Supporting Information

Broadband short-wave near-infrared-emitting phosphor $MgNb_2O_6:Cr^{3+}$ for *pc*-LED applications

Dechao Yu,[1,2,4] Qingyang Ding,[1] Tiantian Shen,[1] Liang Qiu,[3] Fanquan He,[4] Xinxin Han,[2] Enhai Song,[4]

Songlin Zhuang,[1] and Dawei Zhang[1,*]

[1]*Engineering Research Center of Optical Instrument and System, Ministry of Education and Shanghai Key Lab of Modern Optical System, University of Shanghai for Science and Technology, Shanghai 200093, PR China*

[2]*MOE Key Laboratory of New Processing Technology for Non-ferrous Metals and Materials, Guangxi Key Laboratory of Processing for Non-ferrous Metals and Featured Materials, Guangxi University, Nanning, Guangxi 530004, PR China*

[3]*Hechi College, Hechi 546300, PR China*

[4]*State Key Laboratory of Luminescent Materials and Devices, School of Materials Science and Engineering, South China University of Technology, Guangzhou 510641, PR China*

***Corresponding author:**

Dawei Zhang. Email: dwzhang@usst.edu.cn

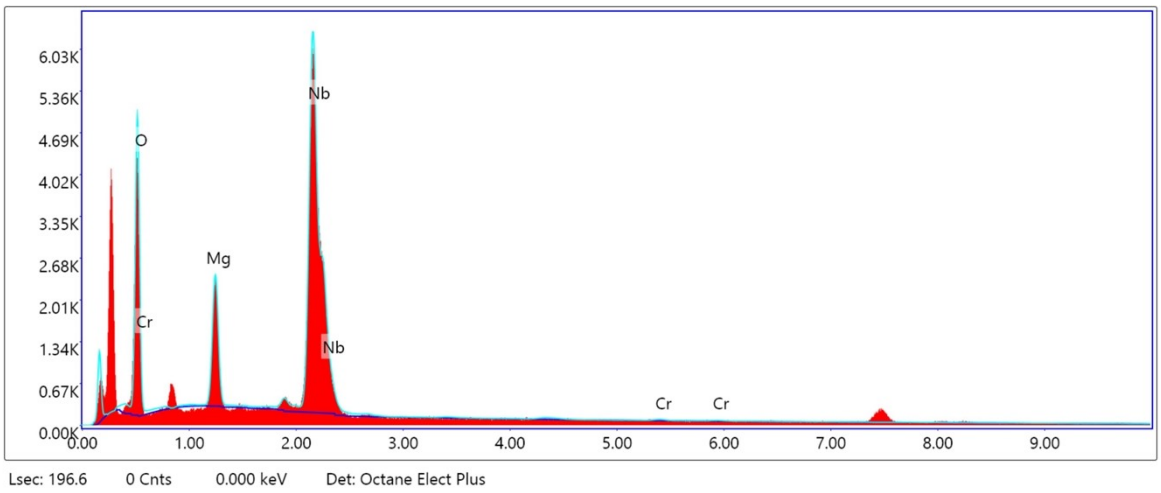

Figure S1 The EDS analysis spectra of the $MgNb_2O_6$:1%Cr^{3+} phosphor

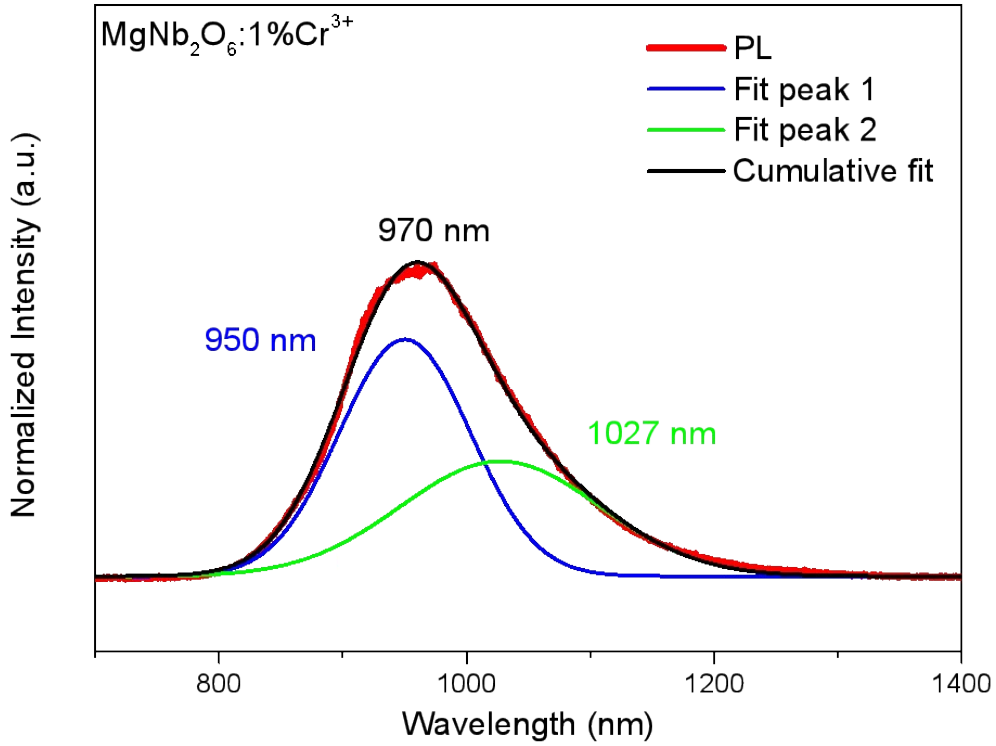

Figure S2 A Gaussian fitting for the PL spectrum of the $MgNb_2O_6$:1%Cr^{3+} phosphor

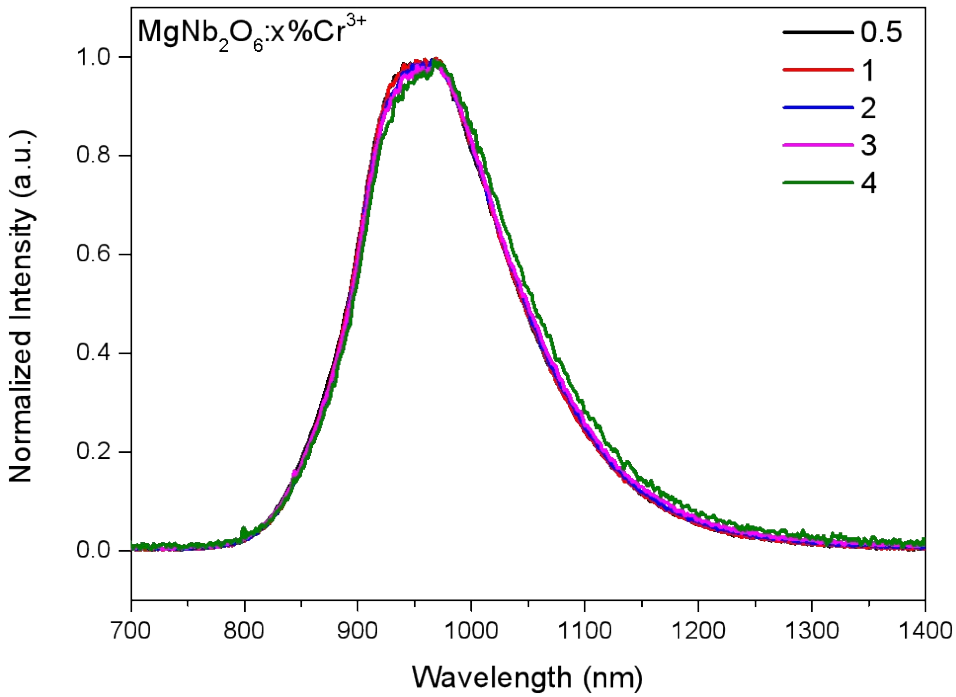

Figure S3 Normalized PL spectra of the $MgNb_2O_6$:x%Cr^{3+} (x = 0.5, 1, 2, 3, 4) samples under excitation of 515 nm.

