

**Electronic Supplementary Information**

**Crystal-field induced tuning of luminescence properties of  
 $\text{Na}_3\text{Ga}_x\text{Al}_{1-x}\text{F}_6:\text{Cr}^{3+}$  phosphors with good thermal stability  
for NIR LEDs**

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**Table S1** Lattice parameters of  $\text{Na}_3\text{Ga}_x\text{Al}_{1-x}\text{F}_6:0.05\text{Cr}^{3+}$  ( $x = 0, 0.25, 0.50, 0.75, 1.00$ ).

	$a / \text{\AA}$	$b / \text{\AA}$	$c / \text{\AA}$	$\beta / ^\circ$
$\text{Na}_3\text{AlF}_6$	5.4075(3)	5.5917(2)	9.4511(6)	124.718(4)
$\text{Na}_3\text{Ga}_{0.25}\text{Al}_{0.75}\text{F}_6$	5.4231(3)	5.6077(3)	9.4801(7)	124.695(6)
$\text{Na}_3\text{Ga}_{0.5}\text{Al}_{0.5}\text{F}_6$	5.4336(3)	5.6218(3)	9.4992(7)	124.671(6)
$\text{Na}_3\text{Ga}_{0.75}\text{Al}_{0.25}\text{F}_6$	5.4527(2)	5.6483(3)	9.5351(6)	124.611(5)
$\text{Na}_3\text{GaF}_6$	5.47288(15)	5.67811(14)	9.5716(2)	124.5644(16)

**Table S2** The actual content of  $\text{Cr}^{3+}$  in  $\text{Na}_3\text{Ga}_x\text{Al}_{1-x}\text{F}_6:0.05\text{Cr}^{3+}$  ( $x = 0, 0.25, 0.50, 0.75, 1.00$ ).

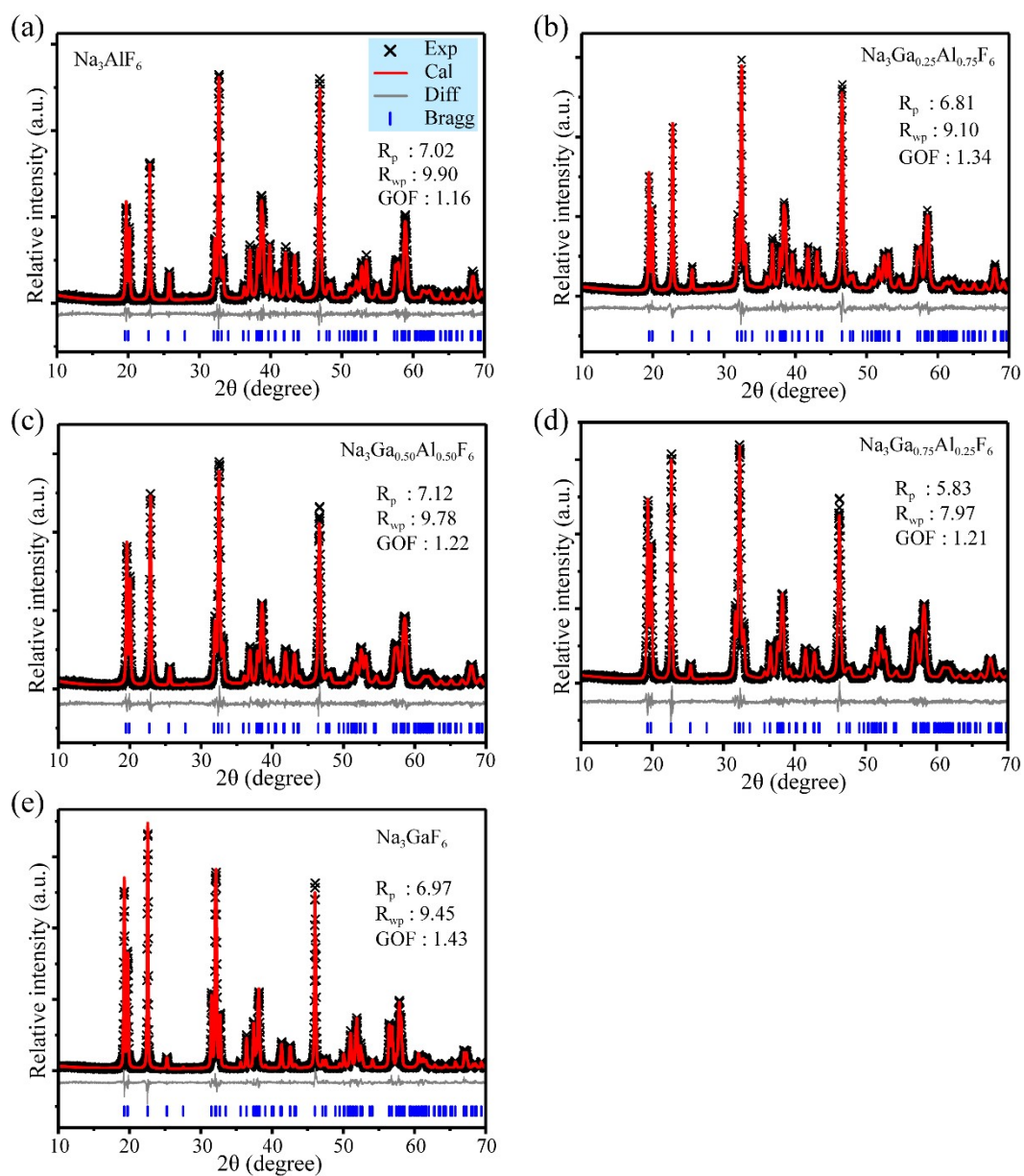
x	0	0.25	0.50	0.75	1.00
$\text{Cr}^{3+}$ content (%)	4.89	4.90	4.93	4.95	4.96
IQE (%)	16.1	19.2	23.7	28.5	28.1

