Supporting Information

Efficient and thermally stable broadband near-infrared emission in garnet Gd$_3$In$_2$Ga$_3$O$_{12}$:Cr^{3+} phosphor

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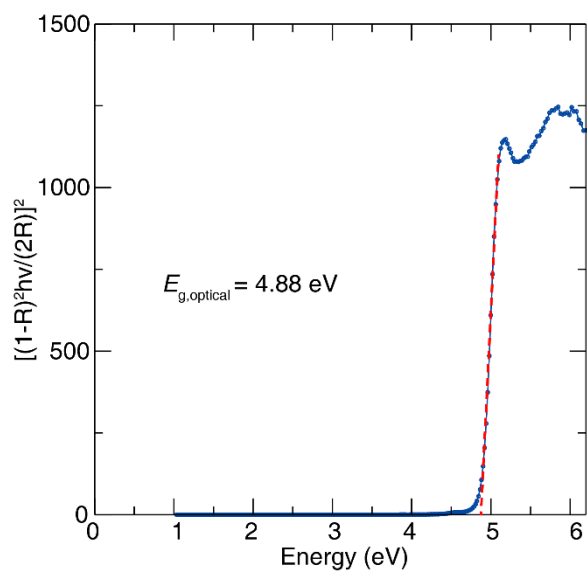
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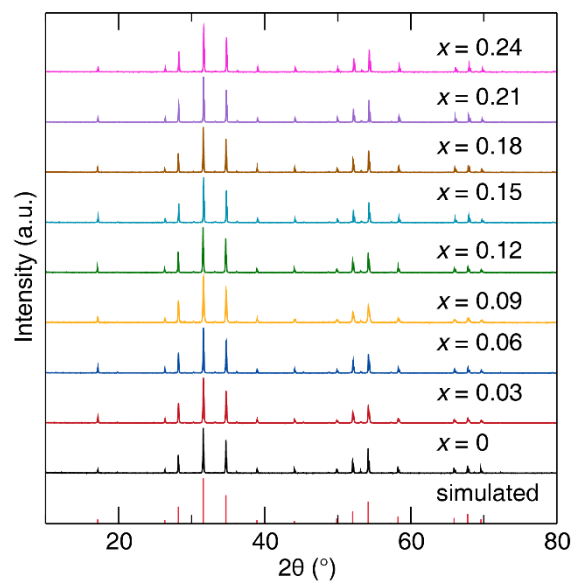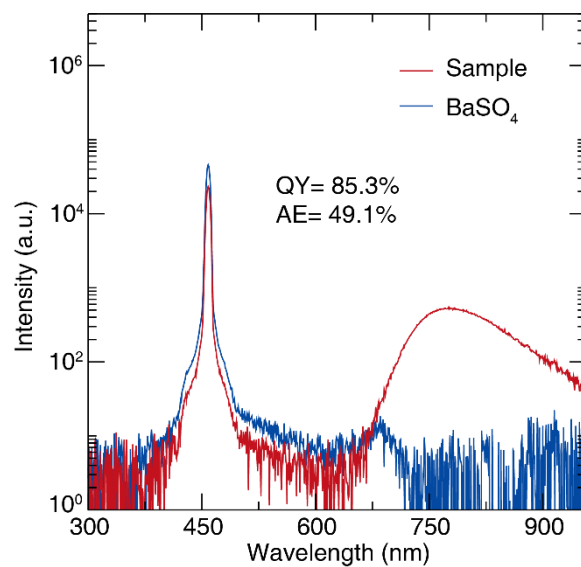
Fig. S1 Powder XRD patterns of $Gd_3In_{2-x}Cr_xGa_3O_{12}$ (x = 0, 0.03, 0.06, 0.09, 0.12, 0.15, 0.18, 0.21, and 0.24), comparing with the simulated XRD pattern for $Gd_3In_2Ga_3O_{12}$.
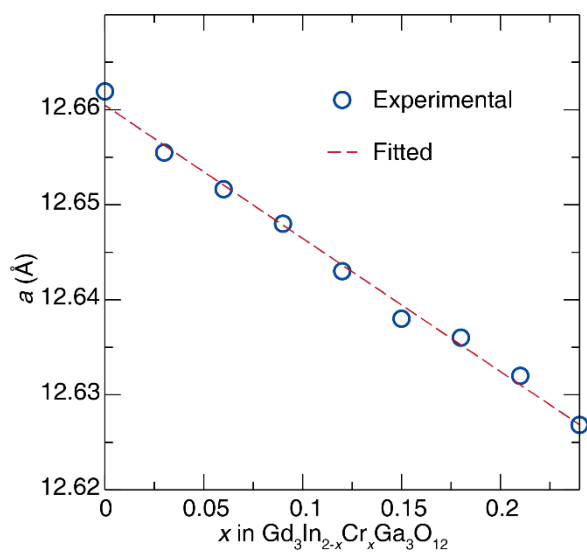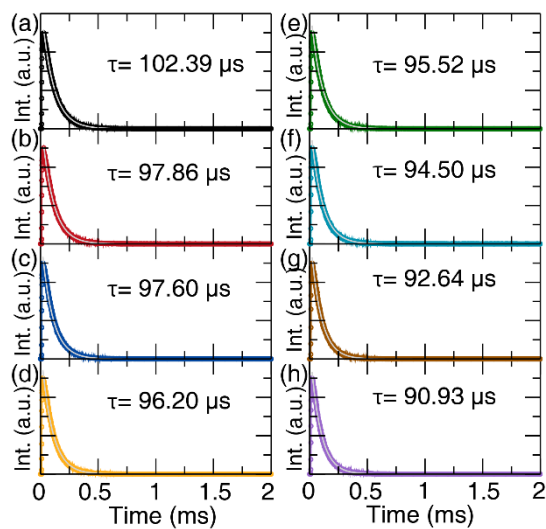