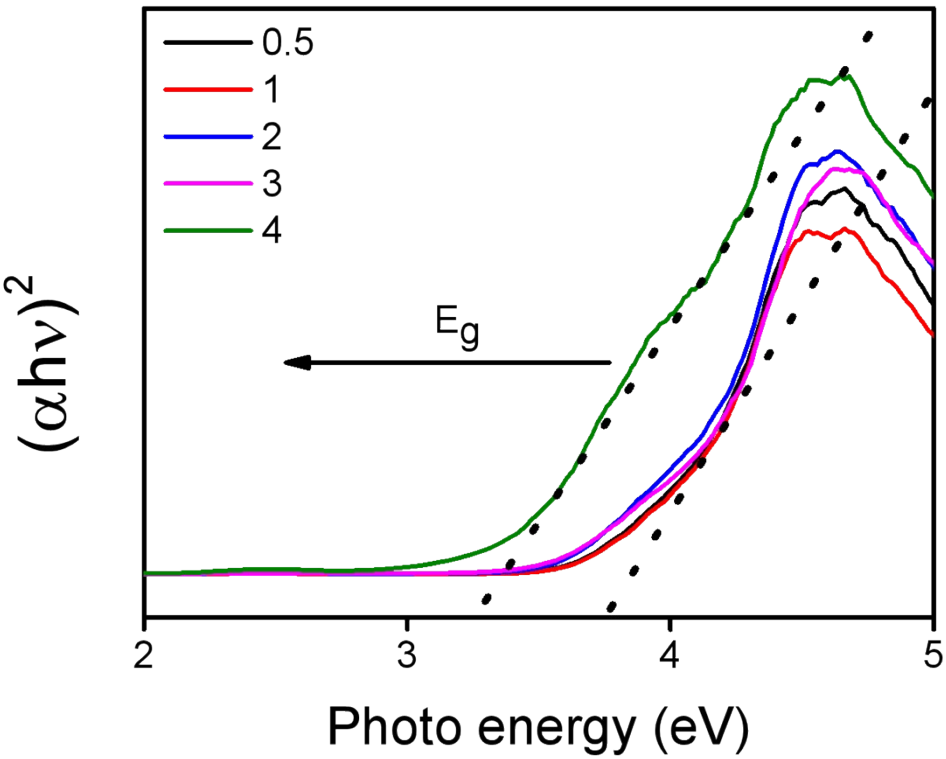

Figure S4 The calculated bandgap (Eg) of the $MgNb_2O_6$:x%Cr^{3+} (x = 0.5, 1, 2, 3, 4) phosphor samples.

