Supporting Information

A Novel Broadband Near-Infrared Phosphor $Na_3Mg_4LiSi_{12}O_{30}:Cr^{3+}$: Moderate synthesis and Application

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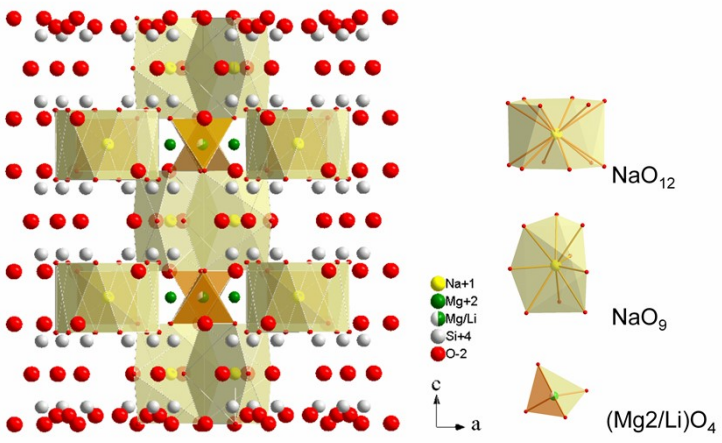

Figure S1. Crystal structure of NMLS and coordination of Na and (Mg2/Li).

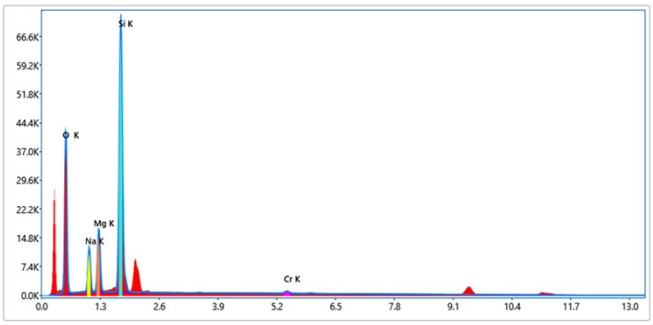

Figure S2. EDS spectrum of NMLS:9%Cr^{3+}.

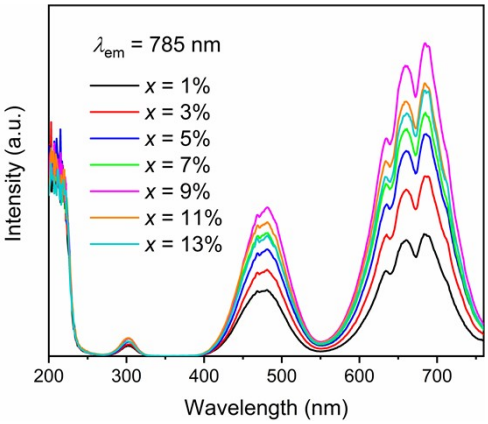

Figure S3. PLE spectra of the NMLS: xCr^{3+} phosphors at RT.

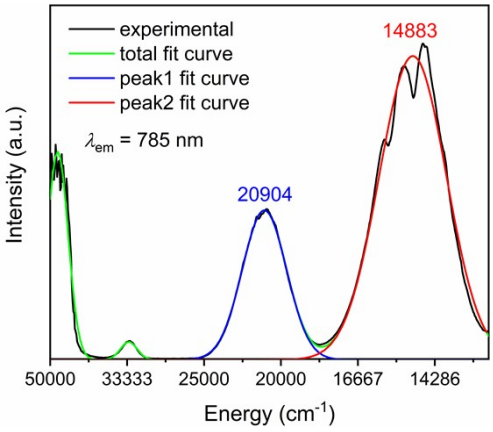

Figure S4. PLE spectrum of $^4T_1(^4F)$ and $^4T_2(^4F)$ bands at room temperature fitted by a Gaussian function. Blue line and red line are the Gaussian band for $^4T_1(^4F)$ and $^4T_2(^4F)$, respectively. Green line is total fitted spectrum.

