

Supporting information

Enhanced luminescence properties of $\text{Ca}_{1+x}\text{Sr}_{2-x}\text{Al}_2\text{O}_6:\text{Eu}^{3+}$ ($0 \leq x \leq 1$) red phosphors based on composition modulation

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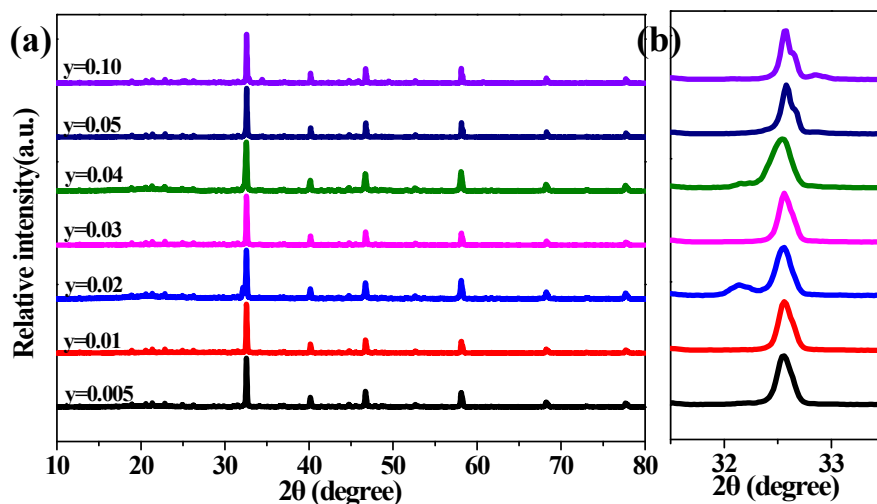


Fig.S1 (a) XRD patterns of $\text{CaSr}_2\text{Al}_2\text{O}_6:\text{yEu}^{3+}$ ($y = 0.005, 0.01, 0.02, 0.03, 0.04, 0.05$ and 0.10) samples and (b) the corresponding enlarged XRD patterns in the range of 31.5° to 33.5° .

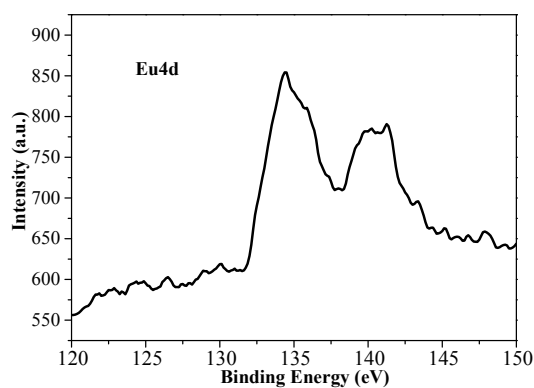


Fig. S2 The Eu4d X-ray photoelectron spectrum of the $\text{CaSr}_2\text{Al}_2\text{O}_6:\text{Eu}^{3+}$ sample.

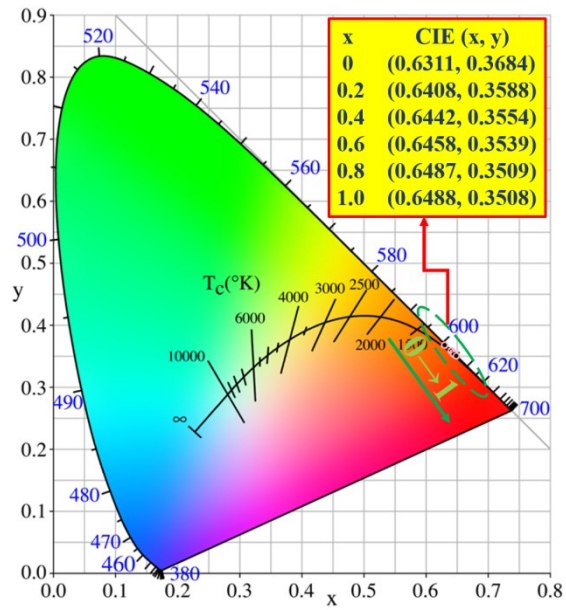


Fig.S3 The CIE chromaticity diagram of $\text{Ca}_{1+x}\text{Sr}_{2-x}\text{Al}_2\text{O}_6:0.02\text{Eu}^{3+}$ ($x = 0, 0.2, 0.4, 0.6, 0.8$ and 1.0) samples.

