

Composition-structure-luminescence and enhancement of Cr<sup>3+</sup>  
activated broadband near infrared phosphors for night vision, bio-  
imaging, and noninvasive detection

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**Table S1.** Crystallographic data, structure refinement parameters of KSP0: 0.03Cr<sup>3+</sup>.

Formula	KSc <sub>0.97</sub> Cr <sub>0.03</sub> P <sub>2</sub> O <sub>7</sub>
Radiation type	Cu K $\alpha$
2 $\theta$ range (°)	5-130
Step (°)	0.01
R <sub>B</sub> (%)	2.59
R <sub>P</sub> (%)	2.88
R <sub>WP</sub> (%)	4.04
S (%)	1.67
Crystal system	Monoclinic
Space group	<i>P</i> 2 <sub>1</sub> / <i>c</i> (No. 14)
a (Å)	7.4535(1)
b (Å)	10.3481(2)
c (Å)	8.3557(1)
$\beta$	106.4860(9)
Volume (Å <sup>3</sup> )	617.98(1)
Z	4

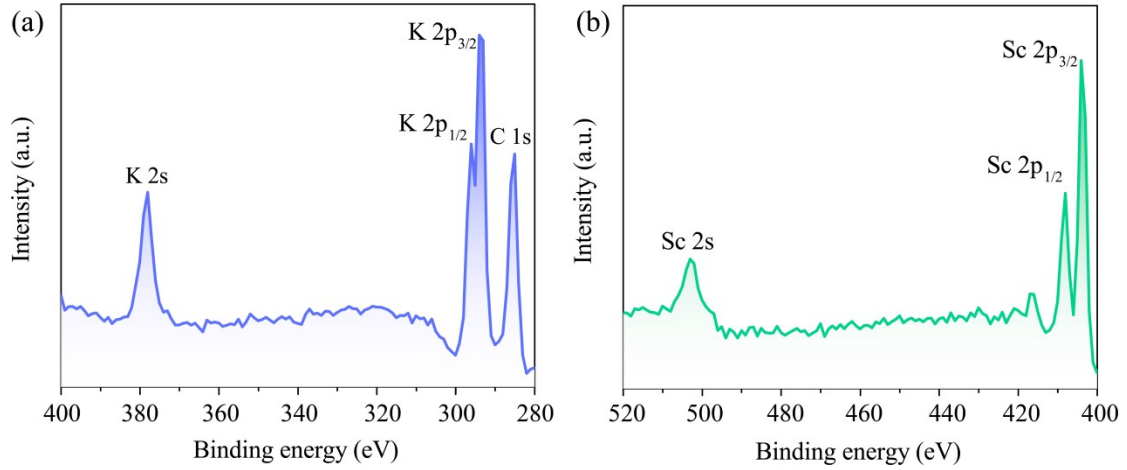
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**Table S2.** Atomic parameters of KSPO: 0.03Cr<sup>3+</sup>.

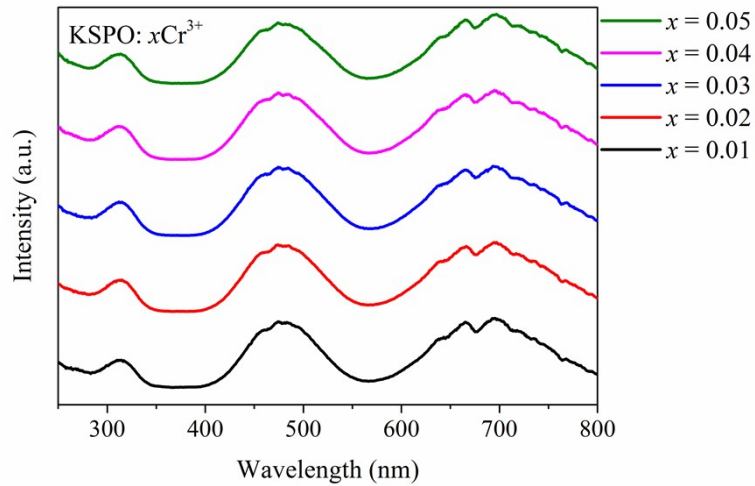
Atom	Wyck.	Occ.	x/a	y/b	z/c	U [Å <sup>2</sup> ]
K1	4e	1	0.8193(3)	0.6794(1)	0.9410(2)	0.0000
Sc1	4e	0.97	0.7643(2)	0.0993(1)	0.7430(2)	0.0000
Cr1	4e	0.03	0.7643(2)	0.0993(2)	0.7430(2)	0.0000
P1	4e	1	0.5593(3)	0.3595(3)	0.8108(3)	0.0000
P2	4e	1	0.8654(3)	0.4011(2)	0.6773(3)	0.0000
O1	4e	1	0.5534(6)	0.2209(5)	0.7662(5)	0.0000
O2	4e	1	0.3650(6)	0.4228(5)	0.7617(6)	0.0000
O3	4e	1	0.6752(6)	0.3912(5)	0.9854(5)	0.0000
O4	4e	1	0.6595(6)	0.4350(4)	0.6932(5)	0.0000
O5	4e	1	0.9897(6)	0.5053(5)	0.7745(5)	0.0000
O6	4e	1	0.8600(7)	0.4090(5)	0.4981(6)	0.0000
O7	4e	1	0.9228(6)	0.2652(5)	0.7506(6)	0.0000

