

## *Supplementary Materials*

### **Tb<sup>3+</sup>-based multi-mode optical ratiometric thermometry**

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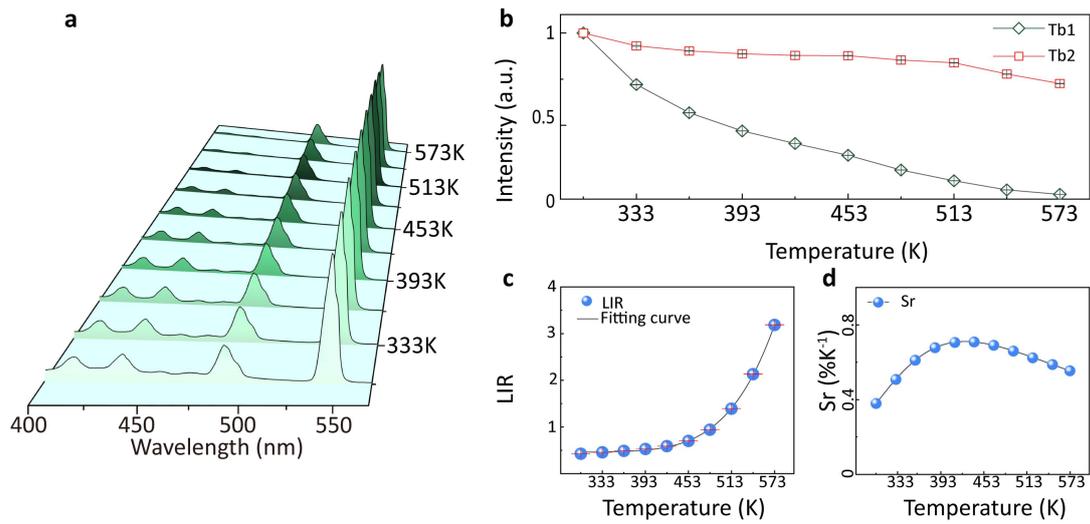
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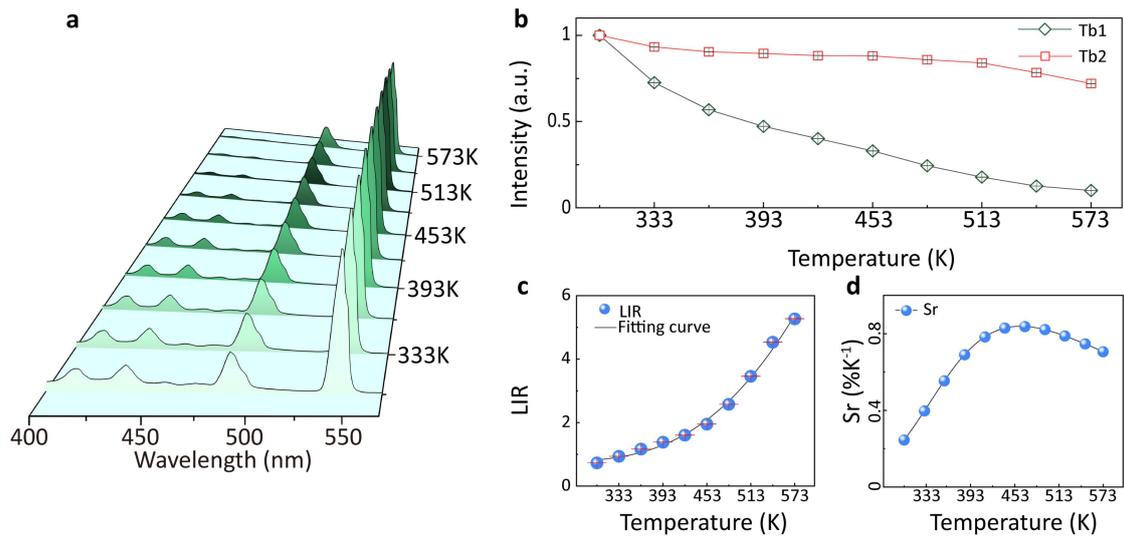
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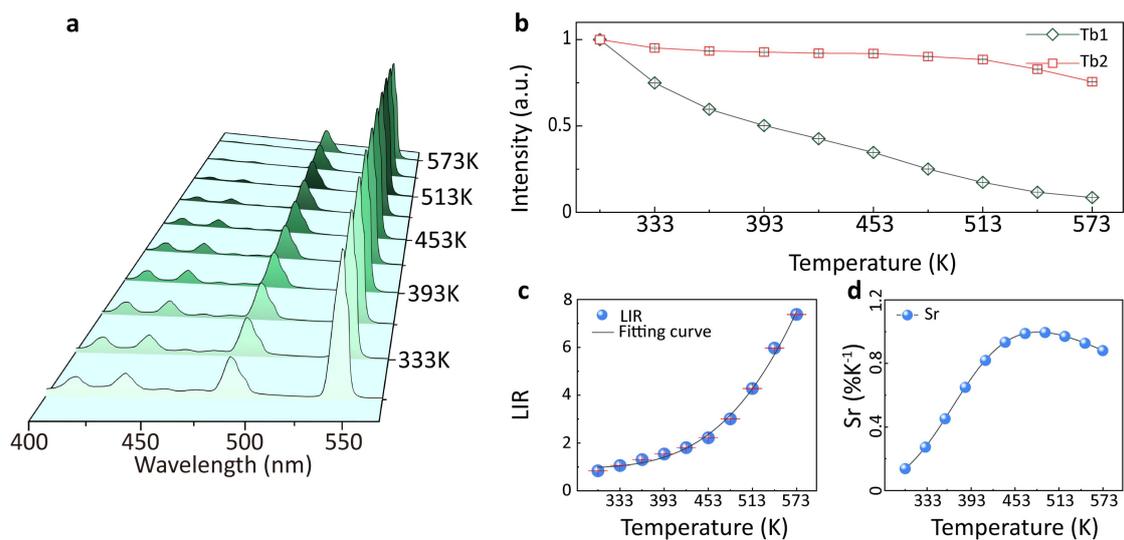
**Fig. S1** Photograph of luminescence of CaWO<sub>4</sub> matrix upon the UV excitation.



