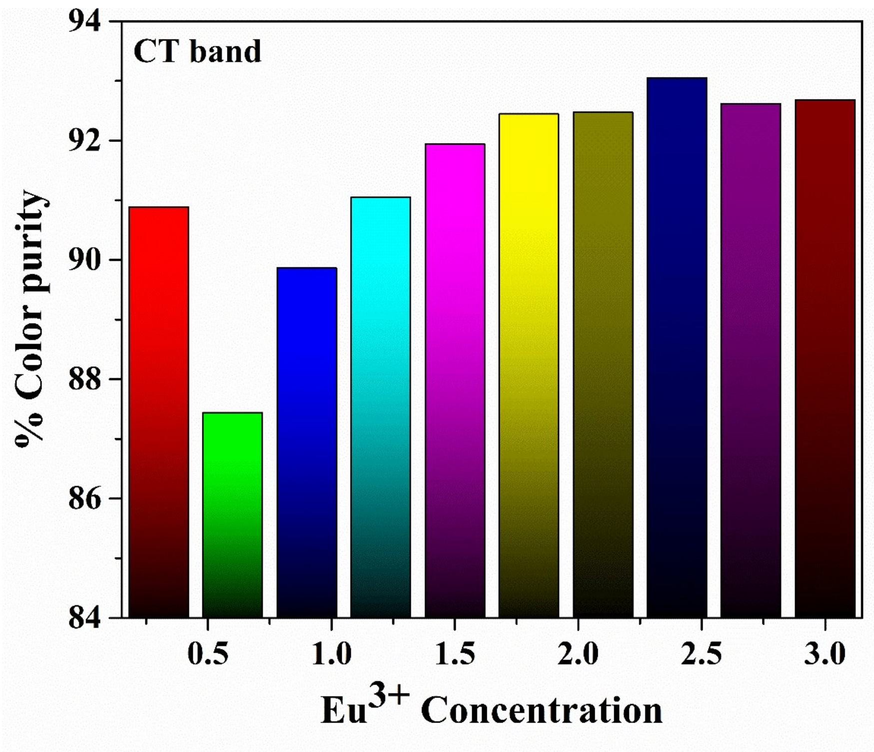


Fig. S10. Color purity percentage of the $Li_3BaSrLa_{3-x}Eu_x(MoO_4)_8$ phosphors

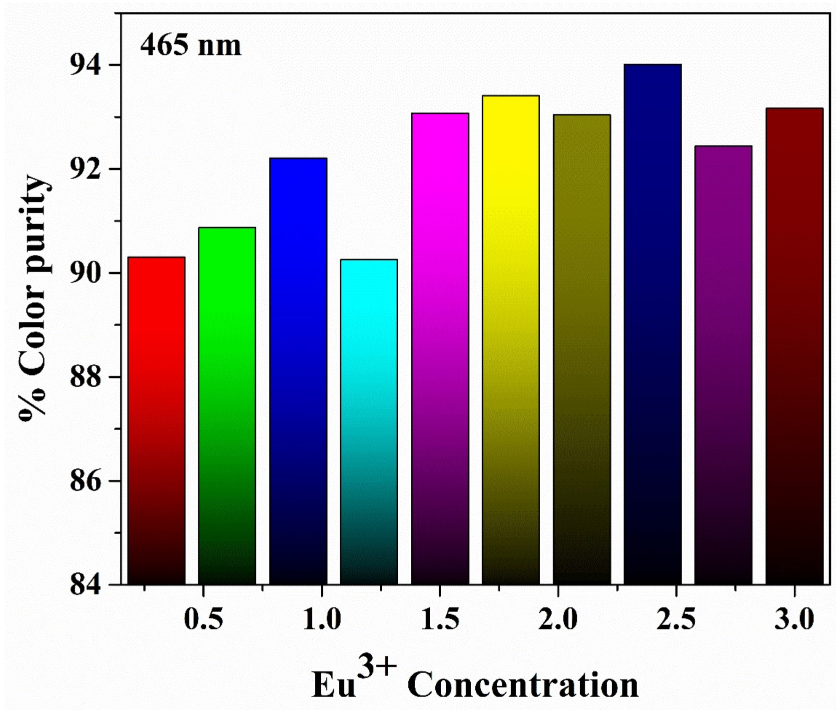


Fig. S11. Color purity percentage of the $Li_3BaSrLa_{3-x}Eu_x(MoO_4)_8$ phosphors

Table ST4 CIE chromaticity coordinates for $Li_3BaSrLa_{3-x}Eu_x(MoO_4)_8$ where x = 0.3 – 3 phosphors

Concentration in x	CIE chromaticity coordinates					
	λ_{exc} = CT Band		λ_{exc} = 394 nm		λ_{exc} = 465 nm	
	x	y	x	y	x	y
0.3	0.6422	0.3682	0.6415	0.3579	0.6415	0.3579
0.6	0.6307	0.3588	0.6426	0.3568	0.6439	0.3555
0.9	0.6403	0.3542	0.6458	0.3486	0.6495	0.3499
1.2	0.6451	0.3507	0.6504	0.3492	0.6425	0.3471
1.5	0.6486	0.3489	0.6479	0.3517	0.6530	0.3468
1.8	0.6505	0.3486	0.6504	0.3493	0.6544	0.3452
2.1	0.6508	0.3466	0.6477	0.3519	0.6529	0.3467
2.4	0.6528	0.3482	0.6551	0.3445	0.6568	0.3428
2.7	0.6512	0.3481	0.6445	0.3550	0.6504	0.3493
3	0.6513	0.3494	0.6492	0.3504	0.6534	0.3462

