Supporting Information

Inducing octahedral distortion to enhance NIR emission in Cr-doped garnet $Ca_3(Al,Sc)_2Ge_3O_{12}$

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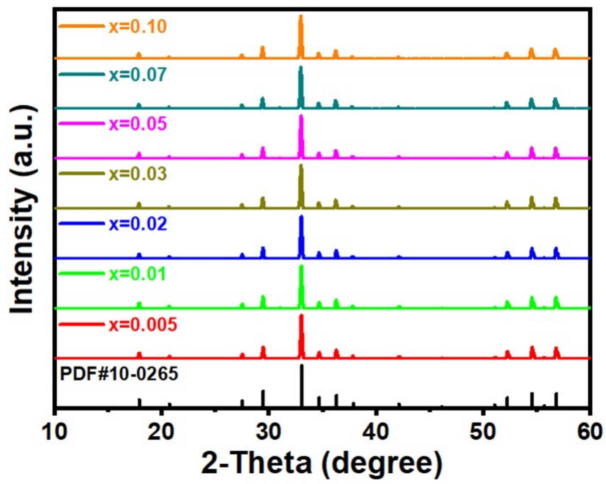

Fig. S1 XRD patterns of CAGO: $2xCr^{3+}$.

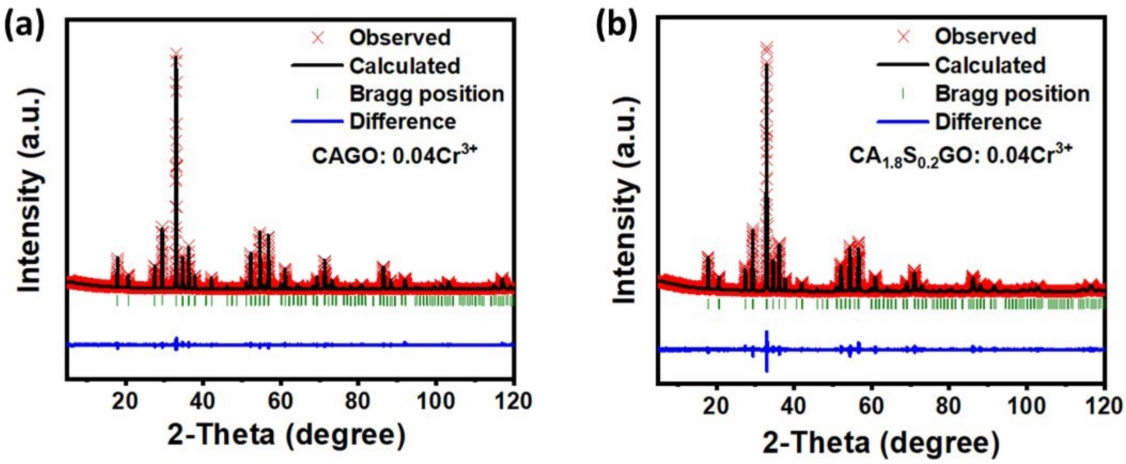

Fig. S2 The refinement results of (a) CAGO: $0.04Cr^{3+}$ and (b) $CA_{1.8}S_{0.2}GO$: $0.04Cr^{3+}$.

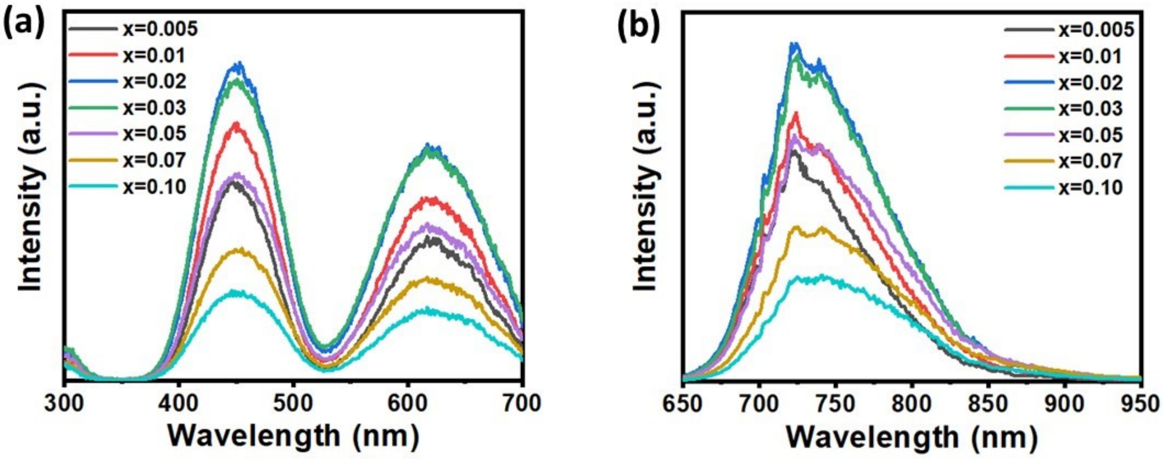

Fig. S3 (a) PLE and (b) PL spectra of CAGO: $2x Cr^{3+}$.