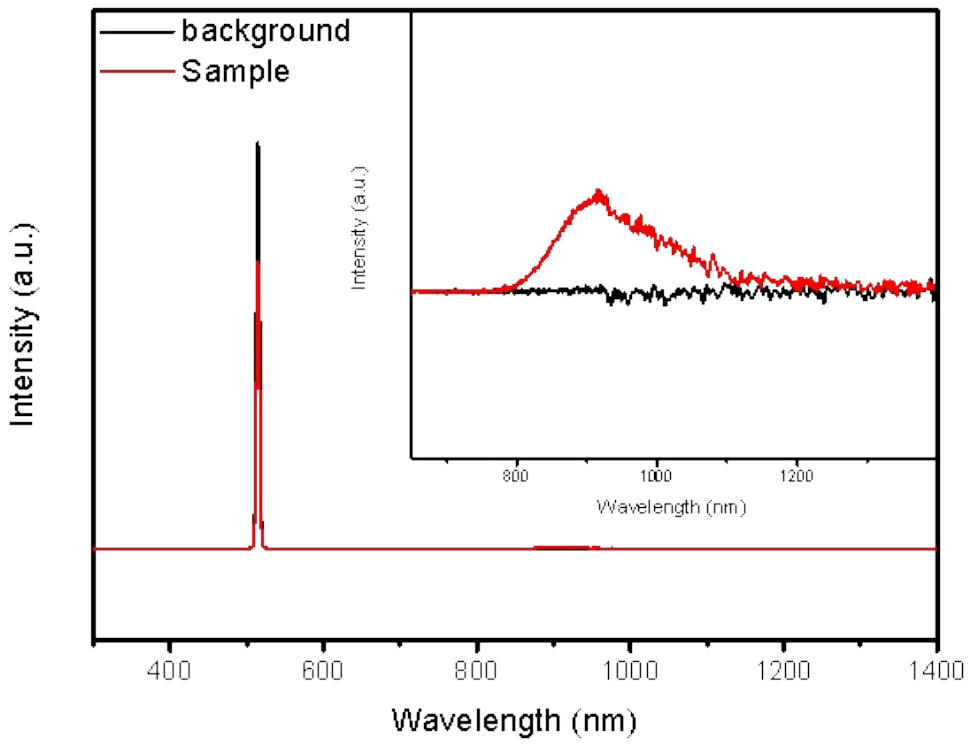

Figure S5 The measured spectra for determining the photoluminescence quantum yield of the $MgNb_2O_6$:1%Cr^{3+} sample.

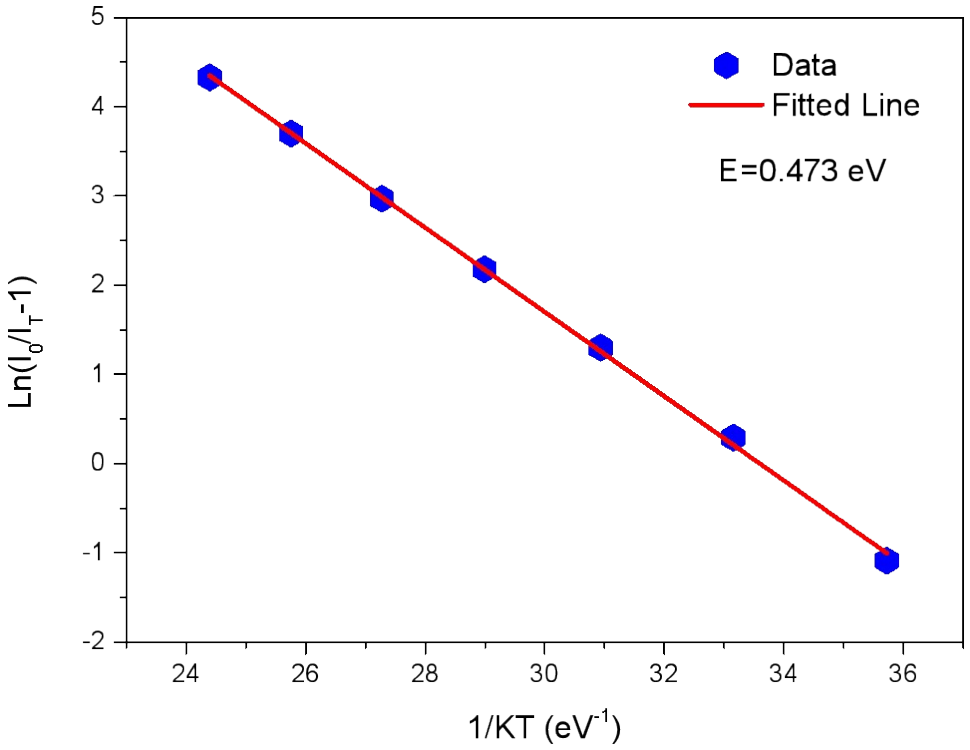

Figure S6 $Ln(I_0/I_T–1)$ versus 1/KT plot of the temperature dependent spectra ($I_0=I_{298K}$)

