Supplementary information

$CaLuGaO_4$: Bi^{3+}, Al^{3+} blue phosphor with excellent thermal stability for multiple LED applications

Zhicheng Liao[a], Qian Zhang[b], Liting Qiu[c], Xiantao Wei[d], Yonghu Chen[*b], Min Yin[*b]

[a] CAS Key Laboratory of Microscale Magnetic Resonance, and School of Physical Sciences, University of Science and Technology of China, Hefei 230026, China

[b] Key Laboratory of Strongly-Coupled Quantum Matter Physics, Chinese Academy of Sciences, School of Physical Sciences, University of Science and Technology of China, Hefei 230026, PR China

[c] School of Mechanical, Electronic & Information Engineering, Putian University, Putian 351100, P. R. China

[d] Physics Experiment Teaching Center, School of Physical Sciences, University of Science and Technology of China, Hefei 230026, PR China

[*] **Corresponding authors.**

E-mail addresses: yhuchen@ustc.edu.cn (Y. Chen), yinmin@ustc.edu.cn (M. Yin)

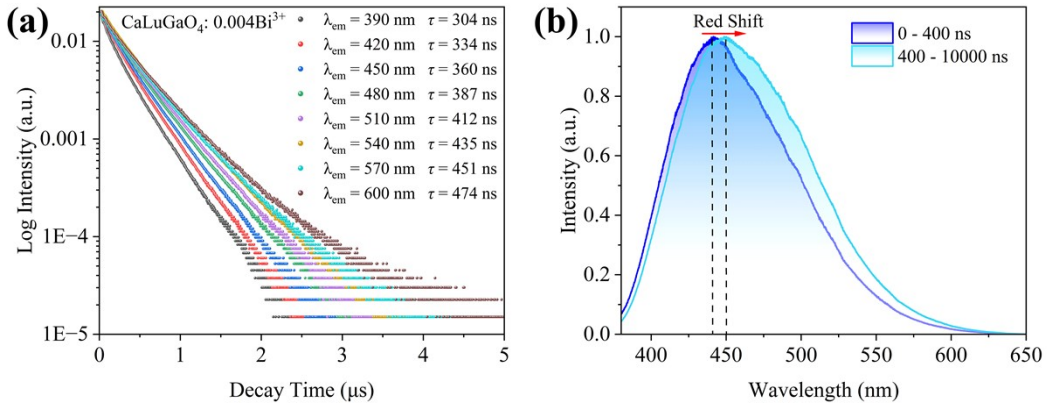

Fig. S1 (a) Room temperature fluorescence decay curves of $CaLuGaO_4$: $0.004Bi^{3+}$ with the monitoring wavelength ranging from 390 nm to 600 nm. (b) PL spectra of $CaLuGaO_4$: $0.004Bi^{3+}$ within two separate time windows, 0 – 400 ns and 400 – 10000 ns, after the termination of 355 nm excitation.

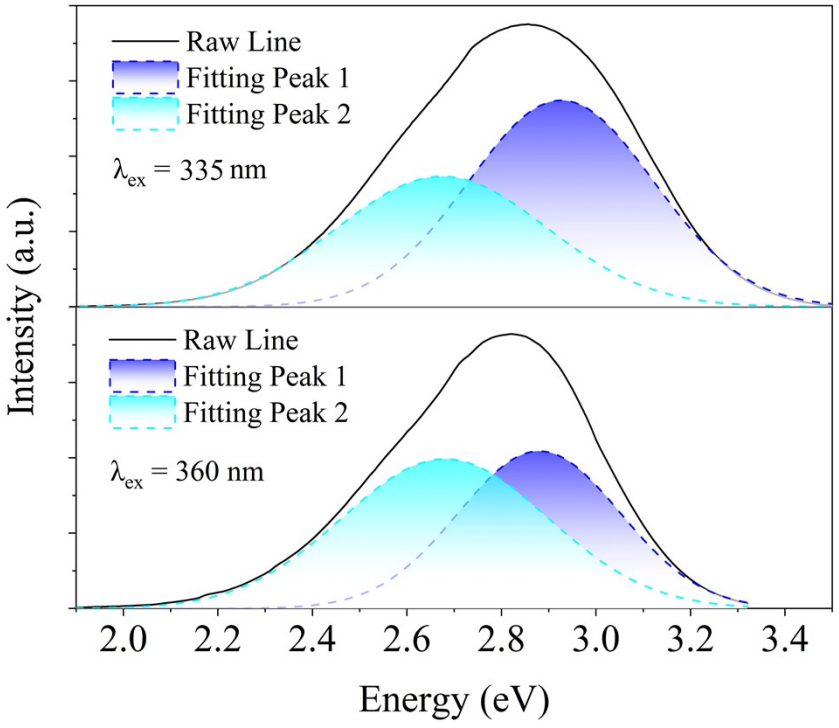

Fig. S2 The Gaussian fitting of the PL spectra of $CaLuGaO_4$: Bi^{3+} excited at 335 nm and 360 nm.

