Supporting Information

Achieving Cr^{6+}-free Cr^{3+}-activated spinel phosphor by one-step solid-state reaction

Yiqing Zhou,[a] Quantian Cao,[a] Yue Han,[a] Zhongxian Qiu,[a,*] Jilin Zhang,[a] Wenli Zhou,[a] Shixun Lian[a,*]

[a] Key Laboratory of Light Energy Conversion Materials of Hunan Province College, Key Laboratory of Chemical Biology & Traditional Chinese Medicine Research (Ministry of Education), College of Chemistry and Chemical Engineering, Hunan Normal University, Changsha 410081, China

Corresponding authors' email: zxqiu@hunnu.edu.cn (Z. Qiu);
sxlian@hunnu.edu.cn (S. Lian)

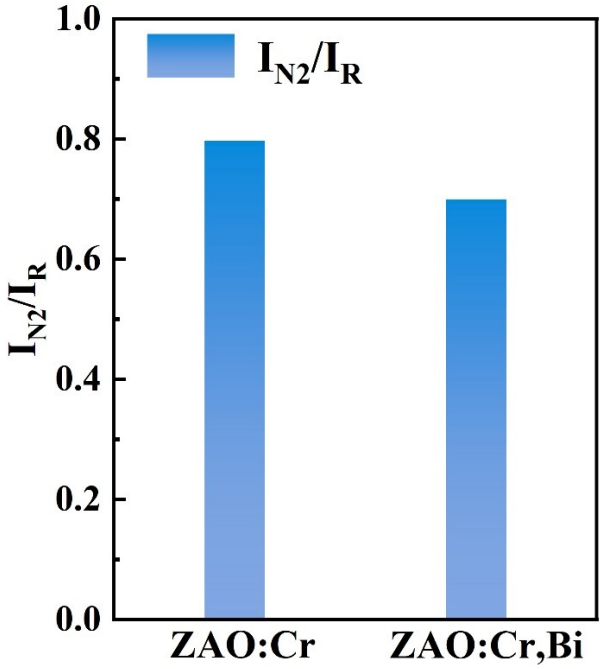

Figure S1. Emission intensity ratio of N2/R line.

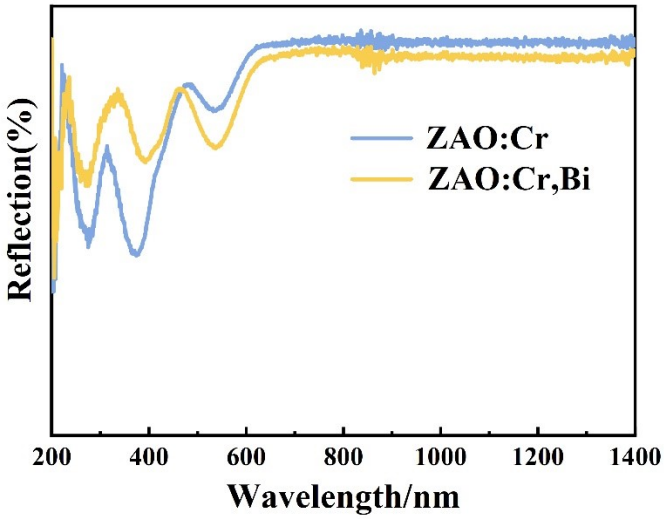

Figure S2. UV-NIR diffuse reflection spectra of ZAO:Cr and ZAO:Cr,Bi

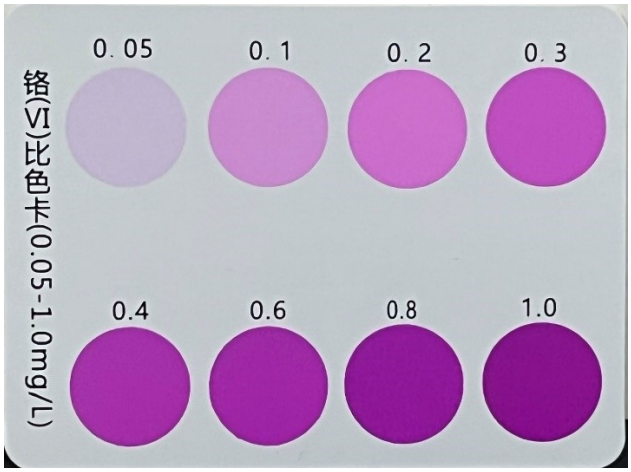

Figure S3. Chromium (VI) colorimetric card (0.05–1.0 mg/L)

Table S1 Cationic compositions of ZAO:Cr and ZAO:Cr,Bi by ICP test

Sample		Elemental composition (wt.%)				Elemental composition (mol)				Atomic ratio	
		Zn	Al	Cr	Bi	Zn	Al	Cr	Bi	**Zn/Al**	**Cr/Al**
ZAO:Cr	Nominal ratio	35.57	29.05	0.57	--	1	1.98	0.02	--	0.5051	0.0101
	As-synthesized	37.86	32.19	0.54	--	1	2.06	0.018	--	0.4854	0.0087
	After washing	32.82	30.38	0.45	--	1	2.24	0.017	--	0.4464	0.0076
ZAO:Cr,Bi	Nominal ratio	34.88	28.20	0.55	2.23	1	1.96	0.02	0.02	0.5102	0.0102
	As-synthesized	35.14	34.29	0.56	0.14	1	2.36	0.02	0.0012	0.4237	0.0085
	After washing	36.58	33.91	0.59	0.14	1	2.25	0.02	0.0012	0.4444	0.0089

