Electronic Supplementary Material (ESI) for Materials Advances.

Strong and pure red-emitting Eu^{3+}-doped phosphor with excellent thermal stability for warm WLEDs

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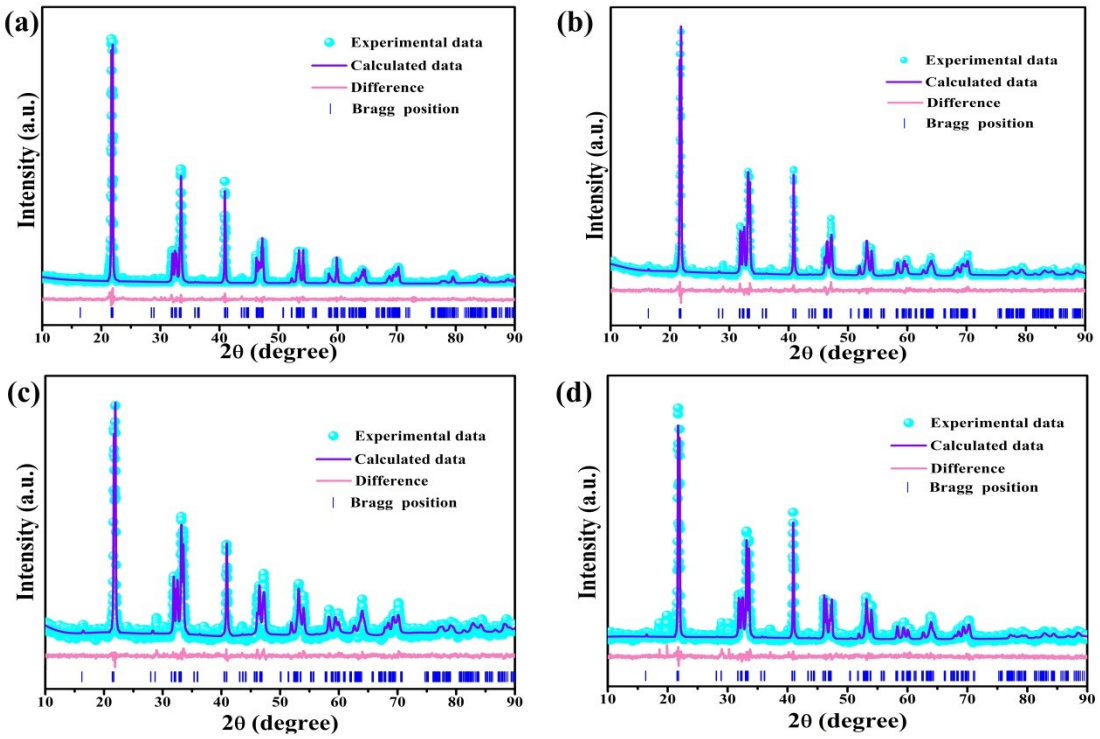

Fig. S1 Rietveld refinements of the LiYO2:xEu^{3+} with x = 0.25, 0.30, 0.35, 0.40 (a-d), respectively.

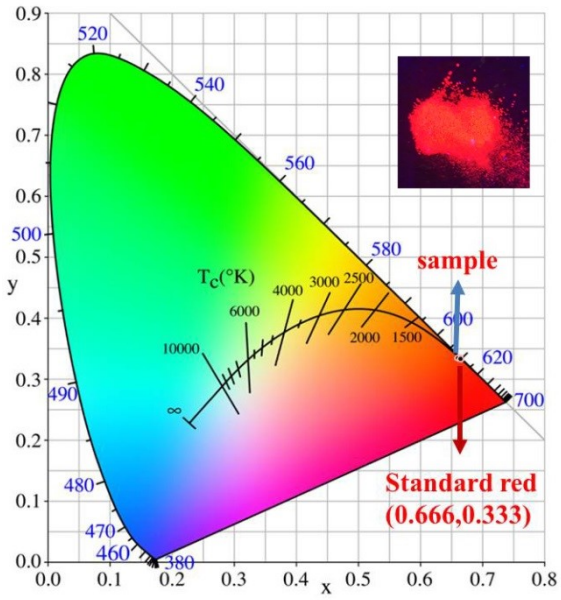

Fig. S2 CIE coordinates profile of $LiYO_2:xEu^{3+}$ (x = 0.15-0.40) samples, the inset pictures are the phosphors under the 365 nm blue light excitation in dark background.

