

Supplementary information for  
**Simultaneously tuning luminescent color and realizing optical temperature sensor by negative thermal expansion in Sc<sub>2</sub>(WO<sub>4</sub>)<sub>3</sub>:Tb/Eu phosphors**

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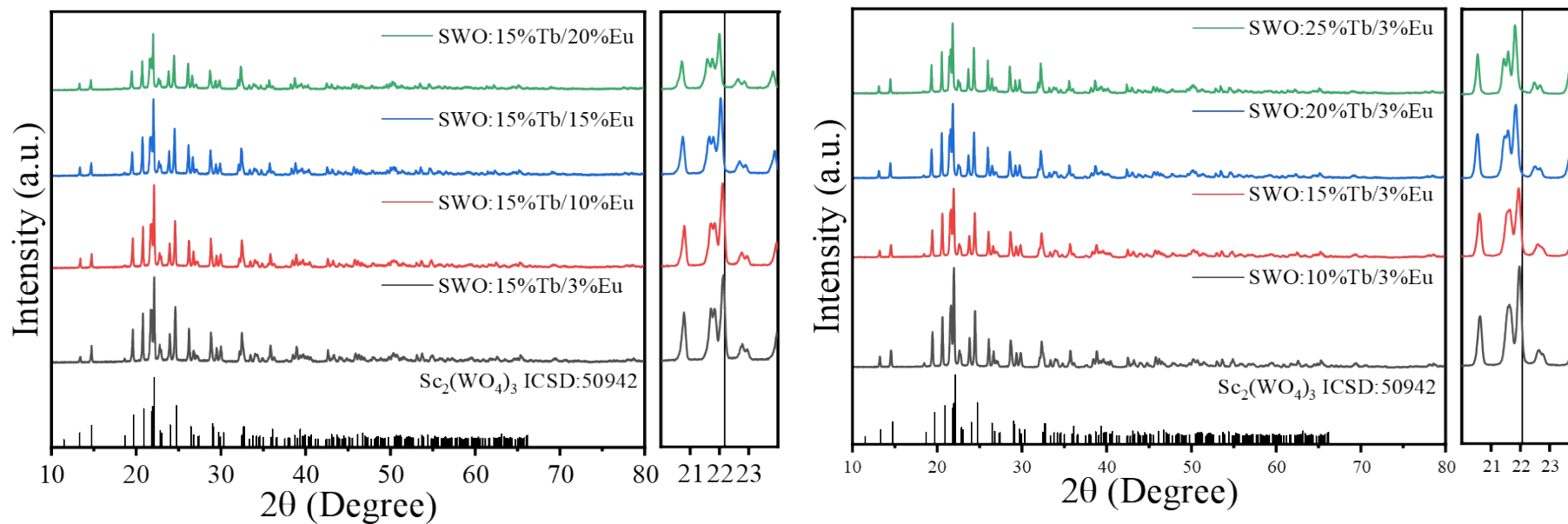
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Table S1 SWO:25%Tb<sup>3+</sup>/3%Eu<sup>3+</sup> phosphor cell parameters and refinement parameters at different temperatures.

T (K)	298	323	348	373	398	423	448	473
Crystal system	Orthorhombic							
Space group	Pnca (No.60)							
	a= 9.747	9.782	9.778	9.777	9.776	9.774	9.772	9.770
Lattice parameters (Å)	b= 13.450	13.479	13.488	13.489	13.492	13.493	13.493	13.494
	c= 9.620	9.669	9.682	9.681	9.681	9.681	9.679	9.678
V (Å <sup>3</sup> )	1261.152	1274.876	1276.962	1276.795	1276.845	1276.712	1276.097	1275.922
R <sub>wp</sub> (%)	3.63	3.61	3.50	3.67	3.61	3.64	3.61	3.66
R <sub>p</sub> (%)	2.66	2.55	2.48	2.56	2.52	2.56	2.53	2.58
χ <sup>2</sup>	3.221	3.198	3.021	3.311	3.211	3.253	3.208	3.290

Table S2 Temperature-dependent lifetime of  $\text{Tb}^{3+}$  ( $\tau_{\text{Tb}}$ ) in SWO: 25% $\text{Tb}^{3+}$  and temperature-dependent lifetime of  $\text{Tb}^{3+}$  and  $\text{Eu}^{3+}$  ( $\tau_{\text{Eu}}$ ) in SWO:25% $\text{Tb}^{3+}$ /3% $\text{Eu}^{3+}$

T (K)	298	323	348	373	398	423	448	473
$\tau_{\text{Tb}}$ of SWO: 25% $\text{Tb}^{3+}$ ( $\mu\text{s}$ )	876	905	1104	1415	1409	1411	1394	1373
$\tau_{\text{Tb}}$ of SWO: 25% $\text{Tb}^{3+}$ /3% $\text{Eu}^{3+}$ ( $\mu\text{s}$ )	285	264	264	131	120	98	84	88
$\tau_{\text{Eu}}$ of SWO:25% $\text{Tb}^{3+}$ /3% $\text{Eu}^{3+}$ ( $\mu\text{s}$ )	683	749	782	625	671	695	707	703



**Fig. S1** XRD patterns of SWO:xTb/yEu phosphors with different Tb<sup>3+</sup>/Eu<sup>3+</sup> concentrations at room temperature.