**Table S3** IQE and EQE of  $\text{Na}_3\text{Ga}_{0.75}\text{Al}_{0.25}\text{F}_6:y\text{Cr}^{3+}$  ( $y = 0.01, 0.10, 0.20, 0.30, 0.35, 0.40$ ).

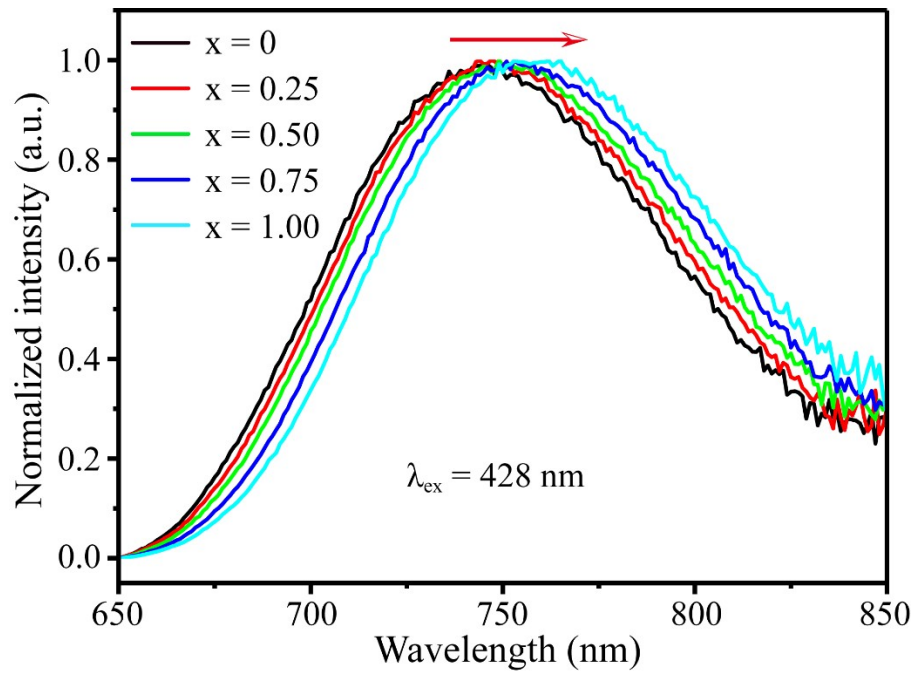
y	0.01	0.10	0.20	0.30	0.35	0.40
IQE (%)	13.2	34.5	38.3	41.2	50.0	39.7
EQE (%)	2.0	7.4	10.7	13.6	18.5	16.7

