Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Enhanced Quantum Efficiency and Thermal Stability by the Crystal-Field Engineering in $Y(Ga,Al)_3(BO_3)_4:Cr^{3+},Yb^{3+}$ Phosphor for Diverse Short-Wave Infrared Applications

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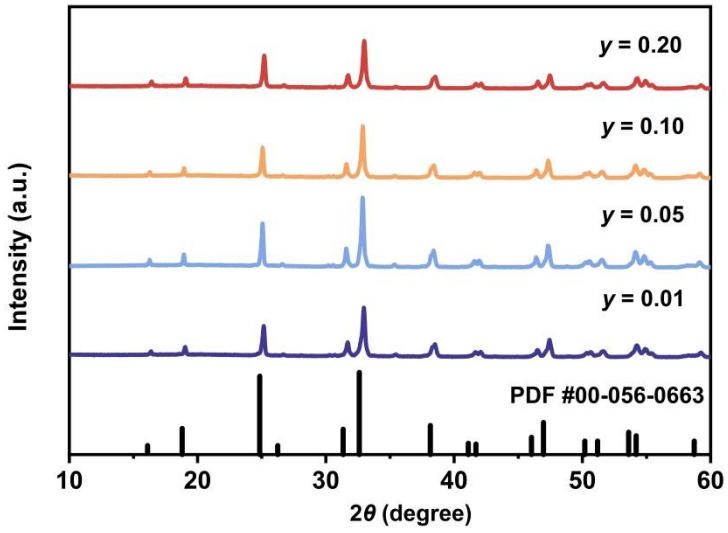

Fig. S1 XRD patterns of YGAB:0.08Cr^{3+},$y$$Yb^{3+}$ (y = 0.01, 0.05, 0.10, 0.20).

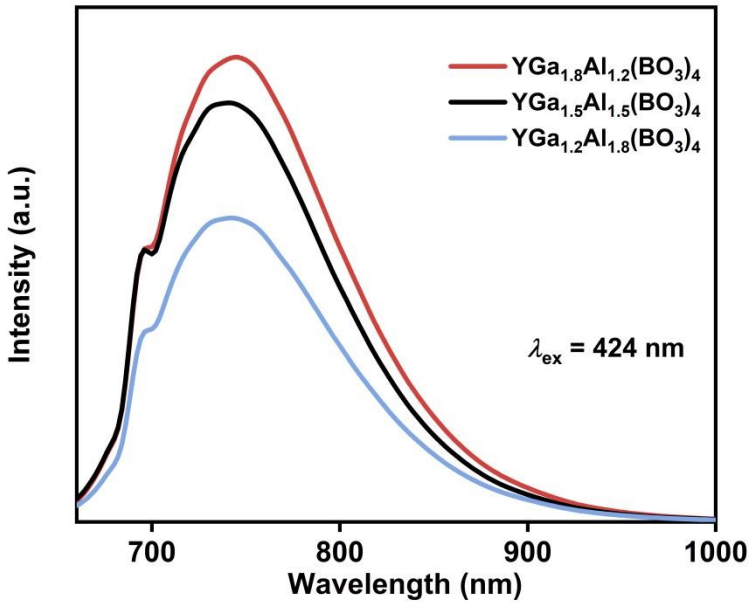

Fig. S2 PL spectra of $YGa_{3-z}Al_z(BO_3)_4:Cr^{3+}$ (z = 1.2–1.8) at room temperature.