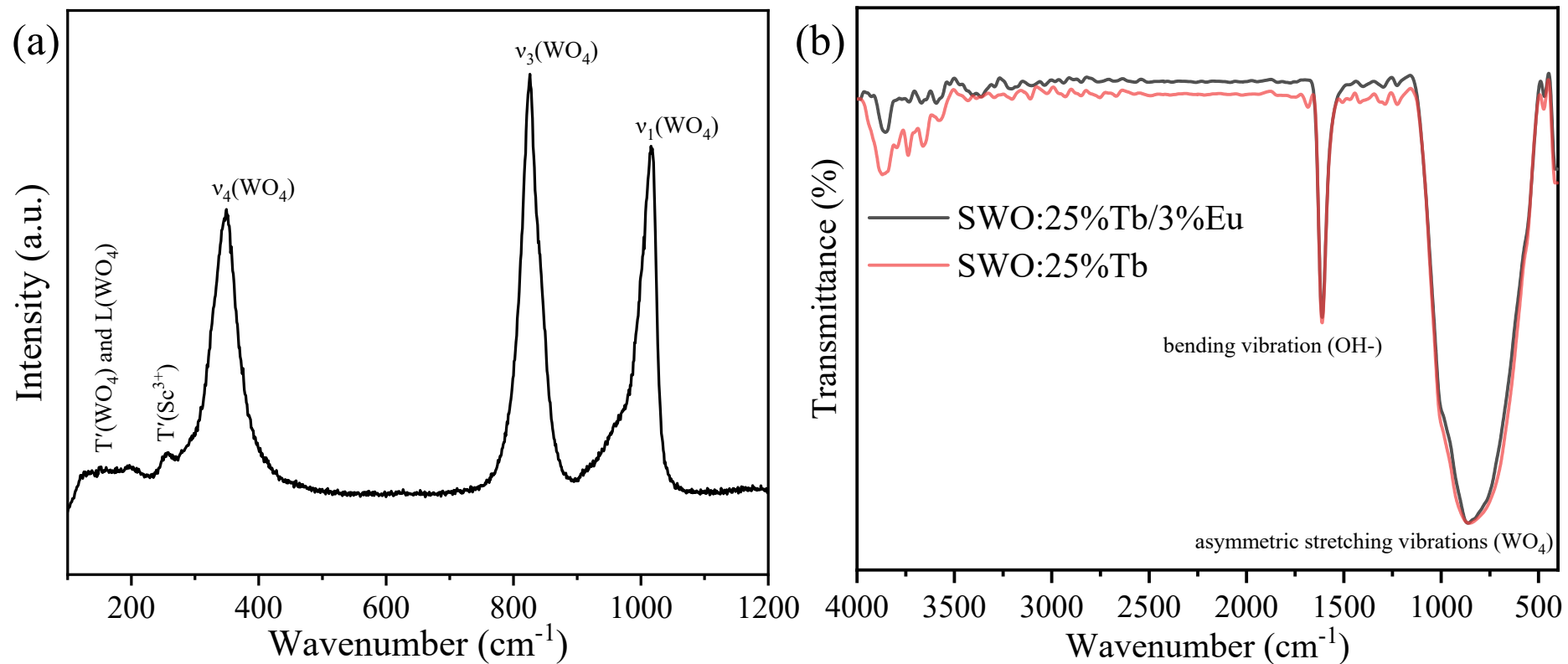
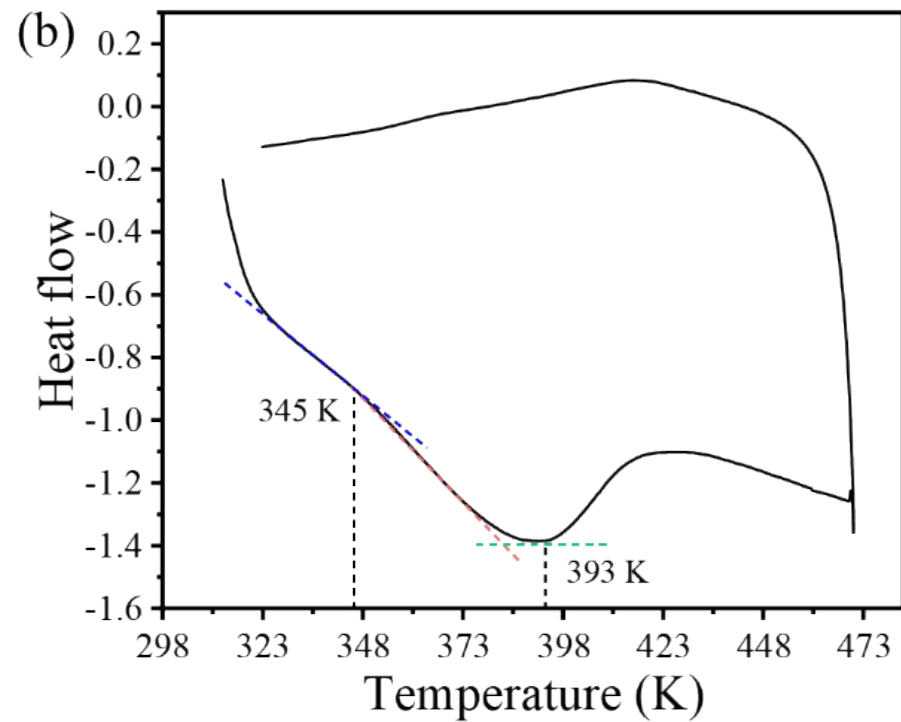