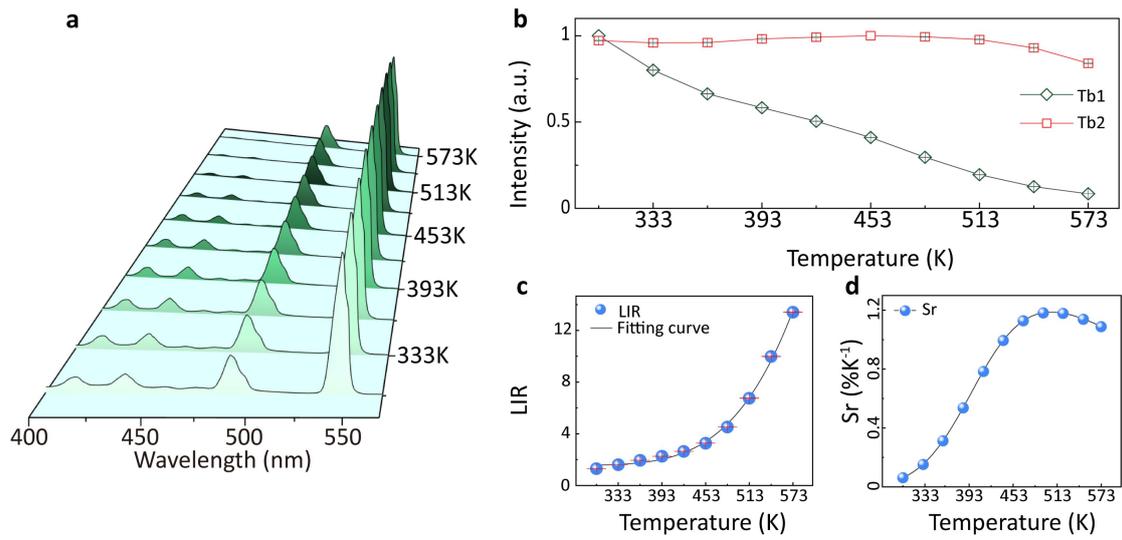
**Fig. S2.** (a) Temperature-dependent emission spectra of  $\text{CaWO}_4:3\%\text{Tb}^{3+}$  under 250 nm excitation, (b) Integrated emission intensities of 438 nm and 488 nm emission, (c) Fitting curve of  $\text{LIR}_{(\text{Tb}2/\text{Tb}1)}$ , (d) Relative sensitivity of  $\text{CaWO}_4:3\%\text{Tb}^{3+}$  as a function of temperature in the 303-573 K range.