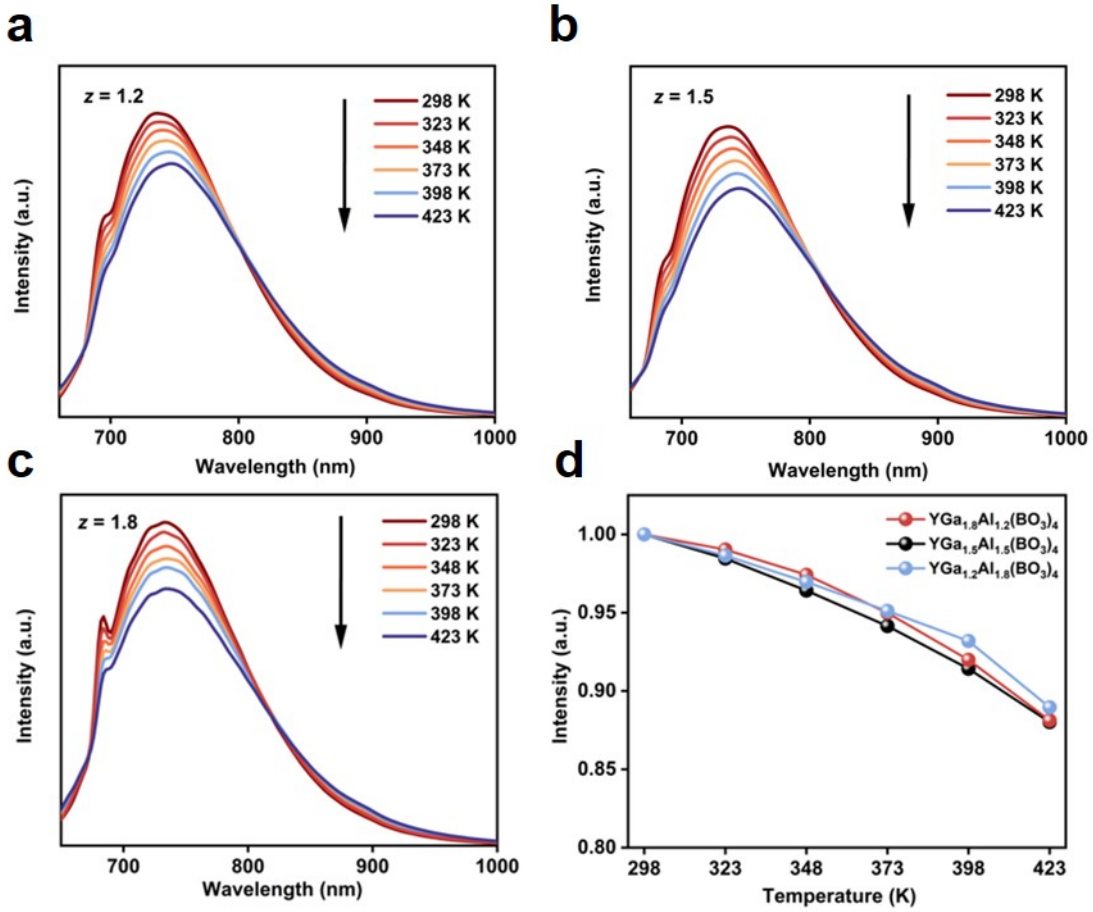

Fig. S3 (a-c) Temperature-dependent emission spectra of $YGa_{3-z}Al_z(BO_3)_4:Cr^{3+}$ (z = 1.2–1.8). (d) Dependence of the emission intensity on the temperature of the above three samples.

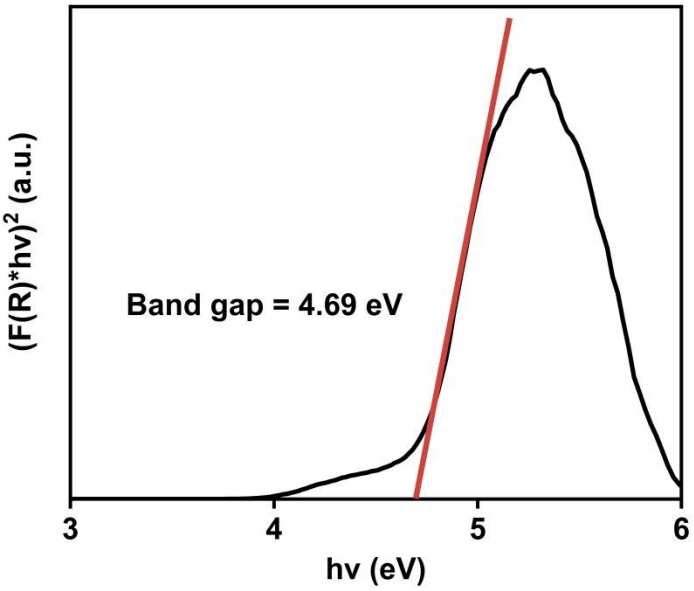

Fig. S4 Tucker curves of the undoped YGAB.