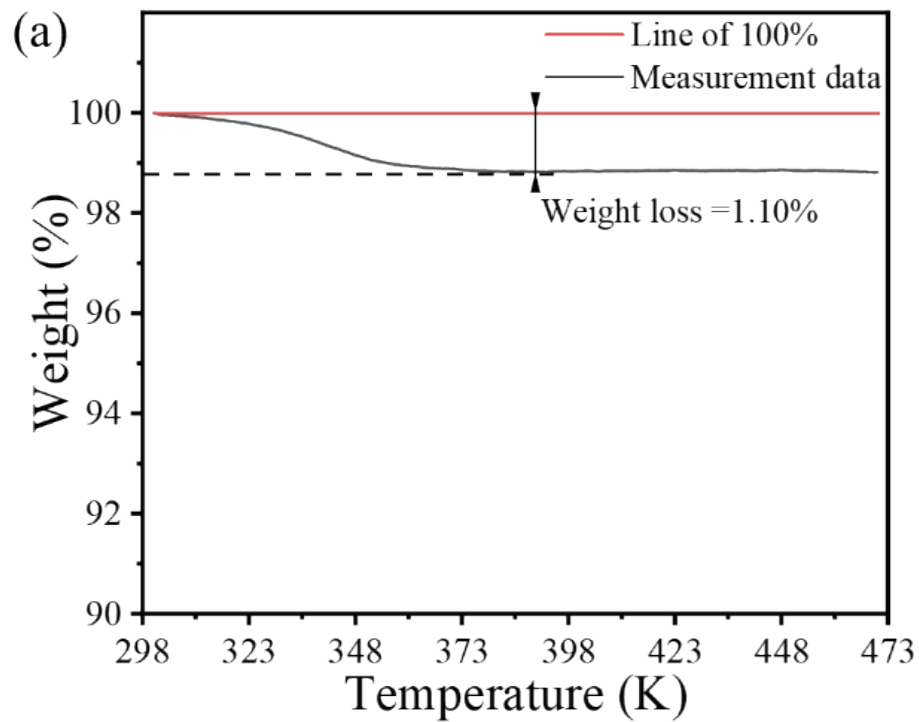
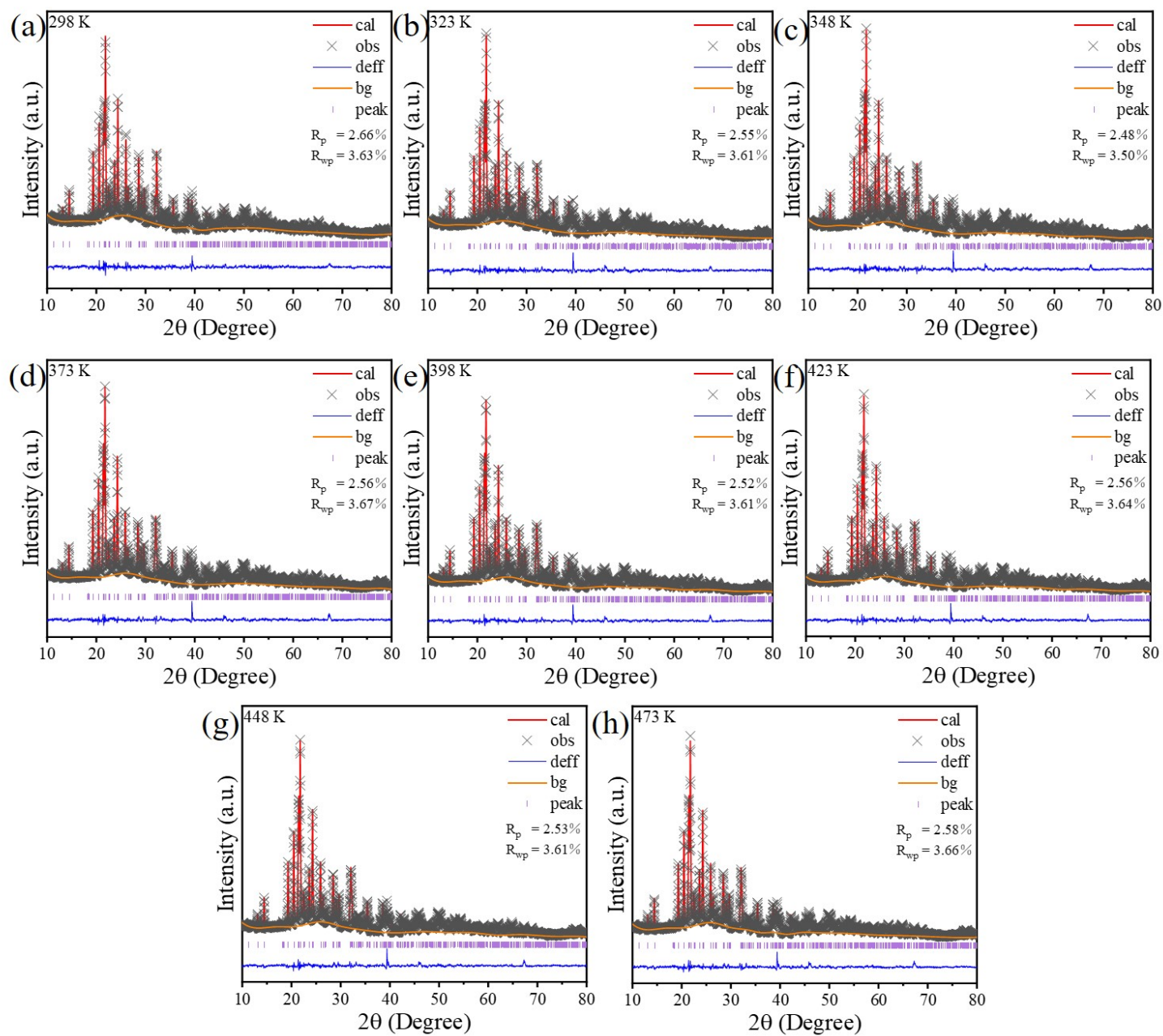