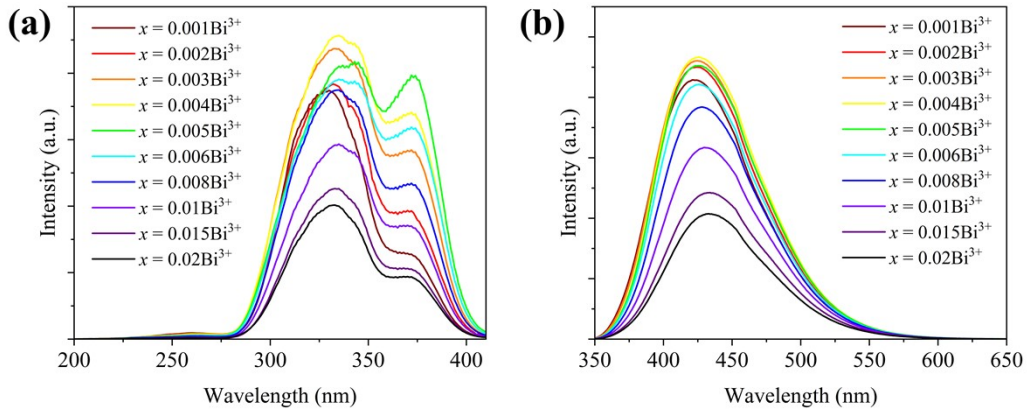

Fig. S3 (a) PLE spectra of $CaLuGaO_4$: xBi^{3+} under 430 nm monitoring wavelength. (b) PL spectra of $CaLuGaO_4$: xBi^{3+} under 335 nm excitation wavelength.

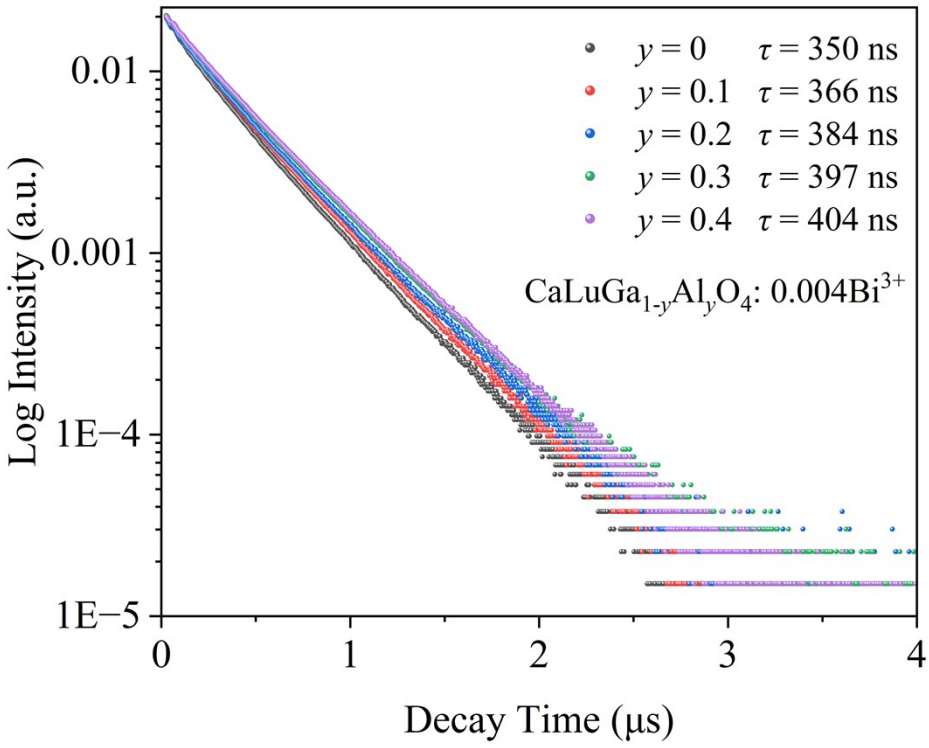

Fig. S4 Room temperature fluorescence decay curves of $CaLuGa_{1-y}Al_yO_4$: 0.004Bi^{3+} (y = 0 – 0.4) monitored at 430 nm.