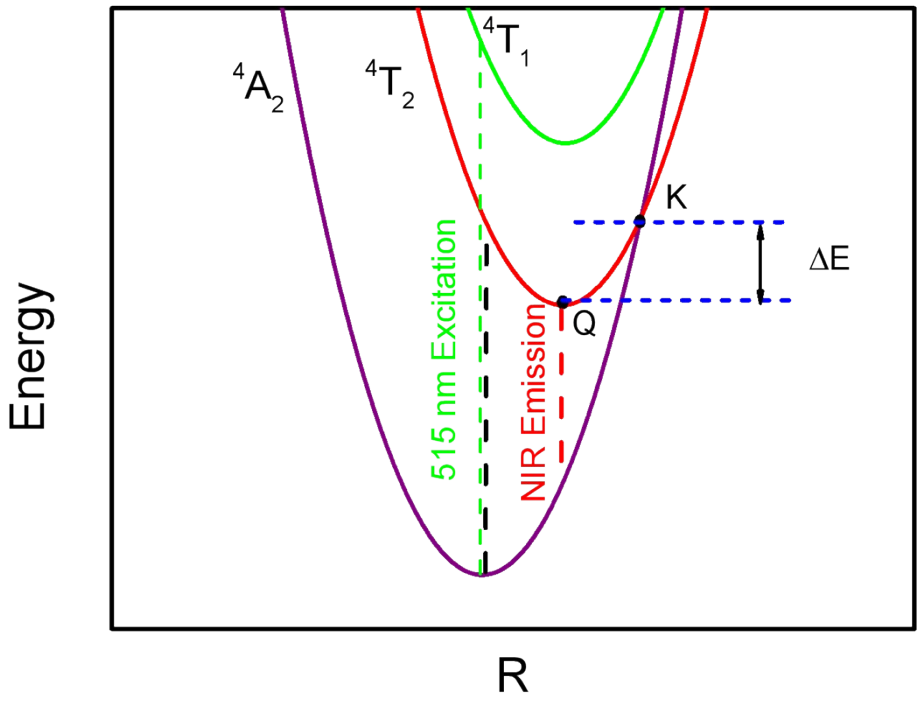

Figure S7 Configurational coordinate diagram of thermal quenching behavior for the $MgNb_2O_6$:1%Cr^{3+} optimal sample

Table S1 The crystal parameters of the $MgNb_2O_6$ host

Compound	$MgNb_2O_6$	Bond	value
Space group	P b c n (60)	Mg-O1	2.081 Å
a	14.1875 Å	Mg-O2	2.081 Å
b	5.7001 Å	Mg-O3	2.082 Å
c	5.0331 Å	Mg-O4	2.082 Å
a/b	2.4890	Mg-O5	2.132 Å
b/c	1.1325	Mg-O6	2.132 Å
c/a	0.3548	Nb-O1	2.080 Å
V	407.03(1) $Å^3$	Nb-O2	1.910 Å
Z	4	Nb-O3	1.795 Å
		Nb-O4	2.071 Å
Average Mg-O	Average Nb-O		
		Nb-O5	1.960 Å
2.065 Å	2.014 Å	Nb-O6	2.272 Å

Table S2 Calculated crystal lattice parameters of the as-prepared $MgNb_2O_6$:x%Cr^{3+} (x = 0, 0.5, 1, 2, 3, 4) phosphor samples

Samples	a	b	c	V
x = 0	14.1875 Å	5.7001 Å	5.0331 Å	407.030 $Å^3$
x = 0.5	14.1875 Å	5.6989 Å	5.0338 Å	407.012 $Å^3$
x = 1	14.1891 Å	5.6995 Å	5.0325 Å	406.994 $Å^3$
x = 2	14.1858 Å	5.7001 Å	5.0332 Å	406.991 $Å^3$
x = 3	14.1892 Å	5.6995 Å	5.0325 Å	406.719 $Å^3$
x = 4	14.1839 Å	5.6984 Å	5.0314 Å	406.668 $Å^3$