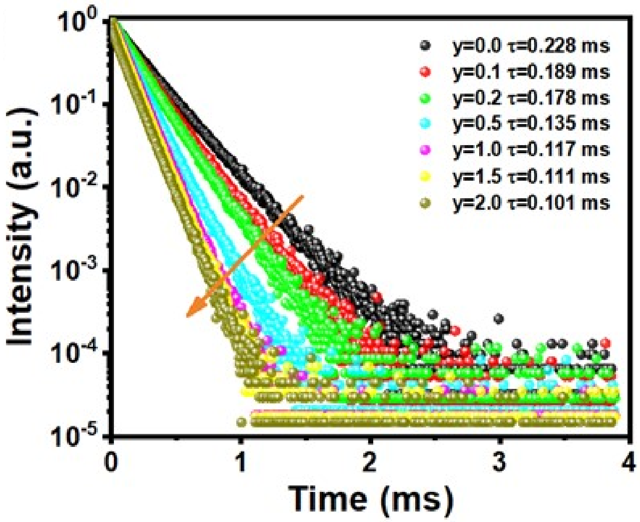

Fig. S4 Decay curves of $CA_{2-y}S_yGO$: $0.04Cr^{3+}$.

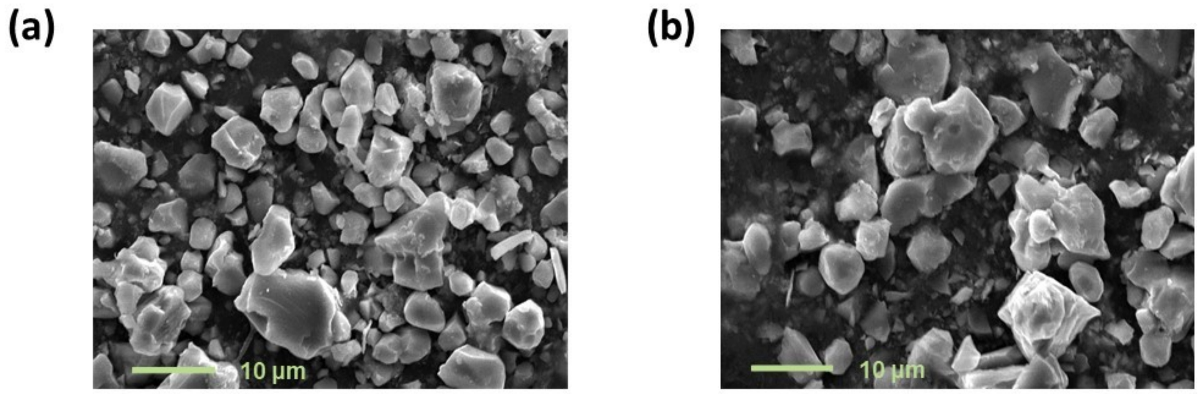

Fig. S5 SEM images of (a) CAGO: $0.04Cr^{3+}$ and (b) $CA_{1.8}S_{0.2}GO$: $0.04Cr^{3+}$.