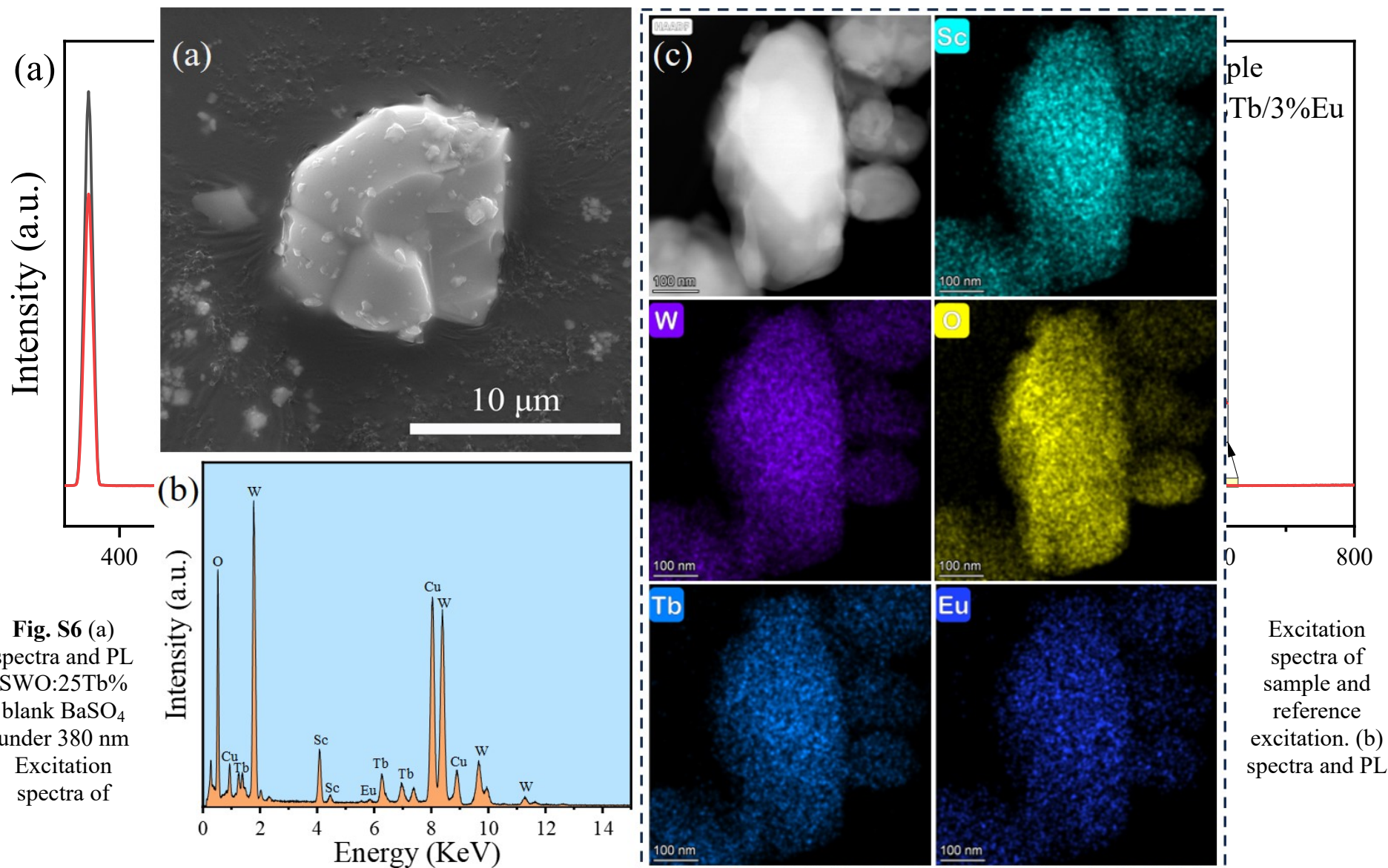
Fig. S2 (a) Raman spectrum of SWO:25Tb%/3%Eu and (b) FT-IR spectra of SWO:25Tb% and SWO:25%Tb/3%Eu