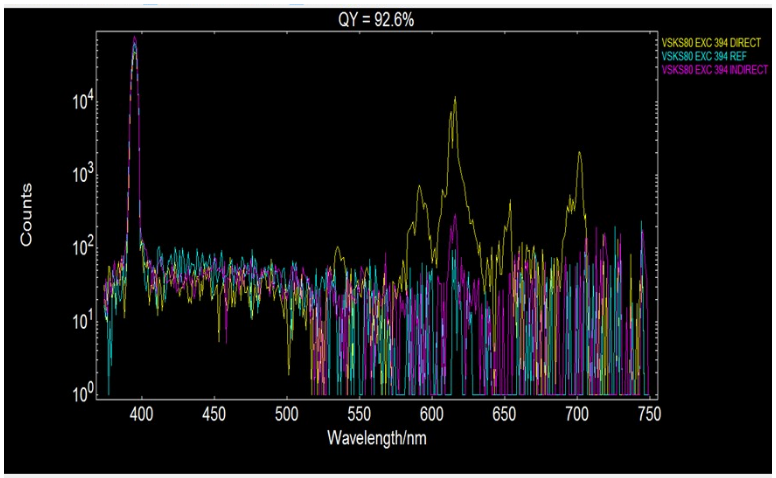
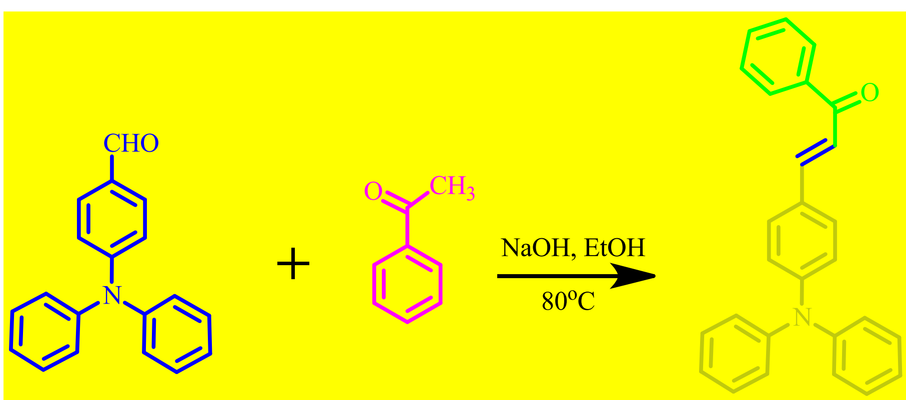


Fig. S12. The absolute quantum yield measurement (screen shot) for the $Li_3BaSrLa_{0.3}Eu_{2.7}(MoO_4)_8$ phosphor

Experimental section of yellow organic dye:

Aldehyde (1.831 mmol, 1 eq.) and NaOH (1.831 mmol, 1 eq.) were added into a mixture of 30 mL of water and 25 mL of ethanol, then 1-phenylethanone (3.663 mmol, 2 eq.) was added. The mixture was heated and stirred at 90 °C for 4 h. After cooling, the mixture was filtered and washed with plenty of water and then dried at RT to produce a yellow powder with a yield of 80% and the synthetic scheme for the preparation of the yellow dye is shown below.



Scheme S1. Synthesis of TPA substituted yellow organic dye.

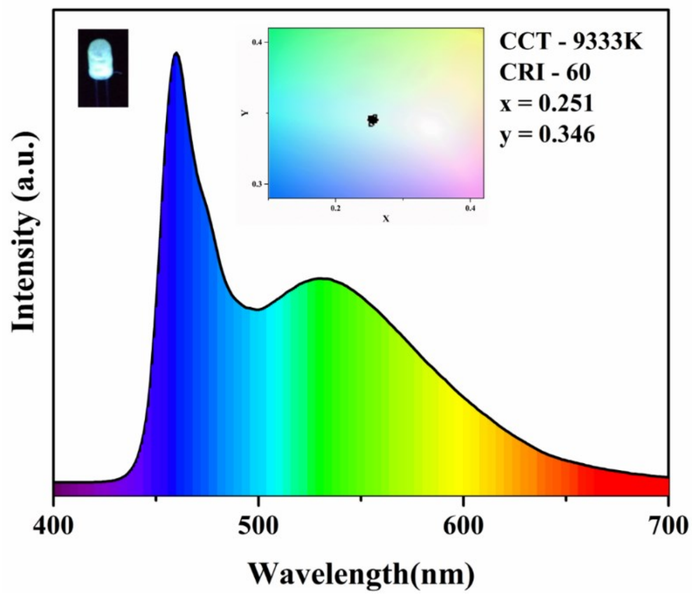


Fig. S13 EL spectrum of white LED by using blue LED with yellow organic dye.