Supporting Information

Non-destructive food-quality analysis using near-infrared luminescence from $Mg_3Gd_2Ge_3O_{12}:Cr^{3+}$

Chaojie Li[a], Małgorzata Sójka[b], Jiyou Zhong[a,*] and Jakoah Brgoch[b,*]

[a]*School of Physics and Optoelectronic Engineering, Guangdong University of Technology, Guangzhou 510006, China. E-mail: zhongjiyou@126.com.*

[b]*Department of Chemistry, University of Houston, Houston, Texas 77204, United States. Email: jbrgoch@uh.edu.*

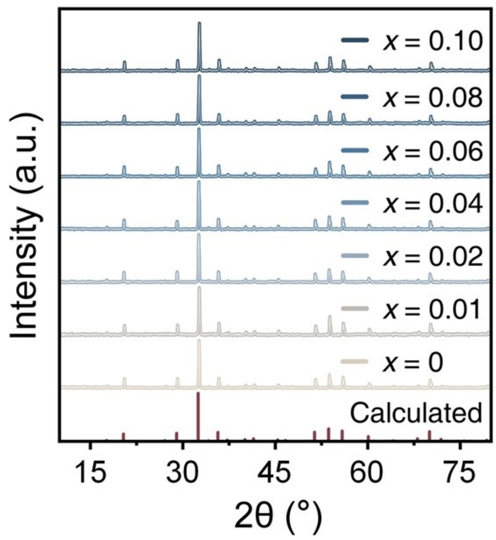

Fig. S1. XRD patterns of the $Mg_{3-x}Gd_2Ge_3O_{12}$:xCr^{3+} (x = 0, 0.01, 0.02, 0.04, 0.06, 0.08, and 0.10) samples compared with the calculated XRD pattern.

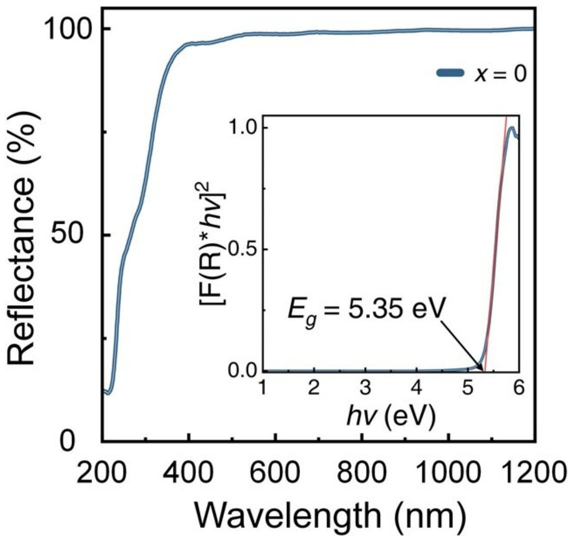

Fig. S2. Diffraction reflection (DR) spectra and optical band gap (inset) of $Mg_3Gd_2Ge_3O_{12}$ sample.

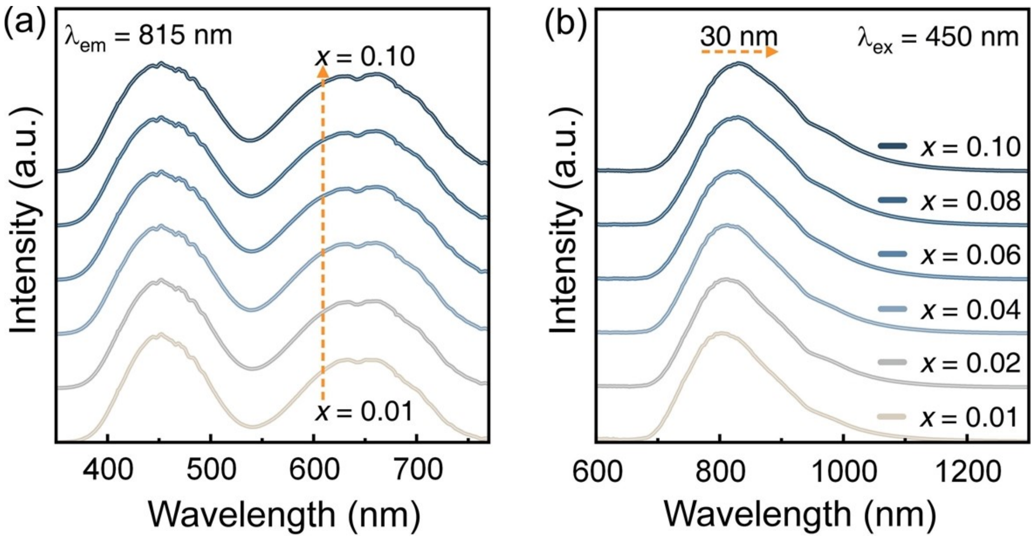

Fig. S3. (a) Photoluminescence excitation, and (b) emission spectra of $Mg_{3-x}Gd_2Ge_3O_{12}$:xCr^{3+} (x = 0, 0.01, 0.02, 0.04, 0.06, 0.08, and 0.10) samples monitored at 815 nm and excited by 450 nm.