**Fig. S3** (a) TG and (b) DSC curves of SWO:25%Tb/3%Eu phosphors.



**Fig. S4** The Rietveld refinement of the XRD pattern of the SWO:25%Tb/3%Eu phosphor for different temperature.

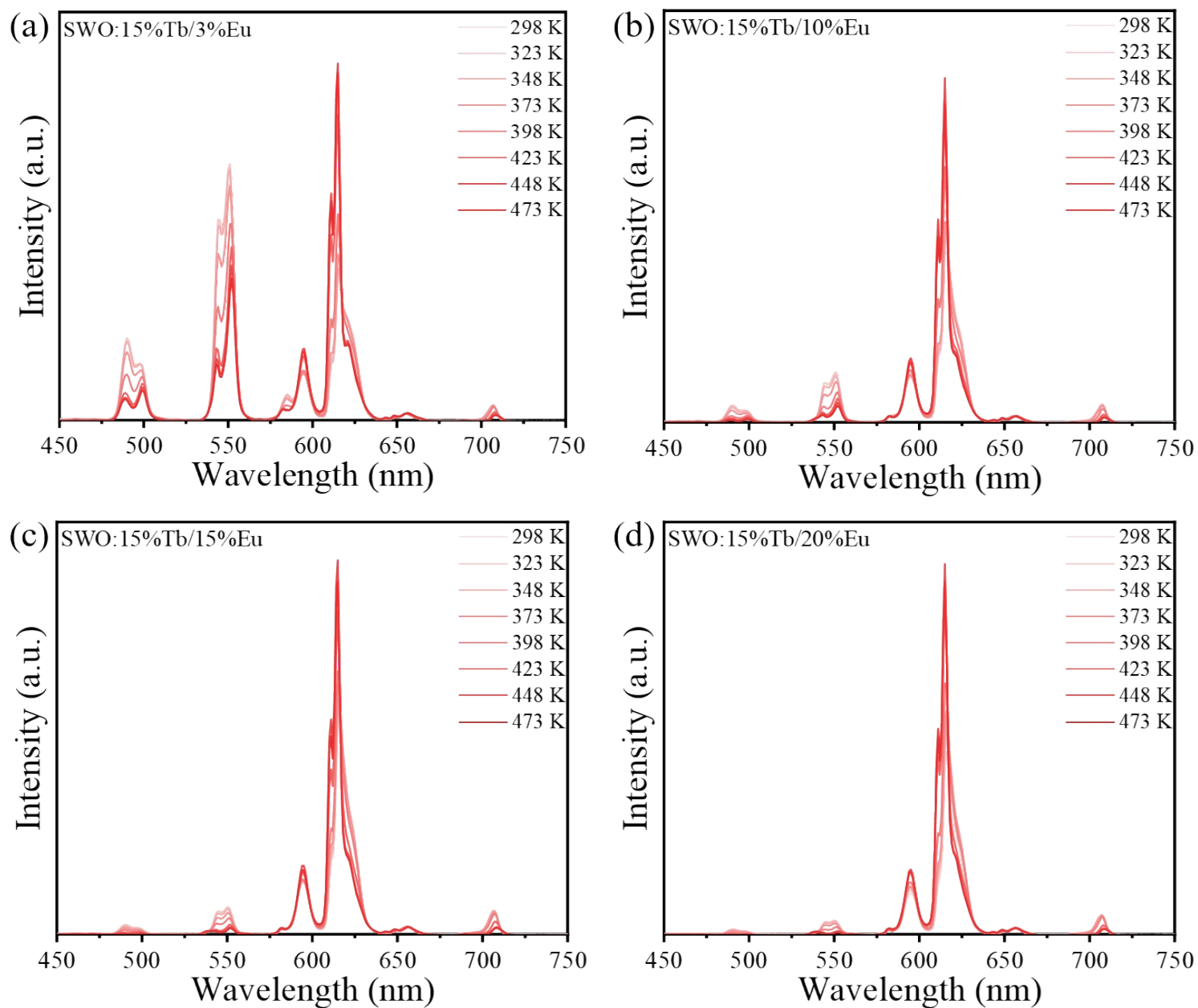


**Fig. S6** (a) spectra and PL SWO:25Tb% blank BaSO<sub>4</sub> under 380 nm Excitation spectra of

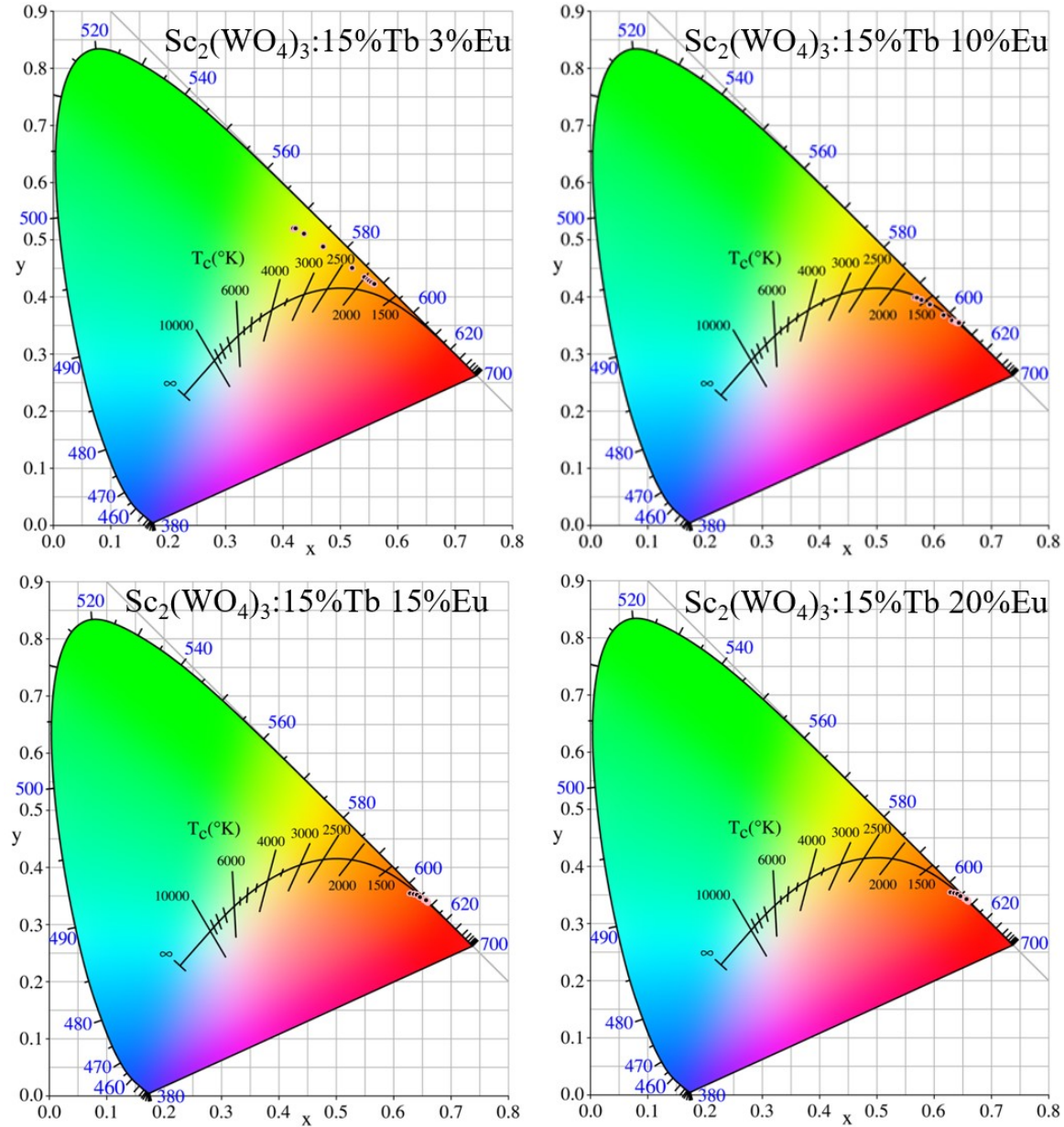
**Fig. S5** (a) SEM image, (b) EDS spectrum (copper was plated on the surface of the sample to enhance conductivity) and (c) HR-STEM image and corresponding elemental mapping of SWO:25%Tb/3%Eu sample.