Table S3 Results of EDS mapping of the $MgNb_2O_6$:1%Cr^{3+} representative

Element	Weight %	Atomic %	Net Int.	Error %	K ratio	Z	A	F
Mg	7.66	12.33	148.60	4.56	0.0620	1.0408	0.7726	1.0066
Nb	67.87	28.58	545.20	2.08	0.5469	0.7833	1.0290	0.9997
O	24.03	58.75	238.30	8.29	0.0982	1.1200	0.3648	1.0000
Cr	0.44	0.33	2.20	59.15	0.0040	0.9055	0.9764	1.0244

Table S4 Fitting functions, R-square, and calculated decay time of the $MgNb_2O_6$:*x*%Cr^{3+} (*x* = 0.5, 1, 2, 3, 4) monitoring at 970 nm under pulsed light excitation of 515 nm

Sample	fitting function	τ_1 (μs)	τ_2 (μs)	τ_{avg} (μs)	R-square
$MgNb_2O_6$:0.5%Cr^{3+}	$I = A_1*\exp(-t/\tau_1) + A_2*\exp(-t/\tau_2) + I_0$	10.29	10.29	10.29	0.99898
$MgNb_2O_6$:1%Cr^{3+}	$I = A_1*\exp(-t/\tau_1) + A_2*\exp(-t/\tau_2) + I_0$	10.20	10.20	10.20	0.99911
$MgNb_2O_6$:2%Cr^{3+}	$I = A_1*\exp(-t/\tau_1) + A_2*\exp(-t/\tau_2) + I_0$	9.43	9.43	9.43	0.99917
$MgNb_2O_6$:3%Cr^{3+}	$I = A_1*\exp(-t/\tau_1) + A_2*\exp(-t/\tau_2) + I_0$	7.13	13.5	8.19	0.9993
$MgNb_2O_6$:4%Cr^{3+}	$I = A_1*\exp(-t/\tau_1) + A_2*\exp(-t/\tau_2) + I_0$	11.00	3.91	5.09	0.99905

Table S5 The NIR output power and photoelectric efficiency of $MgNb_2O_6$:1%Cr^{3+} pc-LED and that of some reported similar pc-LED devices

Phosphors	Chip (nm)	Peak (nm)	NIR output power	Photoelectric efficiency	Ref
$NaInGe_2O_6$:7%Cr^{3+}	470	900	25.2 mW@ 120 mA	8.2%@20 mA	S1
$Mg_3Ga_{1.9}In_{0.1}GeO_8$:3%$Cr^{3+}$	455	910	6.134 mW@ 60 mA	8.5%@60 mA	S2
$ZnTa_2O_6$:4%Cr^3	460	935	39.8 mW@ 300 mA	5%@100 mA	S3
$Li_3Sc_2(PO_4)_3$:8%Cr^{3+}	496	978	5.81 mW@ 80mA	2.62%@80 mA	S4
$MgNb_2O_6$:1%Cr^{3+}	515	970	6.29 mW@ 100mA	2.5%@100 mA	This work

Reference

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S2. D. Dai, Z. Wang, Z. Xing, X. Li, C. Liu, L. Zhang, Z. Yang and P. Li, *J. Alloys Compd.*, 2019, **806**, 926-938.

S3. S. He, P. Li, Y. Ren, G. Wei, Y. Wang, Y. Yang, R. Li, J. Li, Y. Shi, X. Shi and Z. Wang, *Inorg. Chem.*, 2022, **61**, 11284-11292.

S4. S. Zhao, L. Lou, S. Yuan, D. Zhu, F. Wu and Z. Mu, *J. Lumin.*, 2022, **251**, 119188.