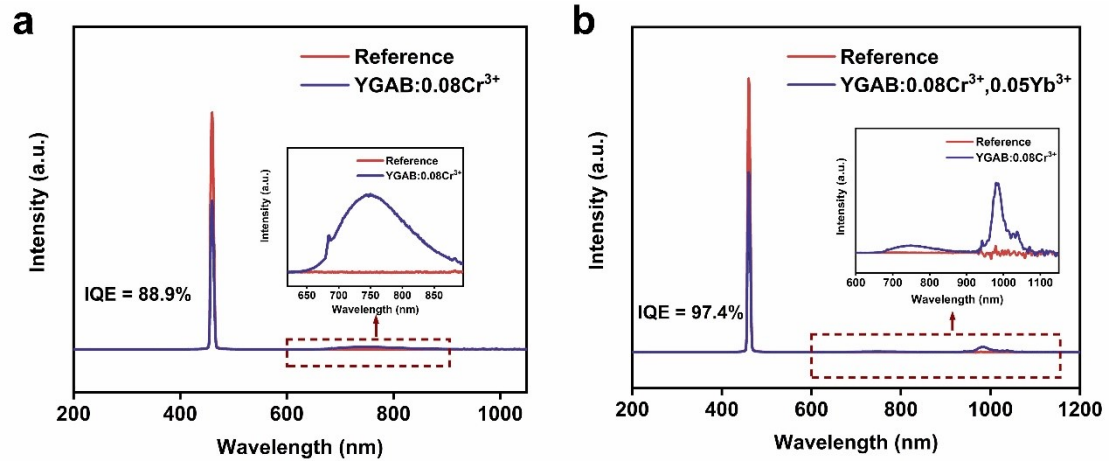

Fig. S5 The quantum efficiency graphs of YGAB:0.08Cr^{3+} and YGAB:0.08Cr^{3+},0.05Yb^{3+} samples.