SWO:25%Tb/3%Eu sample and blank BaSO<sub>4</sub> reference under 380 nm excitation

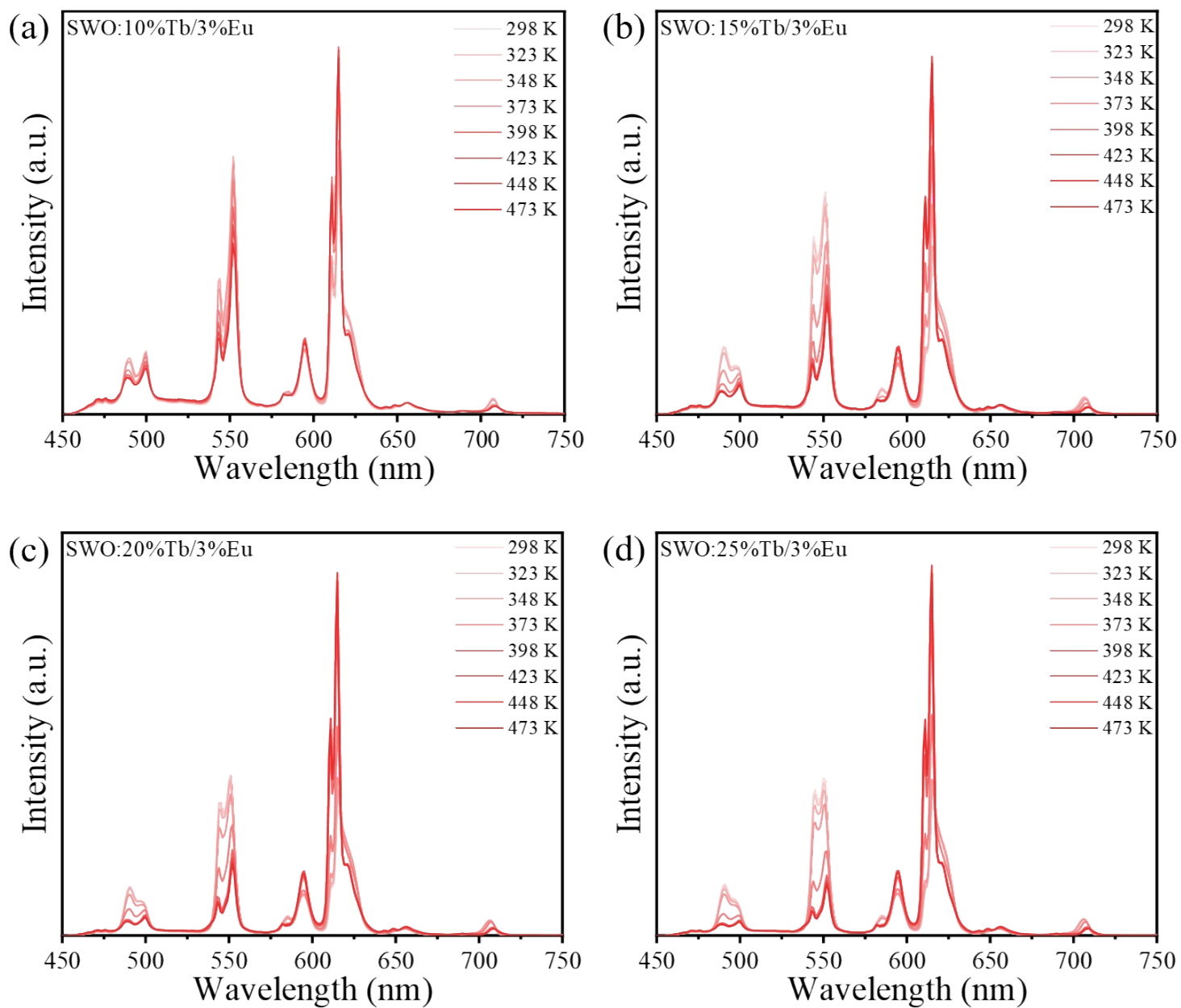




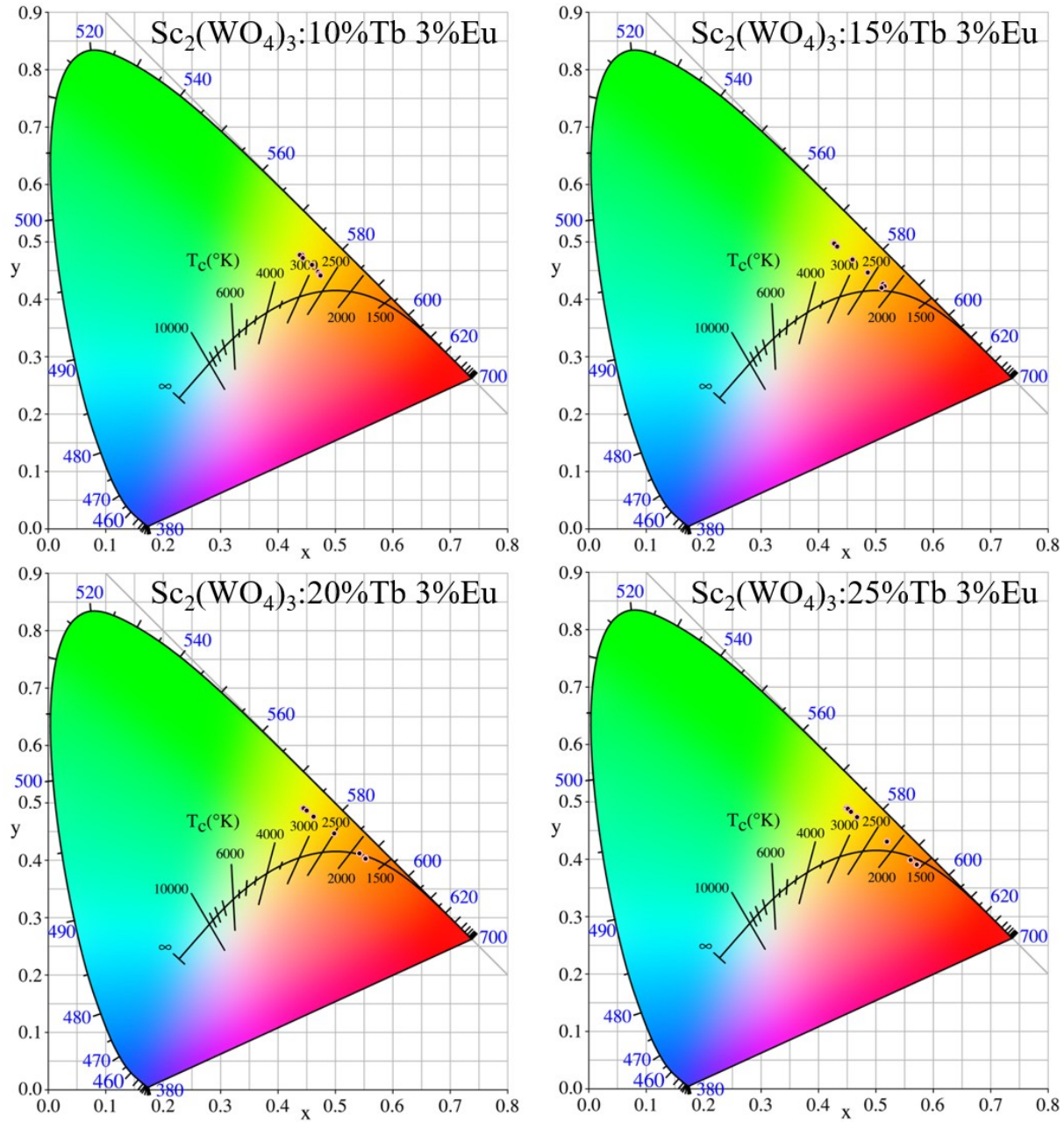
**Fig. S7** Temperature-dependent DS emission spectra SWO:15%Tb/yEu phosphors variation with temperature.