**Table S4** Fitting parameters Eq. 4.

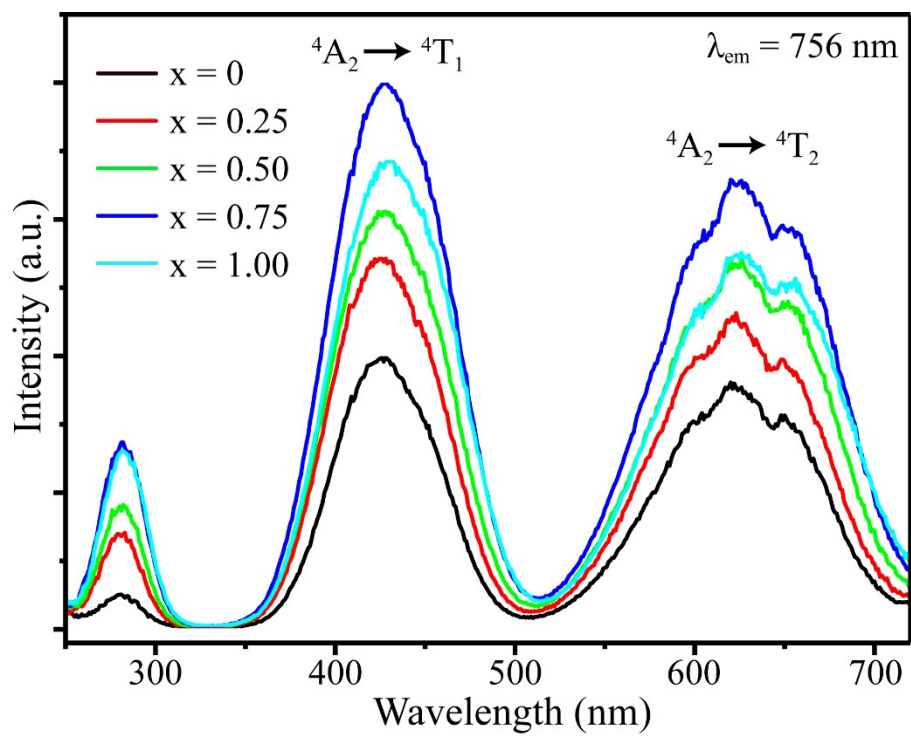
Parameter	$\Delta E$ (eV)	c	$R^2$	Standard Error
Value	0.28	589.93	0.99	0.03