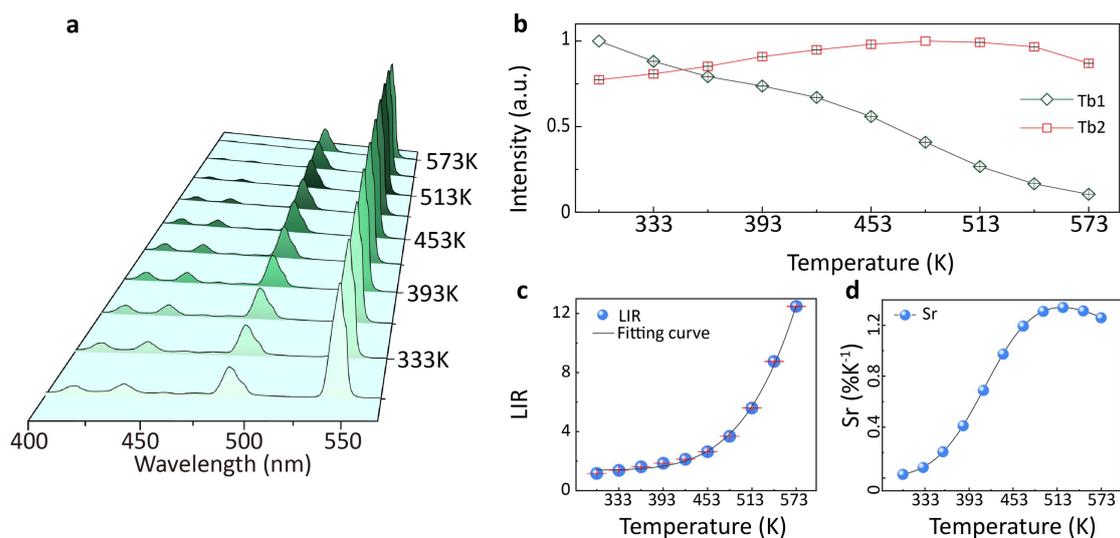
**Fig. S3.** (a) Temperature-dependent emission spectra of  $\text{CaWO}_4:3\%\text{Tb}^{3+}$  under 255 nm excitation, (b) Integrated emission intensities of 438 nm and 488 nm emission, (c) Fitting curve of  $\text{LIR}_{(\text{Tb}2/\text{Tb}1)}$ , (d) Relative sensitivity of  $\text{CaWO}_4:3\%\text{Tb}^{3+}$  as a function of temperature in the 303-573 K range.