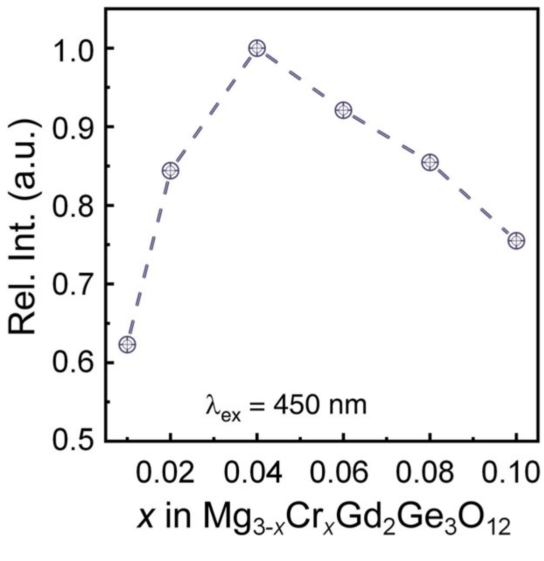

Fig. S4. Relative intensity of $Mg_{3-x}Gd_2Ge_3O_{12}$:xCr^{3+} (x = 0.01−0.10) phosphors excited by 450 nm.

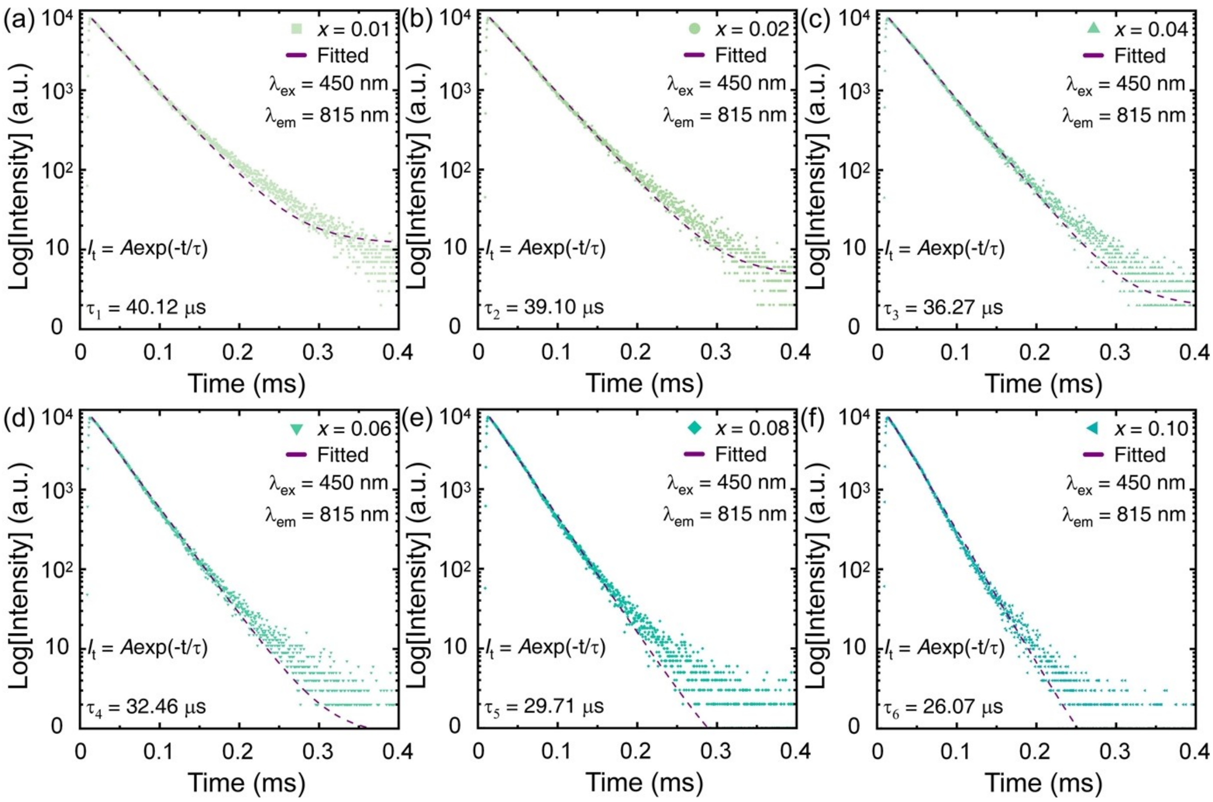

Fig. S5. (a-f) Room-temperature decay curves of $Mg_{3-x}Gd_2Ge_3O_{12}$:xCr^{3+} (x = 0, 0.01, 0.02, 0.04, 0.06, 0.08, and 0.10) samples excited by 450 nm and monitored at 815 nm.

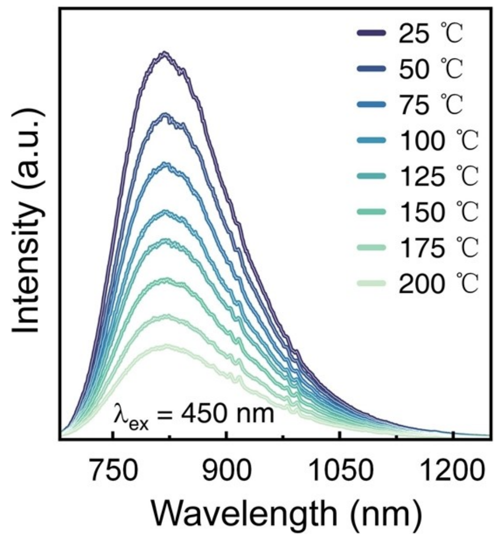

Fig. S6. Temperature-dependent emission spectra of $Mg_{2.96}Gd_2Ge_3O_{12}$:$0.04Cr^{3+}$ samples excited by 450 nm.

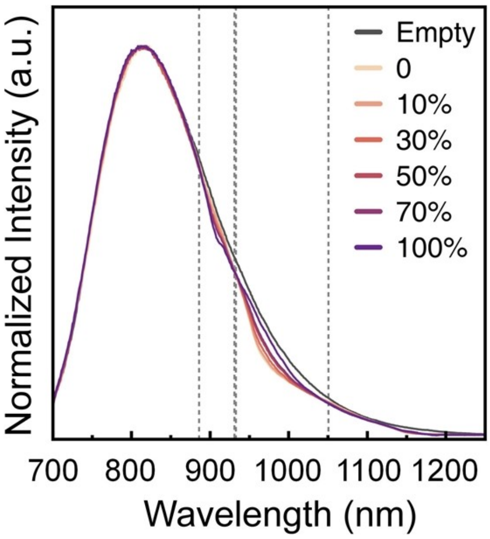

Fig. S7. Normalized transmission spectra of NIR light after penetrating alcohol solution in various concentrations.

Table S1. The refined atomic position of $Mg_3Gd_2Ge_3O_{12}$ sample.

Atom	Wyck. position	Occupation	*x*	*y*	*z*
Mg (1)	16*a*	1	0	0	0