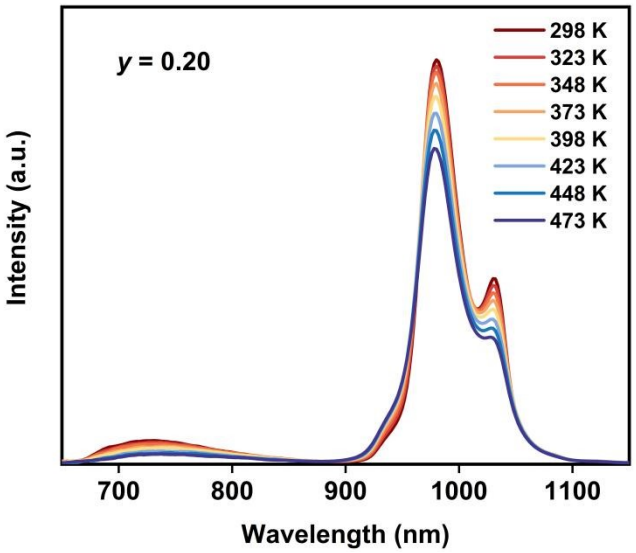

Fig. S6 Temperature-dependent emission spectra of YGAB:0.08Cr^{3+},0.20Yb^{3+}

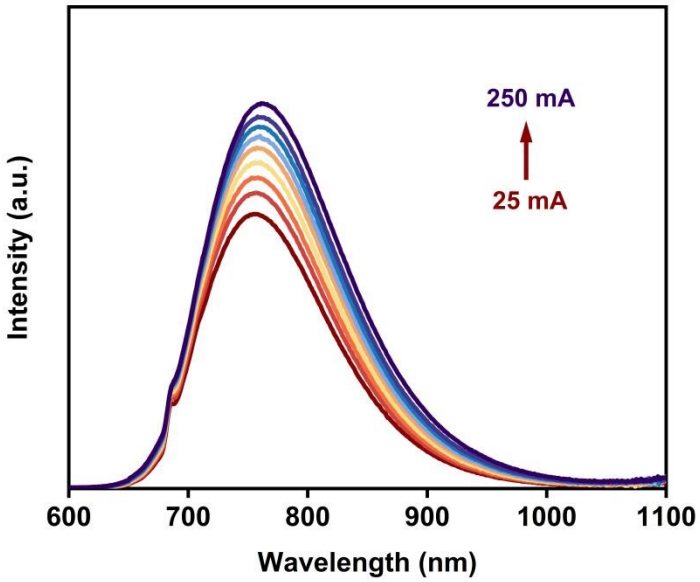

Fig. S7 Emission spectra of the NIR LED through a combination of YGAB:0.08Cr^{3+} with blue LED at varied current over 25–250 mA.

Van Uitert defined θ = 6, 8, 10 as corresponding to dipole–dipole, dipole–quadrupole, and quadrupole–quadrupole interactions, respectively. As shown in Fig. S8, the slop is -1.35, thus the θ is similar to 6 and the multipolar interaction belongs to d-d interaction.

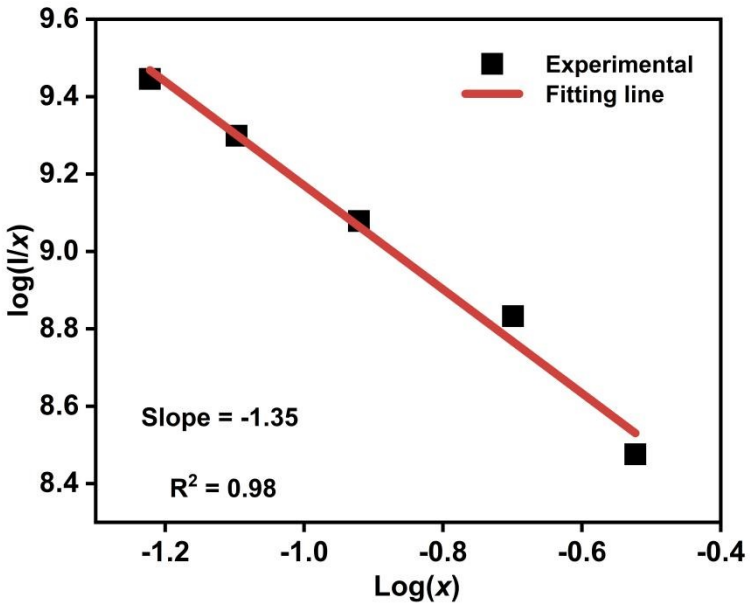

Fig. S8 Relationship of log(I/x) versus log(x) in YGAB:xCr^{3+} (x = 0.04 - 0.40).

Table S1 Refined structural parameters and cell parameter values of YGAB:0.08Cr^{3+} from the Rietveld refinement.

Formula	**$YGa_{1.8}Al_{1.2}(BO_3)_4:Cr^{3+}$**
Crystal system	Rhombohedral
Space group	R32
Cell parameters	a = 9.3808 Å, b = 9.3808 Å, c = 7.3746 Å
	Alpha = 90 Beta = 90 Gamma = 120
Cell volume	562.011Å3
Z	3
Reliability factors	R*p* = 7.9%, R*wp* = 5.98%

Atom	**x**	**y**	**z**
Y1	0.000000	0.000000	0.500000
Ga1	0.447916	0.000000	0.500000
Al1	0.447916	0.000000	0.500000
B1	0.553623	0.000000	0.000000
B2	0.000000	0.000000	0.000000
O1	0.215407	0.187235	0.316716
O2	0.145575	0.000000	0.000000
O3	0.412089	0.000000	0.000000