Supporting Information

Tuning emission color and improving warm-white persistent luminescence of phosphor $BaLu_2Al_2Ga_2SiO_{12}:Pr^{3+}$ via Zn^{2+} co-doping

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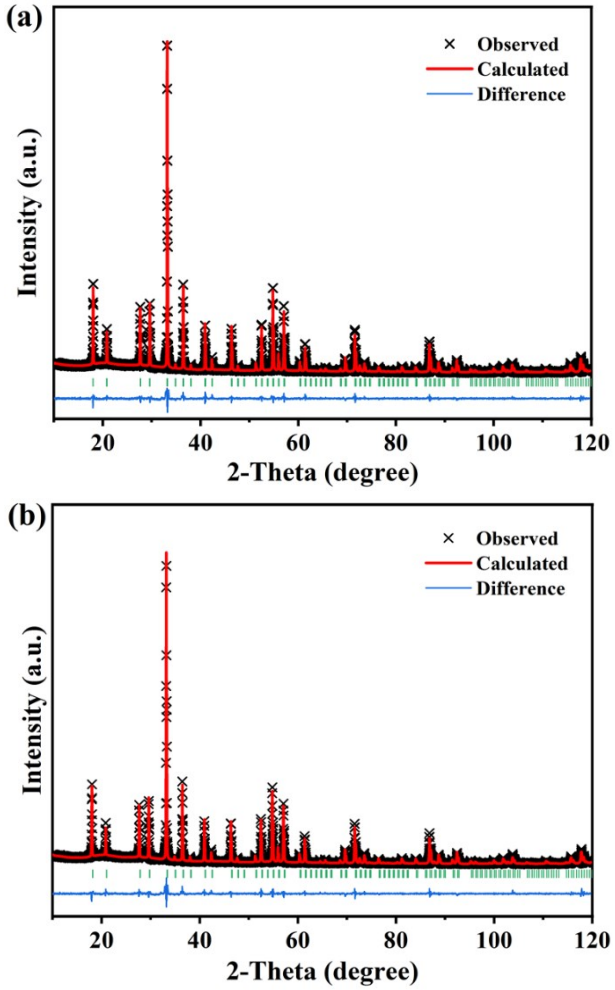

Fig. S1 XRD profiles for the Rietveld refinement result of (a) BLAGSO and (b) BLAGSO:0.04Pr^{3+}

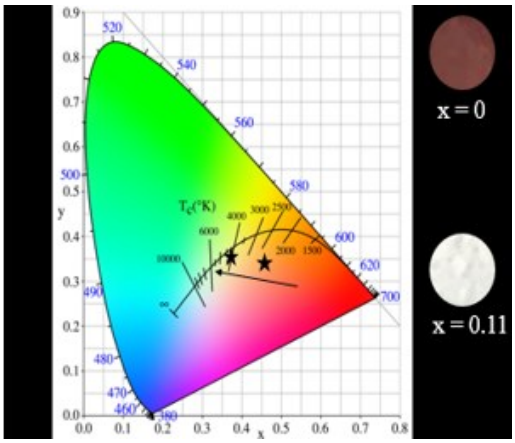

Fig. S2 The Commission Internationale de l´Eclairage (CIE) coordinates of BLAGSO:0.04Pr^{3+}, xZn^{2+}(x = 0, 0.11) samples under 254 nm lamp irradiation.

Table S1 Rietveld fitting results of BLAGSO, BLAGSO:0.04Pr^{3+} and BLAGSO:0.04Pr^{3+}, 0.11Zn^{2+}

Formula	BLAGSO	BLAGSO:0.04Pr^{3+}	BLAGSO:0.04Pr^{3+}, 0.11Zn^{2+}
crystal system	cubic	cubic	cubic
space group	$Ia\bar{3}d$(230)	$Ia\bar{3}d$(230)	$Ia\bar{3}d$(230)
a (Å)	12.0669	12.0786	12.0699
b (Å)	12.0669	12.0786	12.0699
c (Å)	12.0669	12.0786	12.0699
α = β = γ (deg)	90	90	90
Z	8	8	8
V ($Å^3$)	1757.075	1762.175	1758.374
Rp	0.0447	0.0452	0.0430
Rwp	0.0611	0.0623	0.0575
$\chi 2$	2.849	2.969	2.473