Mg (2)	24*c*	1/3	1/8	0	1/4
Gd (1)	24*c*	2/3	1/8	0	1/4
Ge (1)	24*d*	1	3/8	0	1/74
O (1)	96*h*	1	0.09726(0)	0.19325(0)	0.28466(0)

Table S2. The detailed input and output parameters for $Mg_{2.96}Gd_2Ge_3O_{12}$:0.04Cr^{3+}-containing device.

Current (mA)	Total input power (mW)	Total output power (mW)	Blue light output power (mW)	NIR output power (mW)	NIR photoelectric efficiency (%)
25	65.18	7.09	0.99	6.10	9.36
50	133.10	13.99	1.89	12.10	9.09
75	203.10	20.57	2.78	17.79	8.76
100	275.10	26.84	3.60	23.24	8.45
125	348.90	32.87	4.39	28.48	8.16
150	424.30	38.42	5.11	33.31	7.85
175	501.50	44.01	5.85	38.16	7.61
200	579.90	49.41	6.55	42.86	7.39
225	660.50	54.41	7.22	47.19	7.14
250	742.60	59.68	7.91	51.77	6.97
275	825.70	64.01	8.53	55.48	6.72
300	910.70	68.28	9.13	59.15	6.50
325	996.30	71.72	9.66	62.06	6.23
350	1084.00	76.03	10.25	65.78	6.07