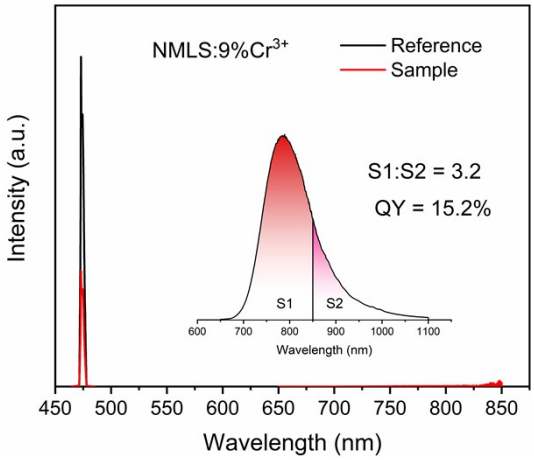

Figure S5. The quantum yield of NMLS: 9%Cr^{3+}.

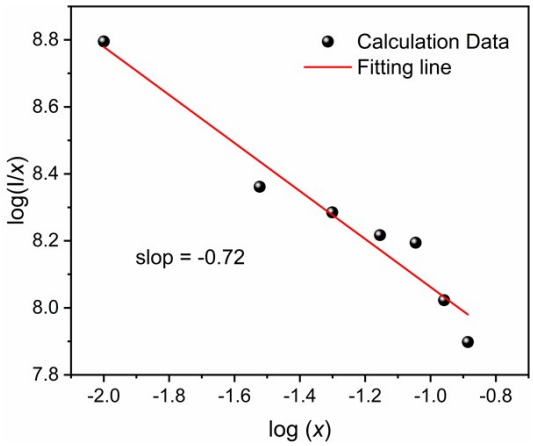

Figure S6. The fitting results between log(I/x) and log(x).

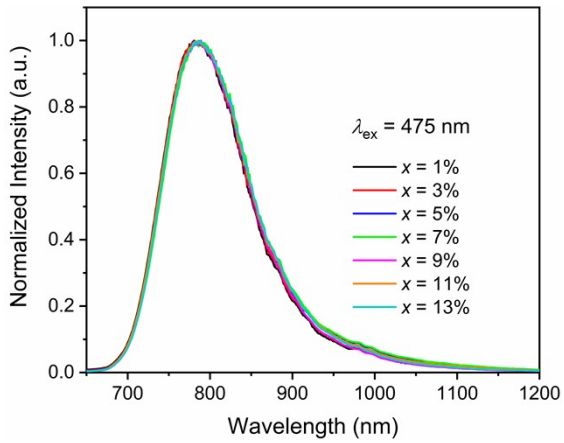

Figure S7. Normalized PL spectrum of NMLS: xCr^{3+}.

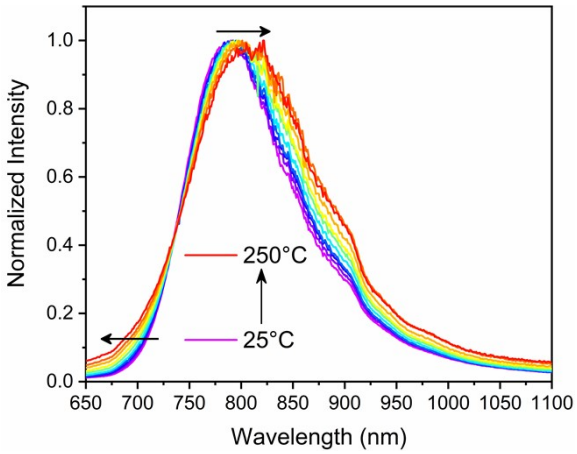

Figure S8. The Normalized temperature-dependent emission spectra of NMLS:9%Cr^{3+}.