Table S2 Atomic positions of BLAGSO

atom	site	x	y	z	Occupancy	U_{iso}
Ba1	24c	0.125	0	0.25	0.3330	0.00612
Lu1	24c	0.125	0	0.25	0.6670	0.01100
Al1	16a	0	0	0	0.5450	0.01538
Ga1	16a	0	0	0	0.4550	0.00777
Al2	24d	0.375	0	0.25	0.3033	0.02568
Ga2	24d	0.375	0	0.25	0.3634	0.01255
Si1	24d	0.375	0	0.25	0.3333	0.00456
O1	96h	-0.03879	0.04806	0.15408	1.0000	0.02588

Table S3 Atomic positions of BLAGSO:0.04Pr^{3+}

atom	site	x	y	z	Occupancy	U_{iso}
Ba1	24c	0.125	0	0.25	0.3330	0.02204
Lu1	24c	0.125	0	0.25	0.6540	0.01658
Pr1	24c	0.125	0	0.25	0.0130	0.01610
Al1	16a	0	0	0	0.5450	0.03068
Ga1	16a	0	0	0	0.4550	0.01394
Al2	24d	0.375	0	0.25	0.3033	0.00112
Ga2	24d	0.375	0	0.25	0.3634	0.00153
Si1	24d	0.375	0	0.25	0.3333	0.02567
O1	96h	-0.03656	0.04779	0.15299	1.0000	0.05205

Table S4 Atomic positions of BLAGSO:0.04Pr^{3+}, 0.11Zn^{2+}

atom	site	x	y	z	Occupancy	U_{iso}
Ba1	24c	0.125	0	0.25	0.2964	0.01560
Lu1	24c	0.125	0	0.25	0.654	0.01896
Zn1	24c	0.125	0	0.25	0.0366	0.01237
Pr1	24c	0.125	0	0.25	0.0130	0.02120
Al1	16a	0	0	0	0.5450	0.02435
Ga1	16a	0	0	0	0.4550	0.01893
Al2	24d	0.375	0	0.25	0.3033	0.02568
Ga2	24d	0.375	0	0.25	0.3634	0.00064
Si1	24d	0.375	0	0.25	0.3333	0.02512
O1	96h	-0.03656	0.04779	0.15299	1.0000	0.06109

Table S5 Atomic distance of BLAGSO:0.04Pr^{3+} and BLAGSO:0.04Pr^{3+}, 0.11Zn^{2+}

	Atom 1	Atom 2	Distance (Å)
BLAGSO:0.04Pr3+	Lu1/Ba1/Pr	Lu1/Ba1/Pr	3.6983
	Lu1/Ba1/Pr	Ga2/Si1/Al2	3.0196
	Lu1/Ba1/Pr	Ga2/Si1/Al2	3.6983
	Lu1/Ba1/Pr	Al1/Ga1	3.3761
	Lu1/Ba1/Pr	O1	2.3483
	Lu1/Ba1/Pr	O1	2.5049
	Al1/Ga1	O1	1.9856
	Ga2/Si1/Al2	O1	1.6875
BLAGSO:0.04Pr^{3+}, 0.11Zn^{2+}	Lu1/Ba1/Zn1/Pr	Lu1/Ba1/Zn1/Pr	3.6956
	Lu1/Ba1/Zn1/Pr	Ga2/Si1/Al2	3.0175
	Lu1/Ba1/Zn1/Pr	Ga2/Si1/Al2	3.6956
	Lu1/Ba1/Zn1/Pr	Al1/Ga1	3.3736
	Lu1/Ba1/Zn1/Pr	O1	2.341
	Lu1/Ba1/Zn1/Pr	O1	2.4939
	Al1/Ga1	O1	1.9828
□	Ga2/Si1/Al2	O1	1.6961