

Electronic Supporting Information

Ca₃Lu(AlO)₃(BO₃)₄:Sm³⁺: A novel red-emitting phosphor with high colour purity for NUV-based warm white LEDs

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Table. S1 Refinement crystallographic parameters for CLAB:Sm³⁺

Atoms	Site	x	y	z	U _{iso}	n
Ca/Lu1	2c	1/3	2/3	1/4	0.0120(13)	0.201/0.797(14)
Ca/Lu2	6h	0.14211(5)	0.87486(5)	1/4	0.016(2)	0.930/0.068(5)
Al	6g	0	1/2	0	0.0160(15)	1
B1	6h	0.229(3)	0.773(3)	3/4	0.004(5)	1
B2	4e	0	0	0.076(12)	0.04(2)	1/2
O1	12i	0.0839(13)	0.4678(12)	1/4	0.016(4)	1
O2	12i	0.3305(2)	0.9192(14)	3/4	0.019(4)	1
O3	6h	0.3035(9)	0.4717(8)	0.53934(12)	0.010(2)	1
O4	6h	0.0847(3)	0.9022(3)	0.587(3)	0.016(4)	1/2

Space group *P63/m*: $a = b = 10.4014(4)$ Å, $c = 5.7000(2)$ Å, $V = 534.06(3)$ Å³, $R_p = 5.64\%$, $R_{wp} = 9.81\%$, $\chi^2 = 1.314$.

Table. S2 Some selected bond lengths of CLAB:Sm³⁺ phosphor.

Ca/Lu1–O1	2.301(11) Å X 3
Ca/Lu1–O3	2.475(7) Å X 6
Ca/Lu2–O1	2.382(11) Å X 1
Ca/Lu2–O2	2.385(11) Å X 1
Ca/Lu2–O3	2.325(8) Å X 2
Ca/Lu2–O4	2.386(2) Å X 1
Ca/Lu2–O4	2.421(3) Å X 1
Ca/Lu2–O4	2.423(3) Å X 1
Al–O1	1.926(7) Å X 2
Al–O2	2.080(10) Å X 2
Al–O3	1.810(8) Å X 2
B1–O2	1.406(3) Å X 1
B1–O3	1.348(2) Å X 2
B2–O4	1.315(13) Å X 3

Table. S3 The quantitative EDAX analysis data of CLAB:0.05Sm³ phosphor [Calcinated at 1100 °C for 4 h].

Element	Wt%	At%
Ca K	32.33	22.88
Lu K	25.33	13.38
Al K	7.03	7.37
B K	30.26	11.56
O K	43.62	57.73
Sm L	3.16	0.60

Table. S4 Colour coordinates, correlated colour temperature and colour purity calculated from emission spectra under 404 nm excitation for CLAB: $x\text{Sm}^{3+}$.

Value of x	Colour coordinates		CCT (K)	Colour purity (%)
	x	y		
0.01	0.613	0.382	3119	98.532
0.05	0.615	0.38	3279	98.530
0.10	0.613	0.38	3212	97.933
0.15	0.609	0.381	3041	97.035
0.20	0.608	0.379	3099	96.136