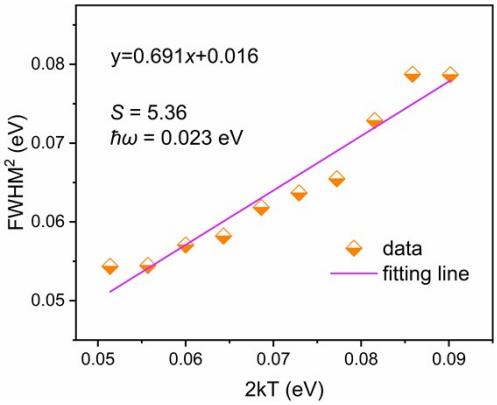

Figure S9. Fitting results of function between $FWHM^2$ and 2kT.

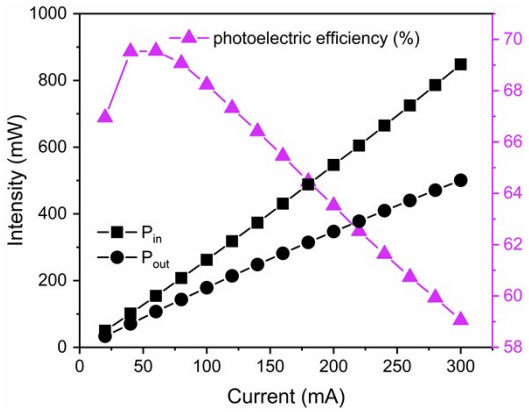

Figure S10. The output power and photoelectric efficiency of 475 nm LED chip with input current.

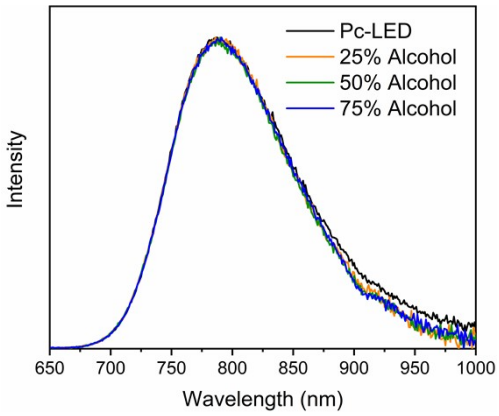

Figure S11. Transmission spectra of the mixed solution of water and alcohol.

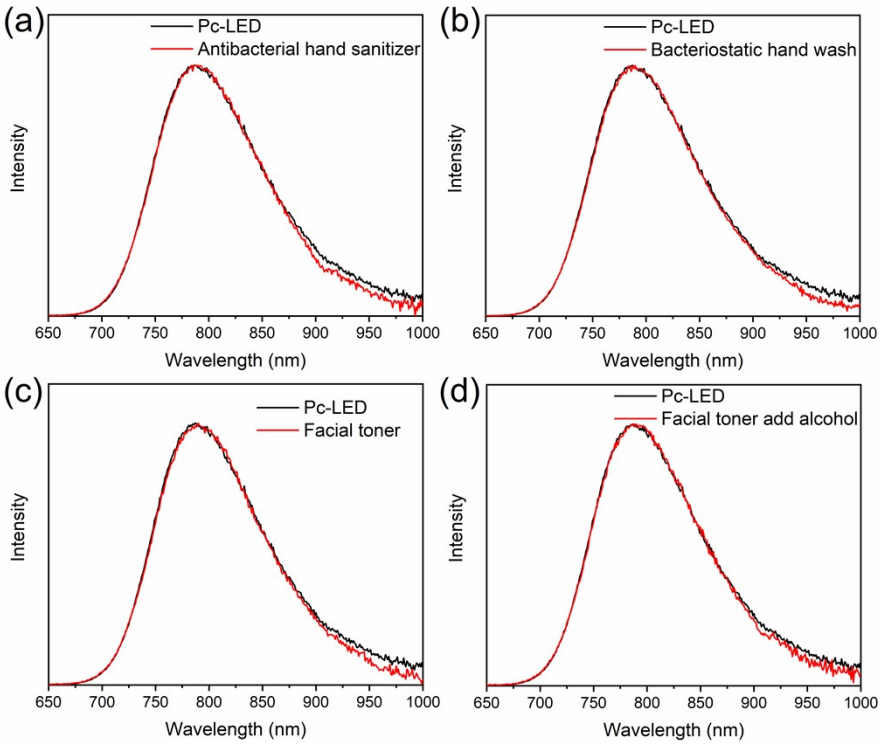

Figure S12. Transmission spectra of NIR light after penetrating antibacterial hand sanitizer**(a)**, bacteriostatic hand wash**(b)**, facial toner**(c)** and facial toner with alcohol**(d)**.

