Supplementary Information for

A high efficiency Trivalent chromium-doped near-infrared-emitting phosphor and its NIR spectroscopy application

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This supporting information contains 4 pages, 1 figure, and 7 tables.

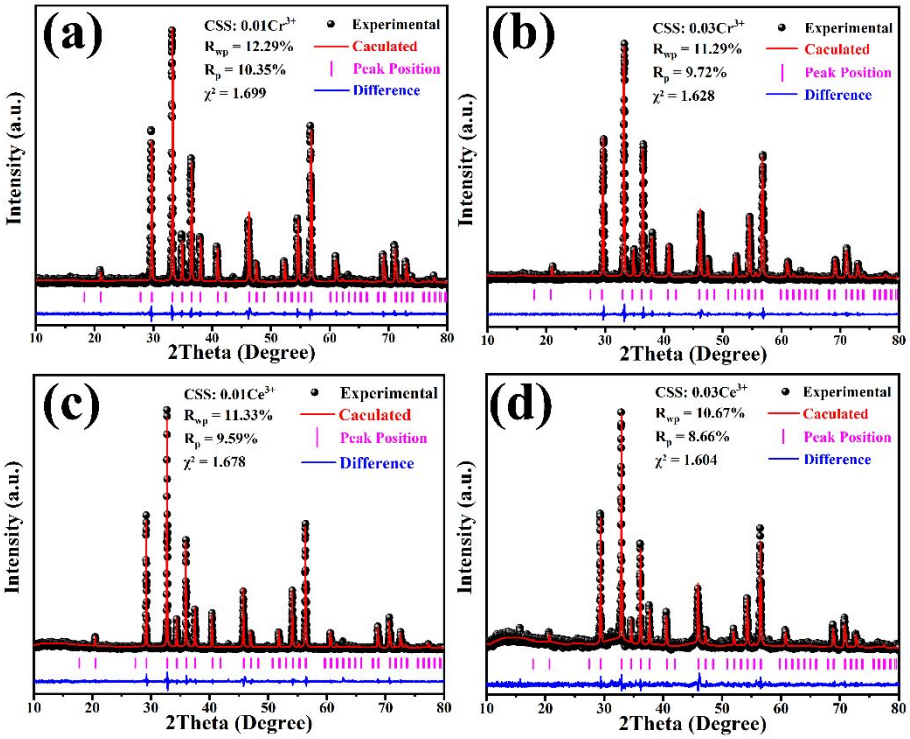

Figure S1. The XRD Rietveld refinement spectrum of a) CSS: 0.01Cr^{3+}, b) CSS: 0.03Cr^{3+}, c) CSS: 0.01Ce^{3+} and d) CSS: 0.01Ce^{3+}.

Table S1. Lattice parameter and cell volume for CSS host, CSS:0.01Cr^{3+}, CSS:0.03Cr^{3+}, CSS:0.01Ce^{3+} and CSS:0.03Ce^{3+}

Formula	CSS	CSS:0.01 Cr^{3+}	CSS:0.03 Cr^{3+}	CSS:0.01 Ce^{3+}	CSS:0.03 Ce^{3+}
lattice parameter (Å)	12.1984(1)	12.1884(1)	12.1879(1)	12.2000(1)	12.2065(1)
Cell volume (Å^3)	1815.14(3)	1810.69(6)	1810.45(3)	1815.85(6)	1818.77(4)

Table S2. Crystallographic data for $Ca_3Sc_2Si_3O_{12}$

Formula	$Ca_3Sc_2Si_3O_{12}$
Crystal system	cubic

Z	8
Space-group	*Ia-3d (230)*
V	1815.14(3) $Å^3$
a	12.1984(1) Å
b	12.1984(1) Å
c	12.1984(1) Å
β	90 ^{o}

Table S3. Atomic coordinates for $Ca_3Sc_2Si_3O_{12}$

Atom	Wyckoff	x/a	y/b	z/c
Ca1	*24c*	0.12500	0	0.25000
O1	*96h*	0.04443	0.05062	0.66039
Si1	*24d*	0.37500	0	0.25000
Sc1	*16a*	0	0	0

Table S4. Selected average bond lengths (Å)

Bond	Distance
Ca-O(CN=8)	2.4049(6)
Sc-O(CN=6)	2.0901(1)
Si-O(CN=4)	1.6499(3)

Table S5. Thermal stability of this work and some previous reported Cr^{3+} doped phosphors

Materials	Temperature (℃)	Relative to the emission intensity at room temperature (~25℃)
This work	150	82% ($^4T_2$ → $^4A_2$)
$NaScGe_2O_6$: Cr^{3+}	150	20.5% ($^4T_2$ → $^4A_2$)
$Bi_2Ga_4O_9$:Cr^{3+}	150	~6% (^2E → $^4A_2$)

$Ca_2LuZr_2Al_3O_{12}:Cr^{3+}$	150	~67% ($^4T_2 \rightarrow {}^4A_2$)
$Ca_2LuHf_2Al_3O_{12}:Cr^{3+}$	150	~72% ($^4T_2 \rightarrow {}^4A_2$)
$Ca_3Hf_2Al_2SiO_{12}:Cr^{3+}$	150	~18% ($^4T_2 \rightarrow {}^4A_2$)

Table S6. Output power and photoelectric efficiency of the 450 nm chip with $Ca_3Sc_2Si_3O_{12}:0.03Cr^{3+}$ under different drive current

Current (mA)	Voltage (V)	NIR Output power (mW)	Photoelectric efficiency (%)
100	2.778	1.218	9.053
150	2.847	2.329	7.96
200	2.909	3.500	7.072
250	2.973	5.096	6.24
300	3.03	6.263	5.584
350	3.087	8.024	4.991

Table S7. Output power and photoelectric efficiency of the 450 nm chip with $Ca_3Sc_2Si_3O_{12}:0.06Ce^{3+},0.03Cr^{3+}$ under different drive current

Current (mA)	Voltage (V)	NIR Output power (mW)	Photoelectric efficiency (%)
100	2.988	4.163	17.961
150	3.149	7.986	16.937
200	3.302	12.234	15.939
250	3.438	15.622	15.154
300	3.575	18.990	14.361
350	3.708	21.653	13.684