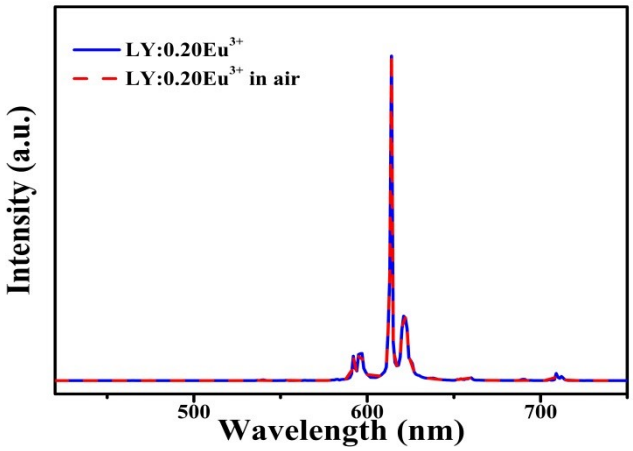

Fig. S3 Emission spectrum of the $LY:0.20Eu^{3+}$ sample and the $LY:0.20Eu^{3+}$ sample placed in the air for two weeks

Table S1 Refined structural data of $LiYO_2:xEu^{3+}$ samples.

x	a, Å	b, Å	c, Å	V, $Å^3$	Rwp,%	Rp,%	X^2
0.15	6.167667	6.185144	6.264522	208.924	5.68	4.45	2.014
0.20	6.173124	6.180048	6.273077	209.111	5.46	4.16	2.351

0.25	6.191825	6.177590	6.298832	210.275	4.86	3.77	1.822
0.30	6.208351	6.175650	6.319654	211.283	5.24	4.06	1.955
0.35	6.219486	6.174877	6.334198	212.028	5.47	4.25	1.885
0.40	6.227838	6.169772	6.344096	212.327	5.06	3.77	2.082

Table S2 the Y-O bond length of $LiYO_2$:xEu^{3+} samples

x	Y-O1 (Å)			Y-O2 (Å)			Average (Å)
0.15	2.22612	2.24311	2.41807	2.23319	2.23491	2.42366	2.29651
0.20	2.22729	2.24320	2.42135	2.23357	2.23556	2.42712	2.29801
0.25	2.22830	2.24567	2.43124	2.23503	2.23747	2.43742	2.30352
0.30	2.22938	2.24795	2.43945	2.23640	2.23940	2.44588	2.30641
0.35	2.23043	2.24991	2.44490	2.23768	2.24109	2.45152	2.30925
0.40	2.22917	2.24992	2.44923	2.23713	2.24097	2.45593	2.31049

Table S3 The atom positions and fraction factors of LY:xEu^{3+} (x = 0.15, 0.20, 0.25, 0.30, 0.35, 0.40) samples.

Atom	**Site**	***x***	***y***	***z***	**Occupancy**
			x=0.15		
Li	*4e*	0.25	0.625	0	1
Y	*4e*	0.25	0.125	0	0.85
Eu	*4e*	0.25	0.125	0	0.15
O1	*4e*	0	0.15	0.20	1
O2	*4e*	0.45	0.10	0.75	1
			x=0.20		
Li	*4e*	0.25	0.625	0	1
Y	*4e*	0.25	0.125	0	0.80
Eu	*4e*	0.25	0.125	0	0.20
O1	*4e*	0	0.15	0.20	1
O2	*4e*	0.45	0.10	0.75	1
			x=0.25		
Li	*4e*	0.25	0.625	0	1
Y	*4e*	0.25	0.125	0	0.75
Eu	*4e*	0.25	0.125	0	0.25
O1	*4e*	0	0.15	0.20	1
O2	*4e*	0.45	0.10	0.75	1

x=0.30					
Li	*4e*	0.25	0.625	0	1
Y	*4e*	0.25	0.125	0	0.70
Eu	*4e*	0.25	0.125	0	0.30
O1	*4e*	0	0.15	0.20	1
O2	*4e*	0.45	0.10	0.75	1
x=0.35					
Li	*4e*	0.25	0.625	0	1
Y	*4e*	0.25	0.125	0	0.65
Eu	*4e*	0.25	0.125	0	0.35
O1	*4e*	0	0.15	0.20	1
O2	*4e*	0.45	0.10	0.75	1
x=0.40					
Li	*4e*	0.25	0.625	0	1
Y	*4e*	0.25	0.125	0	0.60
Eu	*4e*	0.25	0.125	0	0.40
O1	*4e*	0	0.15	0.20	1
O2	*4e*	0.45	0.10	0.75	1

Table S4 the chromaticity coordinates and color purity of $LiYO_2:xEu^{3+}$ samples

	x	y	Color purity

0.15	0.663	0.335	0.9918
0.20	0.662	0.335	0.9888
0.25	0.663	0.335	0.9918
0.30	0.663	0.335	0.9918
0.35	0.664	0.335	0.9948
0.40	0.663	0.334	0.9918

Table S5 Comparison of excitation position, IQE and thermal stability ($I_{298\ K/423\ K}$) for $LiYO_2$:0.20Eu^{3+} and other reported Eu^{3+}-doped phosphors and typical commercial red phosphors

Phosphors	λ_{ex} (nm)	Emission intensity (423 K)	IQE	Ref.
$Y_2Mg_2Al_2Si_2O_{12}:Eu^{3+}$	393	88.5%	60.50%	1
$Y_3Al_5O_{12}:Eu^{3+}$	393	88.9%	23.73%	1
$Sr_2LaNbO_6:Eu^{3+}$	394	62.99%	33.51%	2
$Ca_2GdTaO_6:Eu^{3+}$	396	78%	82%	3
$BaGe_4O_9:Eu^{3+}$	394	-	57.9%	4
$LaSc_3(BO_3)_4:Eu^{3+}$	393	82%	89%	5
LY:0.20Eu^{3+}	395	89%	75%	This work

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