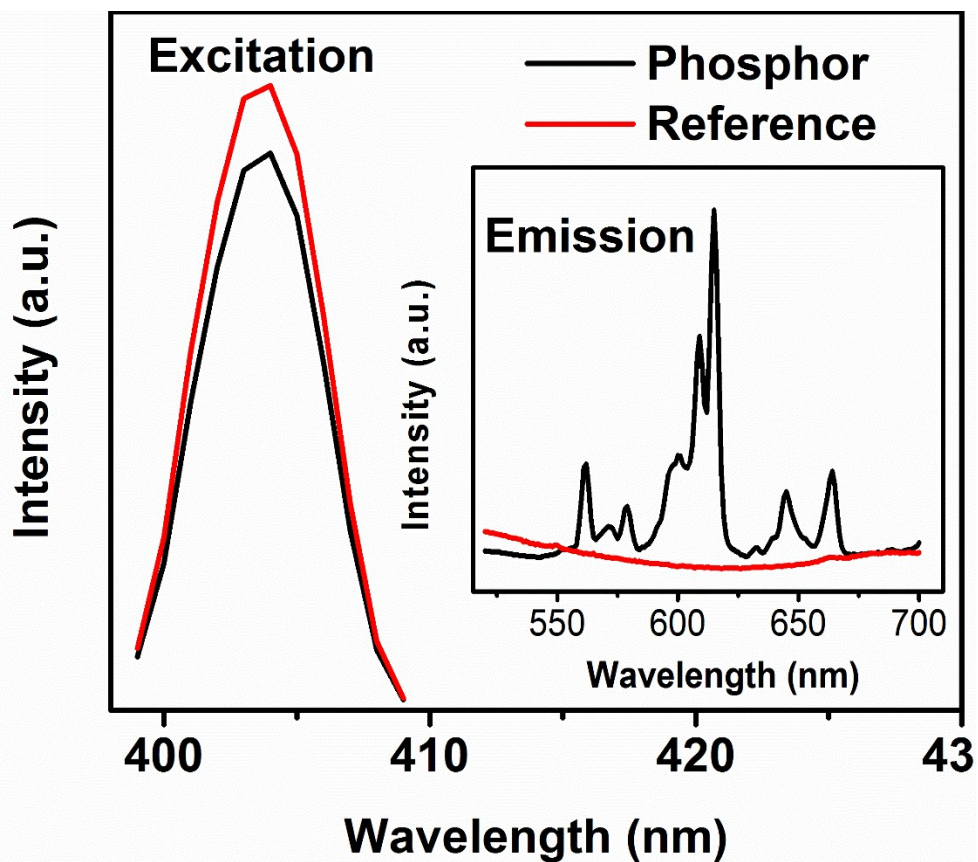


Fig. S1. PL excitation and emission spectra of the CLAB:0.05Sm³⁺ phosphor and the reference sample, measured by using a Horiba FL3 (Japan) attached with an integrating sphere for quantum yield measurement. Inset illustrates the emission spectra in the wavelength range of 520–720 nm.

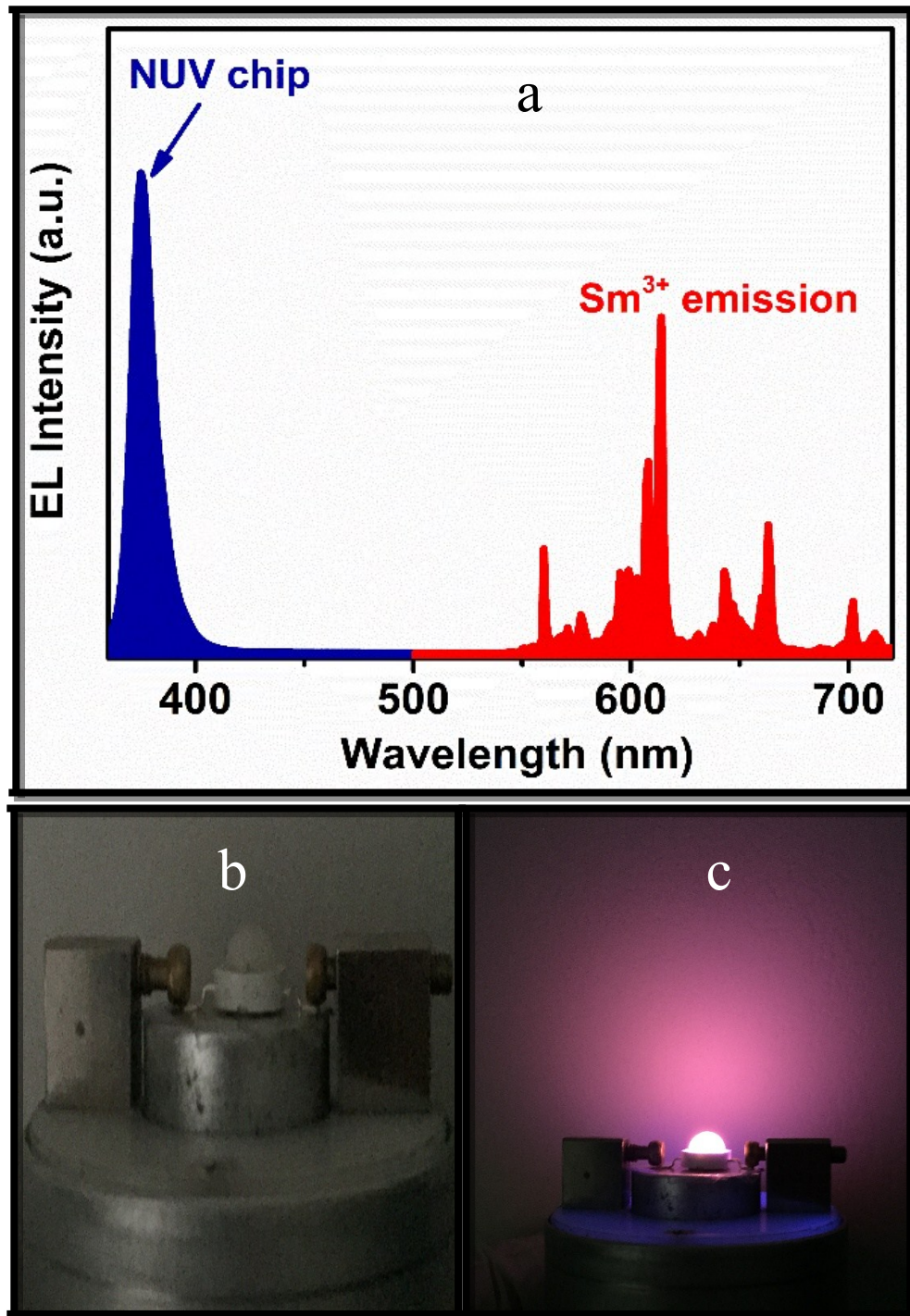


Fig. S2. EL spectrum of the fabricated red-emitting LED device under a forward bias current of 100 mA (a), fully packaged LED device (b) and image of the fabricated LED device under a bias current of 100 mA (c).