Figure S4a shows the comparison of the PL and PLE spectra of the singly doped ZAO:Cr and ZAO:Bi phosphors. **Figure S4b** display the fluorescence decay curves of Bi^{3+} in ZAO:*y*Cr,Bi (y = 0, 0.01, and 0.03) phosphors. Each case follows a double exponential decay behavior and can be fitted by Equation S1:

$$I_t = I_0 + A_1\exp(\frac{-t}{\tau_1}) + A_2\exp(\frac{-t}{\tau_2}) \qquad \text{(S1)},$$

where, I_t and I_0 denote the luminescence intensities at time t and t = 0, A_1 and A_2 are the corresponding fitting parameters, and τ_1 and τ_2 represent the fast and slow components of the decay time. The average decay time (τ) is calculated by

$$\tau = \frac{A_1\tau_1^2 + A_2\tau_2^2}{A_1\tau_1 + A_2\tau_2} \qquad \text{(S2)}.$$

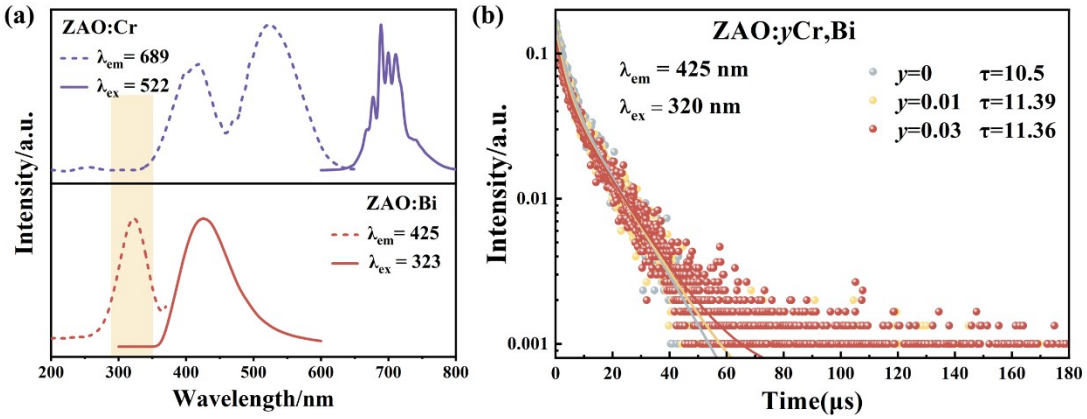

Figure S4. (a) PLE and PL spectra of ZAO:Cr and ZAO:Bi, respectively; (b) Fluorescence decay curves of ZAO:*y*Cr,Bi.

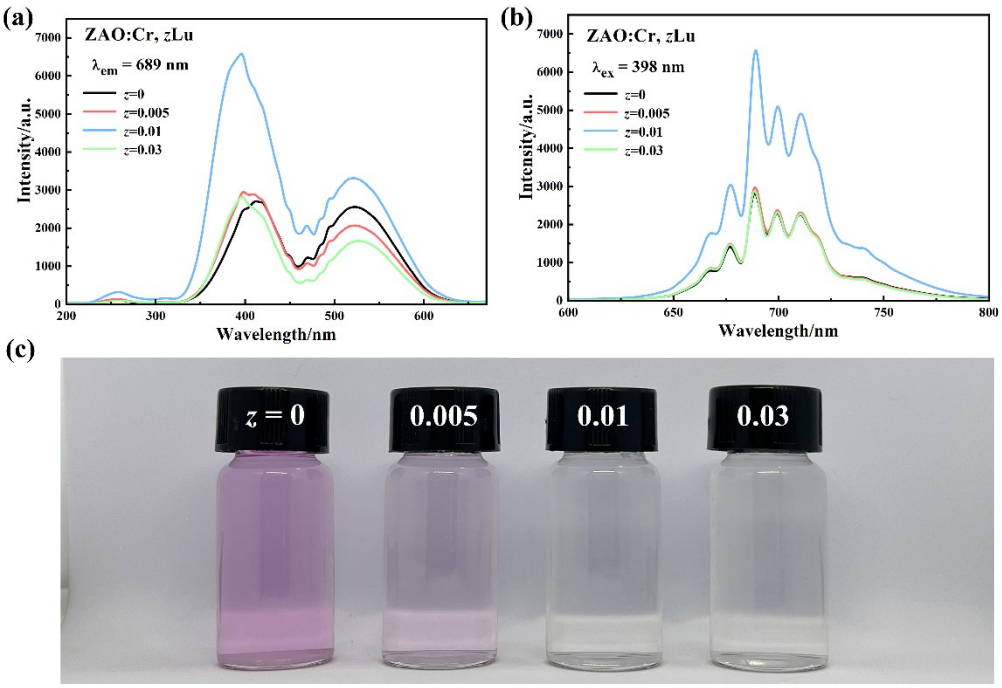

Figure S5. ZAO:Cr,*z*Lu (*z* = 0–0.03): (a) PLE spectra; (b) PL spectra; (c) color reaction of Cr^{6+} detection reagent in washing solutions of the samples.