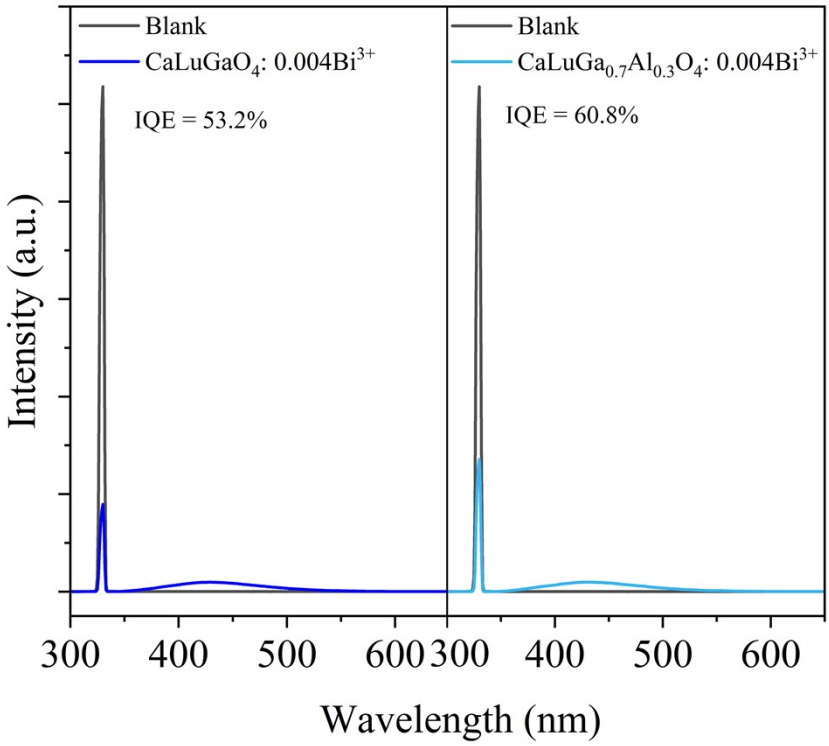

Fig. S5 IQE-based PL spectra of $CaLuGaO_4$: $0.004Bi^{3+}$ and $CaLuGa_{0.7}Al_{0.3}O_4$: $0.004Bi^{3+}$.

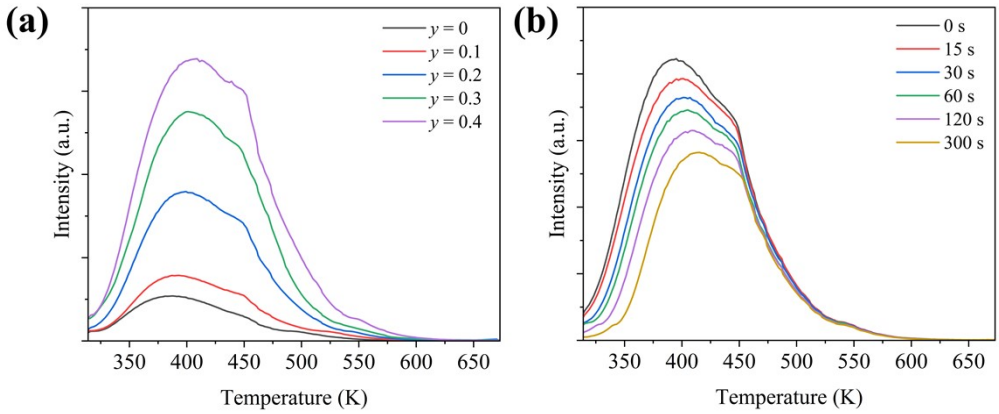

Fig. S6(a) Thermoluminescence curves of $CaLuGaO_4$: $0.004Bi^{3+}$, yAl^{3+} in the temperature of 313 – 673 K, (b) Thermoluminescence curves of $CaLuGaO_4$: $0.004Bi^{3+}$, $0.3Al^{3+}$ at various time intervals following the cessation of excitation light.

Table S1 Bond length data of $CaLuGaO_4$ obtained from Rietveld refinement

Atom 1	Atom 2	Counts	Bond length (Å)
Ca	O1	2	2.294
	O2	2	2.397
	O3	2	2.274
Lu	O1	1	2.325
	O2	2	2.265
	O2	2	2.403
	O3	1	2.303
Ga	O1	1	1.770
	O2	2	1.833
	O3	1	1.756

Table S2 Specific parameter values necessary for the calculation of he and E_{sp}

Parameter	Ca site	Parameter	Lu site
BVP(Ca)	1.967	BVP(Lu)	1.971
Q(Ca)	2.324	Q(Lu)	2.319
Q(O1)	1.550	Q(O1)	1.546
Q(O2)	1.550	Q(O2)	1.546
Q(O3)	1.550	Q(O3)	1.546
f_c(Ca-O1)	0.195	f_c(Lu-O1)	0.199
f_c(Ca-O2)	0.192	f_c(Lu-O2)	0.198
f_c(Ca-O3)	0.196	f_c(Lu-O3)	0.199
α(Ca-O1)	0.712	α(Lu-O1)	0.863
α(Ca-O2)	0.844	α(Lu-O2)	0.875
α(Ca-O3)	0.689	α(Lu-O3)	0.833