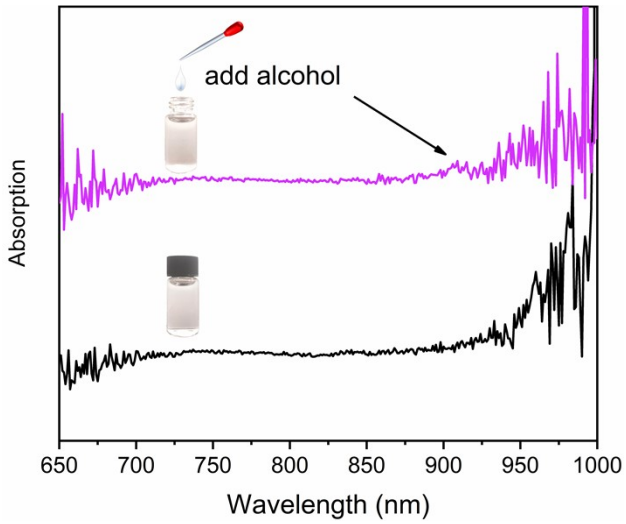

Figure S13. Calculated absorbance spectra of facial toner and facial toner added alcohol.

Table S1. Comparison of Synthesis temperature for typical silicate-based phosphors.

Host	Dopant	Synthesis temperature(℃)	Refs
$LiInSi_2O_6$	Cr^{3+}	1050	1
$(Li/Na)ScSi_2O_6$	Cr^{3+}	1200	2
$CaMgSi_2O_6$	Cr^{3+}	1250	3
$CaScAlSiO_6$	Cr^{3+}	1450	4
$Ca_3Sc_2Si_3O_{12}$	Cr^{3+}	1350	5
$CaLu_2Mg_2Si_3O_{12}$	Cr^{3+}	1350	6
$Ba(Zr/Sn/Hf)Si_3O_9$	Cr^{3+}	1300	7
Li_2ZnSiO_4	Fe^{3+}	1200	8
$(Ba/Sr)_3SiO_5$	Eu^{2+}	1400-1550	9
$SrGa_2Si_2O_8$	Mn^{2+}	1200	10
$Na_3Mg_4LiSi_{12}O_{30}$	Cr^{3+}	600	This work

Table S2. Lattice parameters and agreement factors for NMLS:9%Cr^{3+} refined by Rietveld method when Cr^{3+} ions occupy the Mg1 site.

Formula	NMLS:9%Cr^{3+}
Crystal system	Hexagonal
Space group	P6/mcc
a=b (Å)	10.1408(4)
c (Å)	14.1296(8)
α =β (°)	90
γ (°)	120
Z	2
Volume ($Å^3$)	1258.37(12)
R_p	8.21
R_{wp}	10.95
R_{exp}	5.92
GOF	1.85

Table S3. Atomic positions and occupancies for NMLS:9%Cr^{3+} refined by Rietveld method when Cr^{3+} ions occupy the Mg1 site.

	Np	*x*	*y*	*z*	Occupancy
Na1	2	0.00000	0.00000	0.25000	1.0
Na2	12	0.33330	0.66670	0.00000	1.0
Mg1	12	0.33330	0.66670	0.25000	0.91(7)
Cr^{3+}	12	0.33330	0.66670	0.25000	0.09(7)
Mg2	6	050000	0.00000	0.25000	0.6667
Li1	6	050000	0.00000	0.25000	0.3333
Si1	24	0.902(5)	0.226(5)	0.050(2)	1.0
O1	12	0.77(2)	0.24(2)	0.00000	1.0
O2	24	0.867(10)	0.056(12)	0.051(5)	1.0
O3	24	0.780(7)	0.110(7)	0.125(6)	1.0

References

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