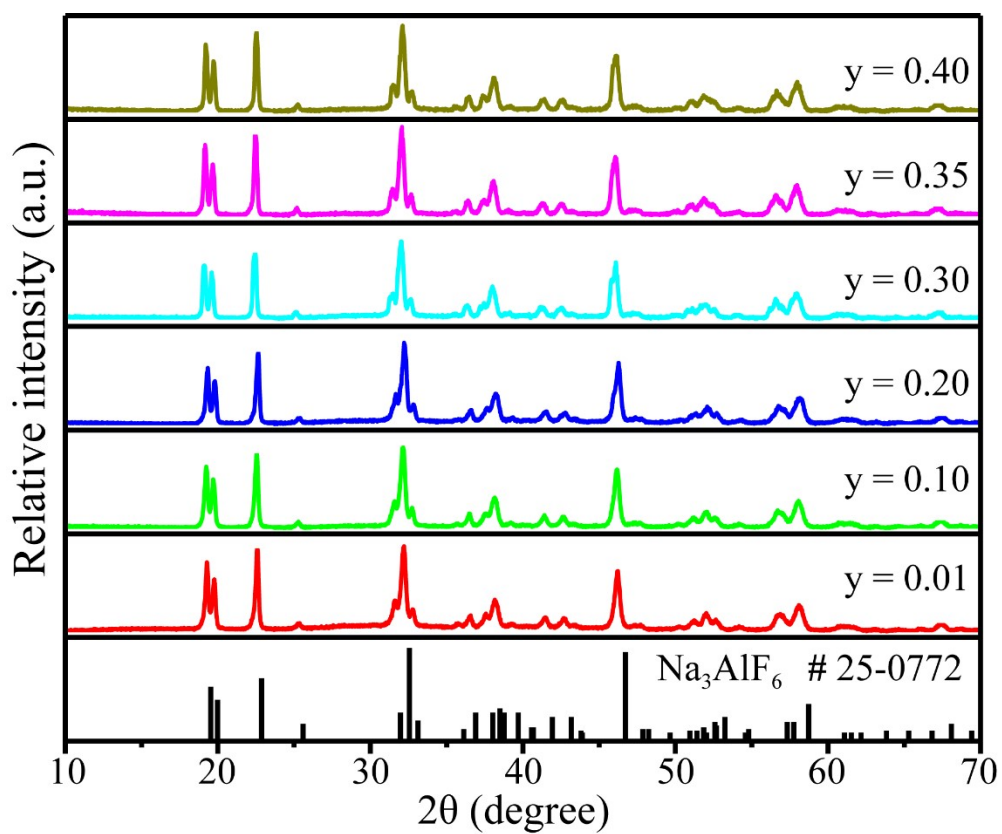
**Fig. S1** Rietveld refinement of (a)  $\text{Na}_3\text{AlF}_6:0.05\text{Cr}^{3+}$ , (b)  $\text{Na}_3\text{Ga}_{0.25}\text{Al}_{0.75}\text{F}_6:0.05\text{Cr}^{3+}$ , (c)  $\text{Na}_3\text{Ga}_{0.50}\text{Al}_{0.50}\text{F}_6:0.05\text{Cr}^{3+}$ , (d)  $\text{Na}_3\text{Ga}_{0.75}\text{Al}_{0.25}\text{F}_6:0.05\text{Cr}^{3+}$ , (e)  $\text{Na}_3\text{GaF}_6:0.05\text{Cr}^{3+}$ .