**Table S3.** Bond length of KSPO: 0.03Cr<sup>3+</sup>.

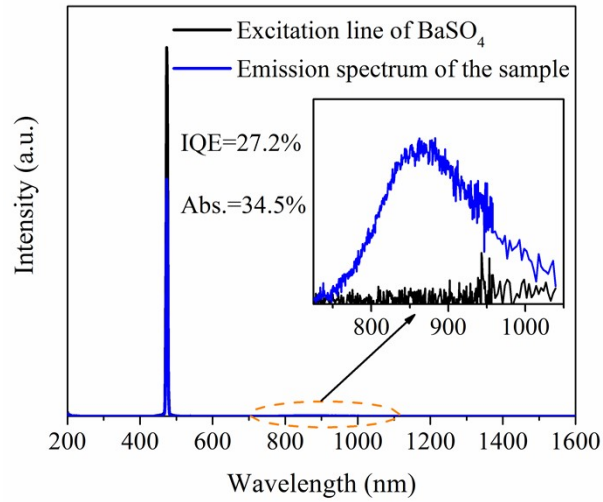
Atom1	Atom2	Symmetry operator	Bond length (Å)
K1	O5	x, y, z	2.792(5)
	O7	2-x, 1-y, 2-z	2.802(4)
	O1	1-x, 0.5+y, 1.5-z	2.858(4)
	O7	2-x, 0.5+y, 1.5-z	2.965(5)
	O5	2-x, 1-y, 2-z	3.068(4)
	O2	1-x, 0.5+y, 1.5-z	3.127(5)
	O3	x, y, z	3.227(5)
		Average length	2.935
Sc1 Cr1	O6	x, 0.5-y, 0.5+z	2.049(5)
	O2	1-x, -0.5+y, 1.5-z	2.060(5)
	O1	x, y, z	2.065(5)
	O3	x, 0.5-y, -0.5+z	2.067(4)
	O7	x, y, z	2.075(5)
	O5	2-x, -0.5+y, 1.5-z	2.117(5)
		Average length	2.072
P1	O1	x, y, z	1.479(6)
	O3	x, y, z	1.506(4)
	O2	x, y, z	1.535(5)
	O4	x, y, z	1.597(5)
	Average length	1.529	
P2	O6	x, y, z	1.489(5)
	O5	x, y, z	1.501(5)
	O7	x, y, z	1.545(5)
	O4	x, y, z	1.616(5)
	Average length	1.538	