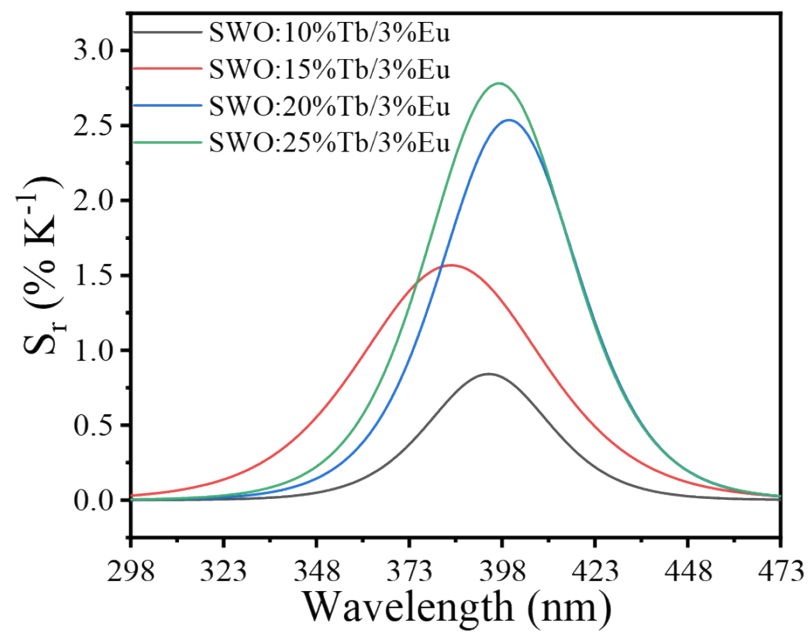
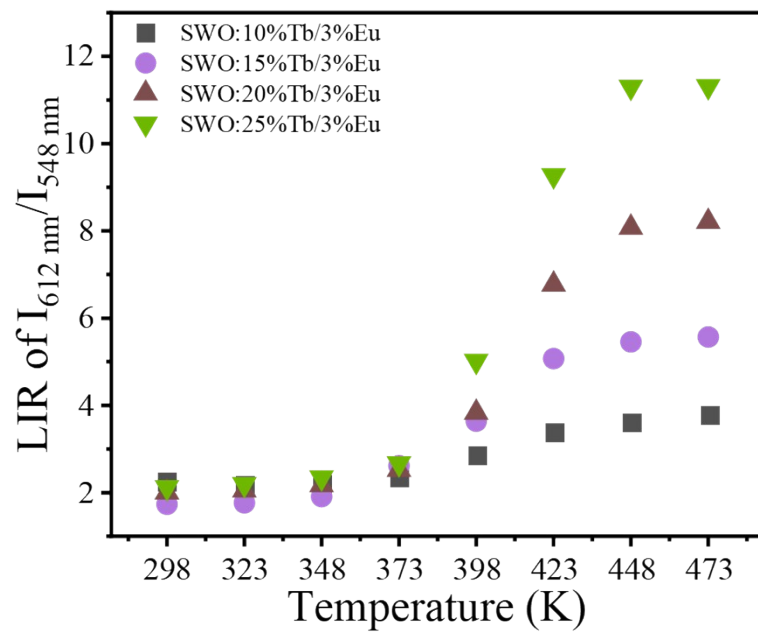
**Fig. S8** CIE chromaticity coordinates of SWO:15%Tb/yEu phosphors variation with temperature.