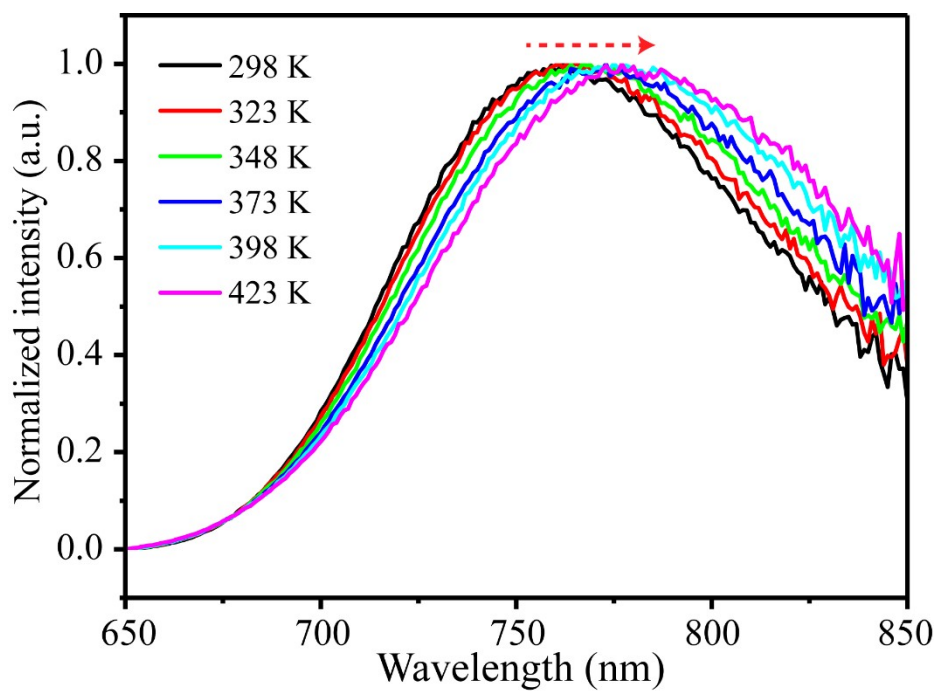
**Fig. S2** Normalized emission spectra of  $\text{Na}_3\text{Ga}_x\text{Al}_{1-x}\text{F}_6:0.05\text{Cr}^{3+}$  ( $x = 0, 0.25, 0.50, 0.75, 1.00$ ).



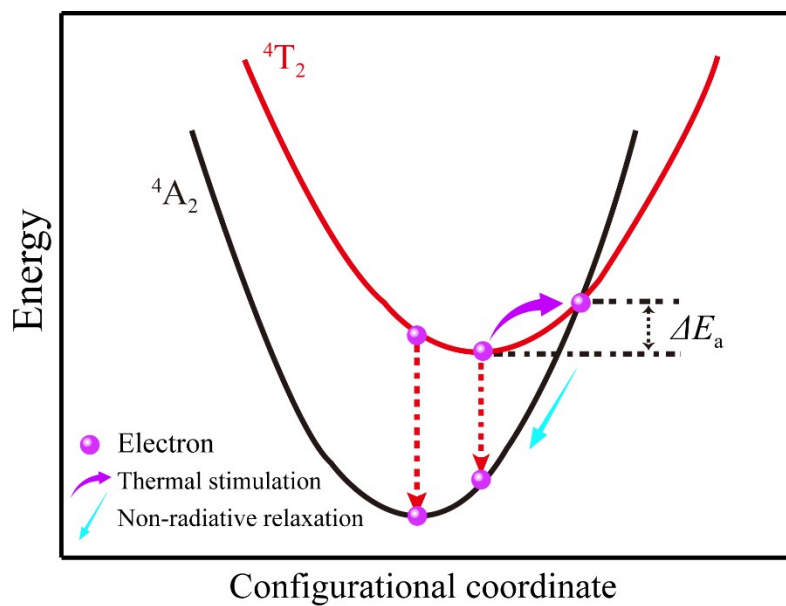
**Fig. S3** Excitation spectra of  $\text{Na}_3\text{Ga}_x\text{Al}_{1-x}\text{F}_6:0.05\text{Cr}^{3+}$  ( $x = 0, 0.25, 0.50, 0.75, 1.00$ ).



**Fig. S4** XRD patterns of  $\text{Na}_3\text{Ga}_{0.75}\text{Al}_{0.25}\text{F}_6:y\text{Cr}^{3+}$  ( $y = 0.01, 0.10, 0.20, 0.30, 0.35, 0.40$ ).



**Fig. S5** Normalized temperature-dependent emission spectra of  $\text{Na}_3\text{Ga}_{0.75}\text{Al}_{0.25}\text{F}_6:0.35\text{Cr}^{3+}$ .



**Fig. S6** Configurational coordinate diagram illustrating band broadening and thermal quenching behaviors of  $\text{Na}_3\text{Ga}_{0.75}\text{Al}_{0.25}\text{F}_6:0.35\text{Cr}^{3+}$ .