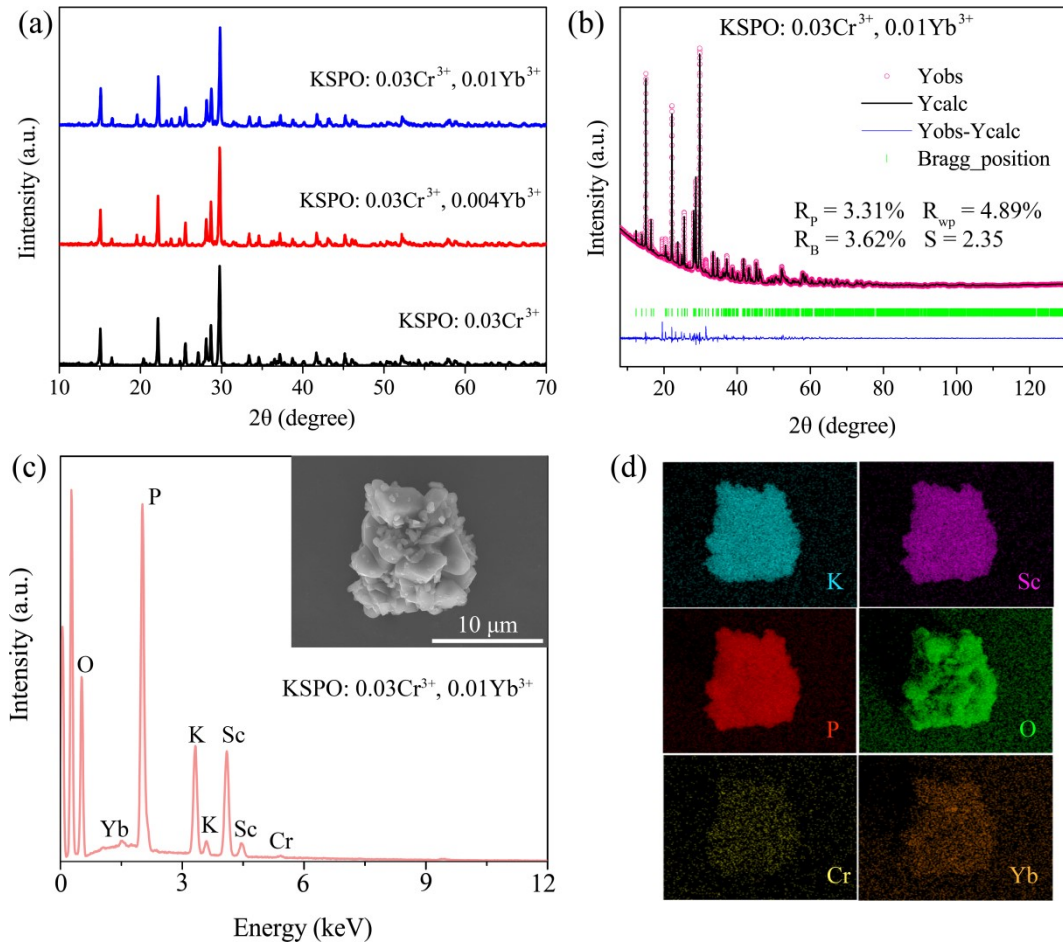
**Fig. S1** The binding energy peaks splitting results of K (a) and Sc (b). The peaks at 293.4, 296.1, and 377.8 eV are attributed to the K 2p<sub>3/2</sub>, K 2p<sub>1/2</sub>, and K 2s. And the peaks at 404.5, 408.3, and 502.7 eV can be assigned to the Sc 2p<sub>3/2</sub>, Sc 2p<sub>1/2</sub>, and Sc 2s.



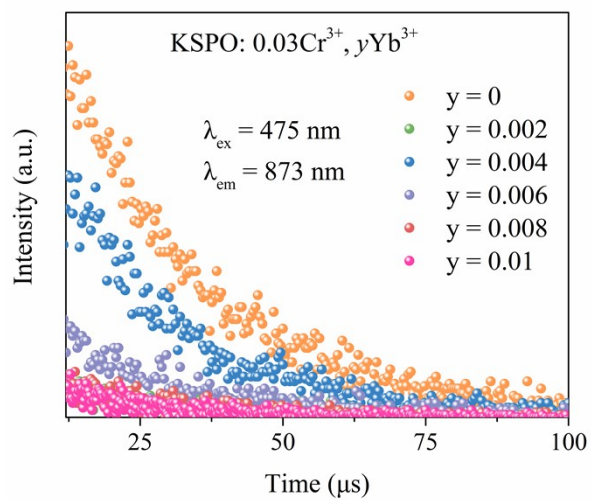
**Fig. S2** PLE spectra of KSPO: xCr<sup>3+</sup> phosphors monitored at 873 nm.



**Fig. S3** PL spectra with BaSO<sub>4</sub> as the reference under 475 nm excitation for quantum efficiency measurements of KSPO: 0.03Cr<sup>3+</sup>.



**Fig. S4** XRD pattern of KSPO: 0.03Cr<sup>3+</sup>, yYb<sup>3+</sup> samples. (b) The refinement result of KSPO: 0.03Cr<sup>3+</sup>, 0.01Yb<sup>3+</sup>. The EDS (c) and SEM mapping (d) of KSPO: 0.03Cr<sup>3+</sup>, 0.01Yb<sup>3+</sup>.



**Fig. S5** The decay curves of Cr<sup>3+</sup> emission in KSPO: 0.03Cr<sup>3+</sup>, yYb<sup>3+</sup> samples.