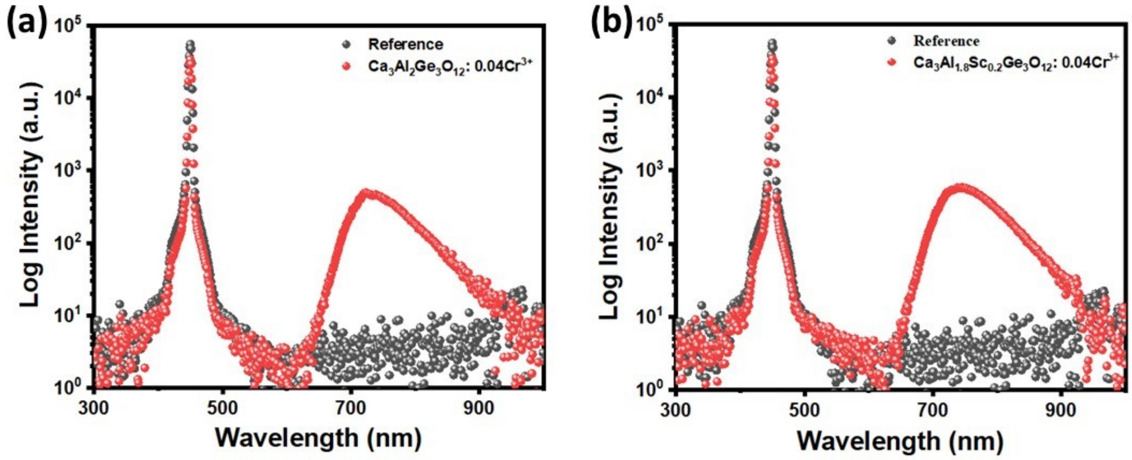

Fig. S6 Spectra of (a) CAGO: $0.04Cr^{3+}$ and (b) $CA_{1.8}S_{0.2}GO$: $0.04Cr^{3+}$ to determine the QE values.

Table S1 Rietveld refinement results of $Ca_3Al_2Ge_3O_{12}$: $0.04Cr^{3+}$and $Ca_3Al_{1.8}Sc_{0.2}Ge_3O_{12}$: $0.04Cr^{3+}$

Phosphor	$Ca_3Al_2Ge_3O_{12}$: $0.04Cr^{3+}$	$Ca_3Al_{1.8}Sc_{0.2}Ge_3O_{12}$: $0.04Cr^{3+}$
Space group	I a -3 d	I a -3 d
Symmetry	cubic	cubic
a = b = c (Å)	12.121(5)	12.160(1)
α = β = γ (°)	90	90
Volume (Å^3)	1781.038(9)	1798.103(2)
Z	8	8
R_p (%)	12.4	14.0
R_{wp} (%)	14.2	15.1
χ^2	1.86	2.09

Table S2 Values of decay time in $Ca_3Al_{2-y}Sc_yGe_3O_{12}$: $0.04Cr^{3+}$ fitted by equation "$I_t=I_0+A*\exp(-t/\tau)$ "

y	0	0.1	0.2	0.5	1.0	1.5	2.0
τ(μs)	228	189	178	135	117	111	101
A	0.972	1.010	1.034	0.997	1.017	0.965	0.861

Table S3 Electro-optical performance of NIR pc-LEDs reported recently.

Phosphors	λ_{max} (nm)	NIR output power	Conversion efficiency	Refs.
$Ca_3Al_{1.8}Sc_{0.2}Ge_3O_{12}$: Cr	744	38.2 mW @ 100 mA	13.7%	This work
$CaLu_2Mg_2Si_3O_{12}$: Cr^{3+}	750	70 mW @ 100 mA	23.2%	1
$Mg_7Ga_2GeO_{12}$: Cr^{3+}	750	23.9 mW @ 100 mA	8.5%	2
$Gd_3Sc_{1.5}Al_{0.5}Ga_3O_{12}$: Cr^{3+}	756	100 mW @ 100 mA	14.0%	3
$Ca_3Sc_2Si_3O_{12}$: Cr^{3+}	770	23.7 mW @ 100 mA	8.9%	4
$Ca_2YHf_2Al_3O_{12}$: Cr^{3+}, Yb^{3+}	775	18 mW @ 100 mA	6%	5
$CaMgSi_2O_6$: Cr^{3+}	788	42.0 mW @ 100 mA	14.0%	6
$KAlP_2O_7$: Cr^{3+}	790	31.1 mW @ 100 mA	11.4%	7
$Ca_2LuGa_3Ge_2O_{12}$: Cr^{3+}	803	27.1 mW @ 100 mA	16.3%	8
$Ca_2LaZr_2Ga_{2.8}Al_{0.2}O_{12}$: Cr^{3+}	820	25 mW @ 100 mA	11.5%	9
$Sr_9Ga(PO_4)_7$: Cr^{3+}	850	19.8 mW @ 150 mA	4.3%	10
$LiInSi_2O_6$: Cr^{3+}	860	51.6 mW @ 100 mA	17.2%	11
$LiScP_2O_7$: Cr^{3+}	880	19 mW @ 100 mA	7%	12
$NaInGe_2O_6$: Cr^{3+}	900	25.2 mW @ 120 mA	4.8%	13

Notes and Referrences

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