Fig. S2 Refined lattice parameter ($a=b=c$) of $Gd_3In_{2-x}Cr_xGa_3O_{12}$ (x = 0, 0.03, 0.06, 0.09, 0.12, 0.15, 0.18, 0.21, and 0.24).

Fig. S3 The calculated optical band gap of $Gd_3In_2Ga_3O_{12}$.

Fig. S4 PLQY of $Gd_3In_{1.82}Cr_{0.18}Ga_3O_{12}$ phosphor under 460 nm excitation.

Fig. S5 (a-h) Decay curves of $Gd_3In_{2-x}Cr_xGa_3O_{12}$ (x = 0, 0.03, 0.06, 0.09, 0.12, 0.15, 0.18, 0.21, and 0.24) fitted by single-exponential function. The colored line is the original data, while the white line is the fitting curve.
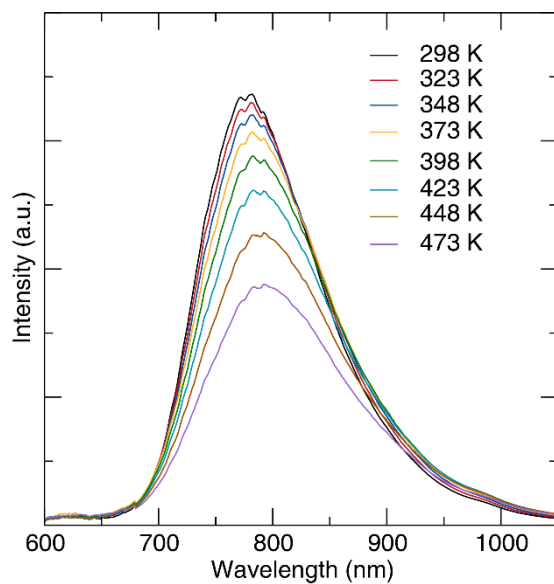
Fig. S6 Temperature-dependent emission spectra of $Gd_3In_{1.82}Cr_{0.18}Ga_3O_{12}$ phosphor excited by 460 nm in temperature range of 298 to 473 K.

Table S1 The refined atomic positions.

atom	Wyck. position	occ.	x	y	z
Gd(1)	24c	1	1/8	0	1/4
In(1)	16a	1	0	0	0
Ga(1)	24d	1	3/8	0	1/4
O(1)	96h	1	0.0965(6)	0.1873(0)	0.2845(6)

Table S2 The detailed input and output parameters for this NIR pc-LED device.

Current (mA)	Total input power (mW)	Total output power (mW)	Blue light output power (mW)	NIR output power (mW)	NIR photoelectric efficience (%)
25	65.88	10.75	1.65	9.10	13.82
50	134.90	20.99	3.26	13.73	13.14
75	206.40	30.81	4.86	25.95	12.57
100	280.20	40.04	6.35	33.69	12.02
125	356.00	48.37	7.69	40.68	11.43
150	433.90	56.98	9.13	47.85	11.03
175	513.3	64.03	10.23	53.80	10.48
200	594.7	71.01	11.38	59.63	10.03
225	678.3	78.92	12.79	66.13	9.75
250	762.9	83.86	13.53	70.33	9.22
275	849.6	89.29	14.42	74.87	8.81
300	637.8	94.18	15.26	78.92	8.42
325	1028.00	98.56	16.00	82.56	8.03
350	1119.00	102.40	16.69	85.71	7.66