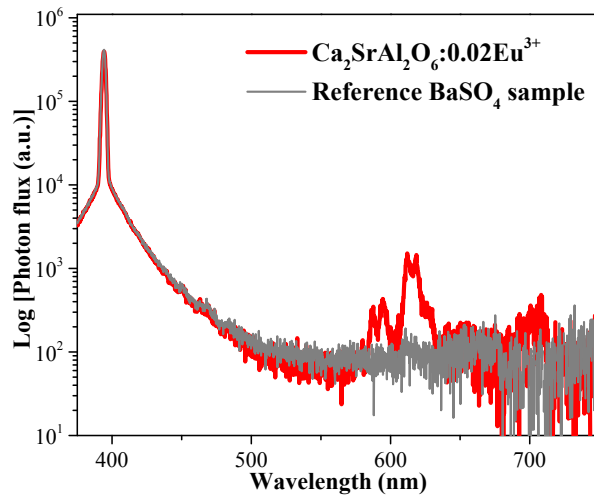


Fig.S4 Excitation and emission spectra of the $\text{Ca}_2\text{SrAl}_2\text{O}_6:0.02\text{Eu}^{3+}$ and reference sample.

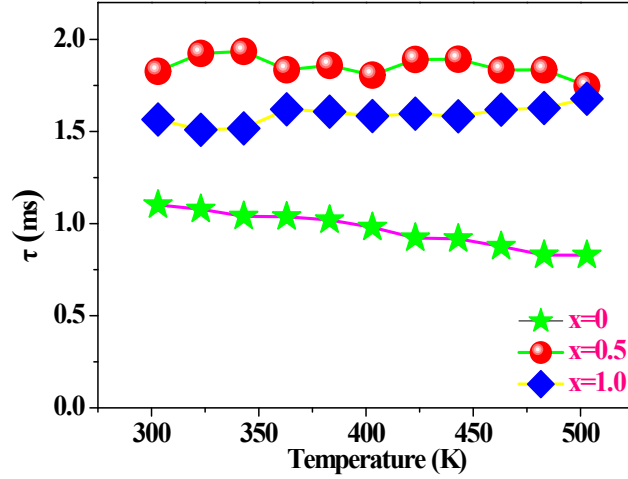


Fig.S5 The temperature dependent luminous lifetimes of $\text{Ca}_{1+x}\text{Sr}_{2-x}\text{Al}_2\text{O}_6:0.02\text{Eu}^{3+}$ phosphors from 303 K to 503 K.

Table S1 Main bond lengths (Å) for $\text{Ca}_2\text{SrAl}_2\text{O}_6$ and $\text{CaSr}_2\text{Al}_2\text{O}_6$.

Bond lengths (Å) for $\text{Ca}_2\text{SrAl}_2\text{O}_6$				Bond lengths (Å) for $\text{CaSr}_2\text{Al}_2\text{O}_6$			
Bond	Length (Å)	Bond	Length (Å)	Bond	Length (Å)	Bond	Length (Å)
Ca1-O6	2.344	Ca5-O1	2.966	Ca1-O6	2.373	Sr3/Ca5-O1	2.833
Ca2-O5	2.378	Ca5-O2	2.536	Ca2-O5	2.393	Sr3/Ca5-O2	2.640
Ca3-O4	2.378	Ca5-O3	2.362	Ca3-O4	2.375	Sr3/Ca5-O3	2.423
Ca3-O3	2.388	Ca5-O4	2.303	Ca3-O3	2.387	Sr3/Ca5-O4	2.359
Sr2/Ca4-O1	2.577	Ca5-O6	2.316	Sr2/Ca4-O1	2.659	Sr3/Ca5-O6	2.625
Sr2/Ca4-O2	2.953	Ca5-O6	2.547	Sr2/Ca4-O2	2.953	Sr3/Ca5-O6	2.723
Sr2/Ca4-O2	2.467	Al1-O1	1.762	Sr2/Ca4-O2	2.871	Sr3/Ca5-O6	2.372
Sr2/Ca4-O3	2.894	Al1-O2	1.782	Sr2/Ca4-O3	2.819	Al1-O1	1.747
Sr2/Ca4-O3	2.486	Al1-O5	1.764	Sr2/Ca4-O3	2.590	Al1-O2	1.762
Sr2/Ca4-O4	2.836	Al1-O6	1.740	Sr2/Ca4-O4	2.844	Al1-O5	1.761
Sr2/Ca4-O5	2.340	Al2-O1	1.732	Sr2/Ca4-O5	2.394	Al1-O6	1.737
Sr2/Ca4-O5	2.769	Al2-O2	1.732	Sr2/Ca4-O5	2.871	Al2-O1	1.749
Sr1-O1	2.622	Al2-O3	1.738	Sr1-O1	2.641	Al2-O2	1.764
Sr1-O4	2.716	Al2-O4	1.746	Sr1-O4	2.737	Al2-O3	1.751
Sr1-O5	2.846			Sr1-O5	2.811	Al2-O4	1.768