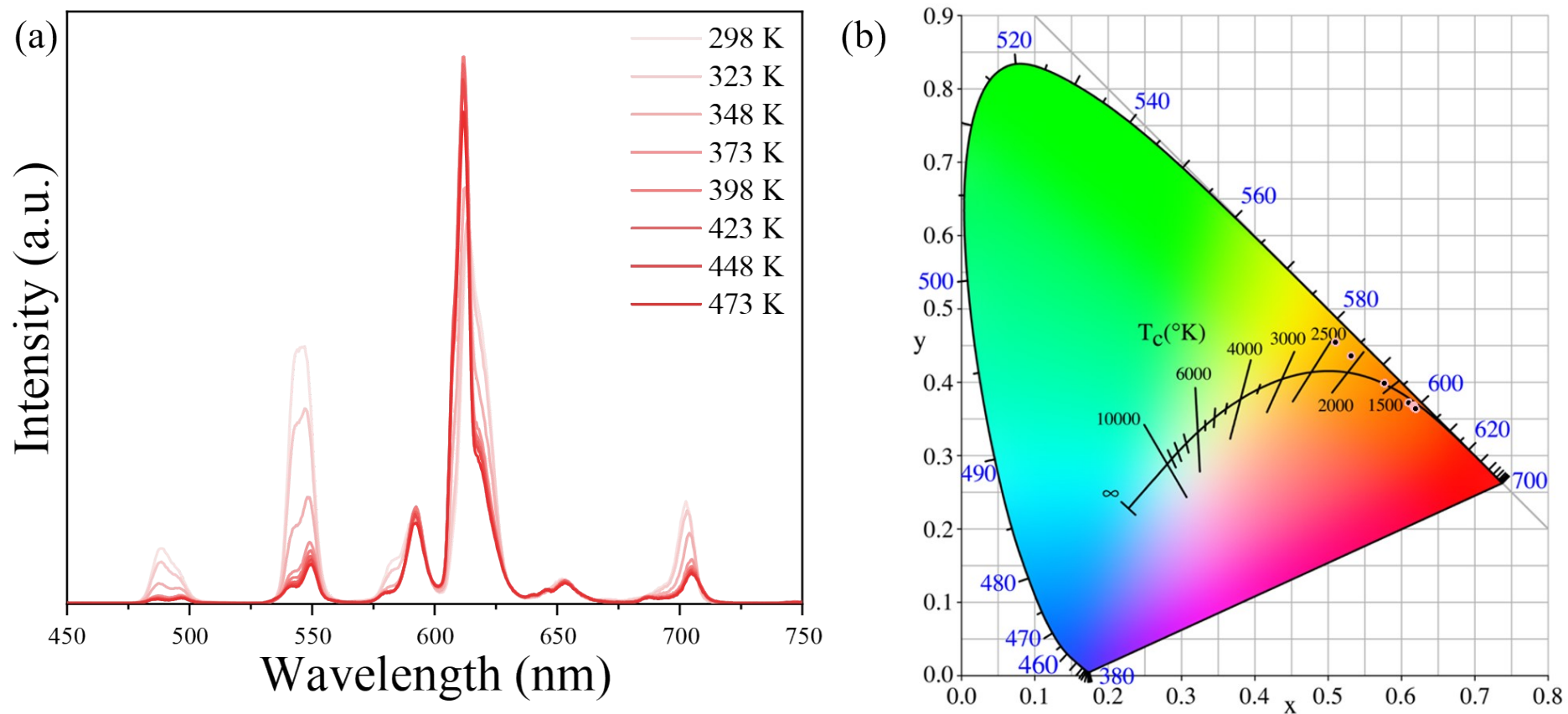
**Fig. S9** Temperature-dependent DS emission spectra SWO:xTb/3%Eu phosphors variation with temperature.



**Fig. S10** CIE chromaticity coordinates of  $\text{SWO}:x\text{Tb}/3\%\text{Eu}$  phosphors variation with temperature.

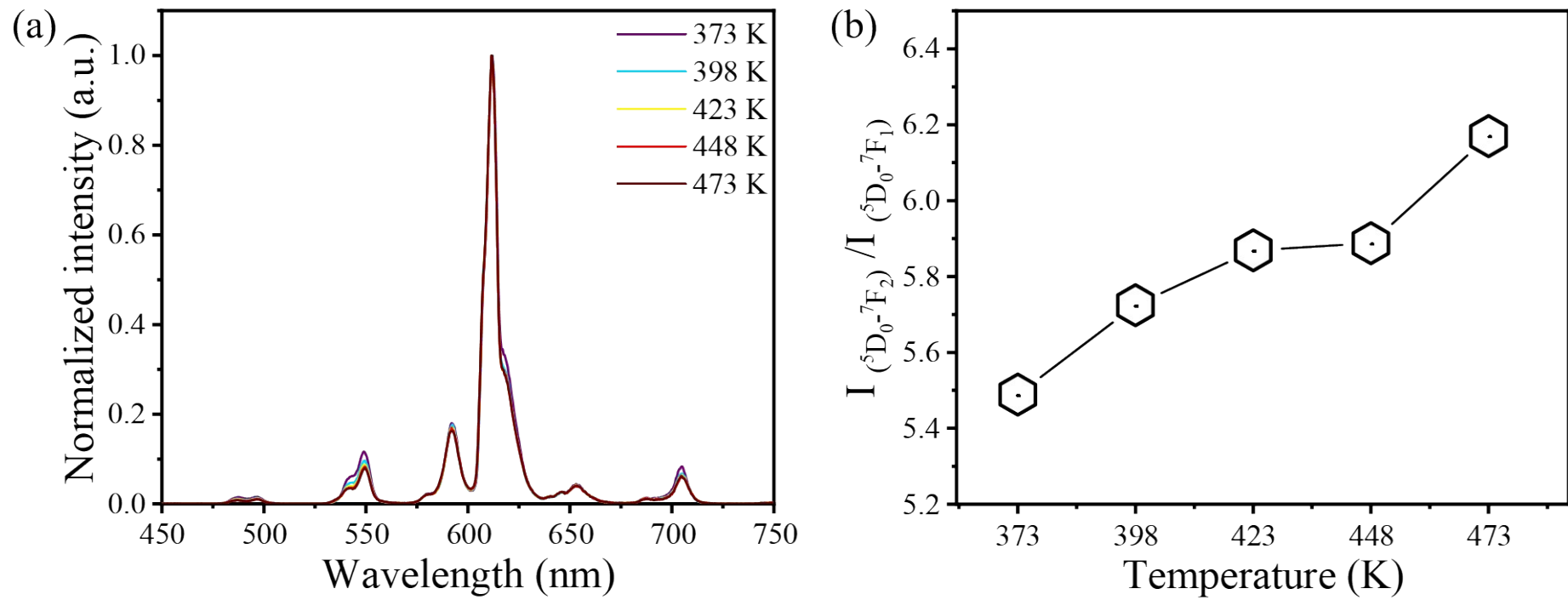


**Fig. S11** LIR and  $S_r$  of SWO:xTb/3%Eu phosphors.



**Fig. S12** Temperature-dependent DS emission spectra and CIE chromaticity coordinates of SWO:25%Tb/3%Eu phosphors.





**Fig. S13** (a) Normalized emission spectra of SWO:25%Tb/3%Eu and (b) ratio of line strengths for electric and magnetic dipole transitions of  $\text{Eu}^{3+}$ (612 nm/593 nm) within the temperature from 298 to 473 K.