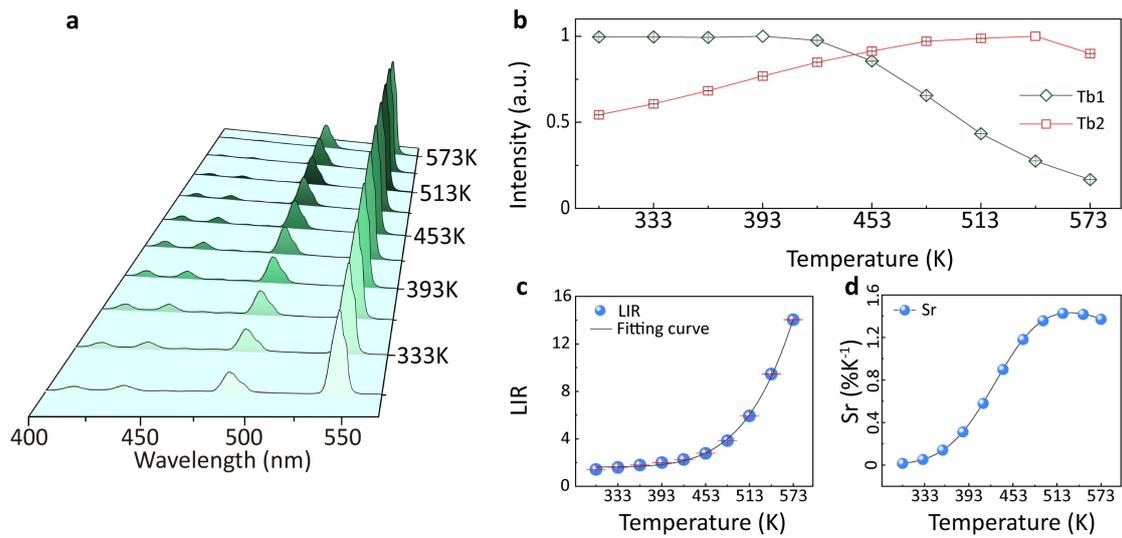
**Fig. S4.** (a) Temperature-dependent emission spectra of  $\text{CaWO}_4:3\%\text{Tb}^{3+}$  under 260 nm excitation, (b) Integrated emission intensities of 438 nm and 488 nm emission, (c) Fitting curve of  $\text{LIR}_{(\text{Tb}2/\text{Tb}1)}$ , (d) Relative sensitivity of  $\text{CaWO}_4:3\%\text{Tb}^{3+}$  as a function of temperature in the 303-573 K range.



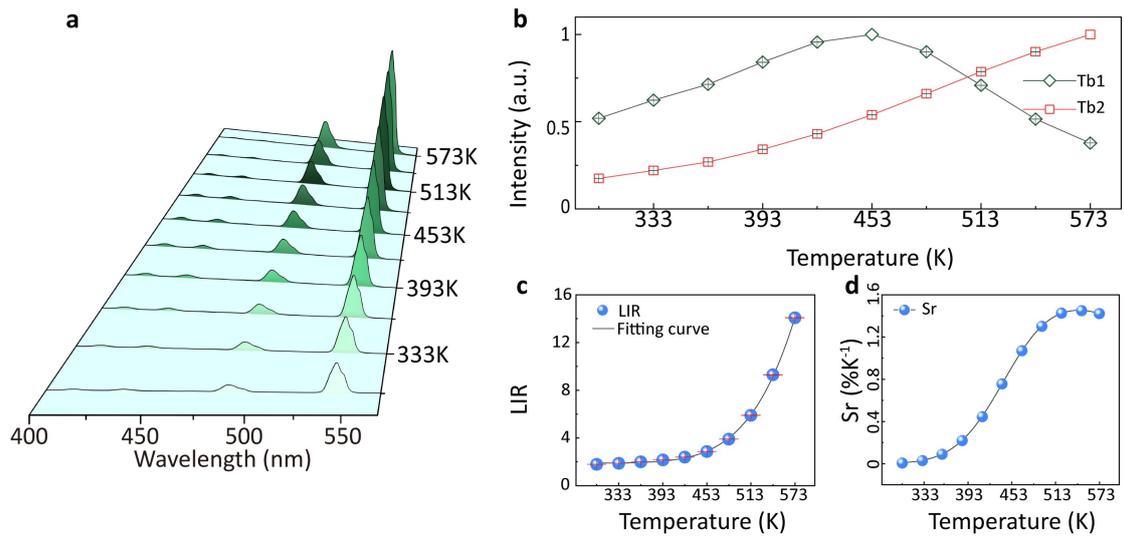
**Fig. S5.** (a) Temperature-dependent emission spectra of  $\text{CaWO}_4:3\%\text{Tb}^{3+}$  under 265 nm excitation, (b) Integrated emission intensities of 438 nm and 488 nm emission, (c) Fitting curve of  $\text{LIR}_{(\text{Tb}2/\text{Tb}1)}$ , (d) Relative sensitivity of  $\text{CaWO}_4:3\%\text{Tb}^{3+}$  as a function of temperature in the 303-573 K range.



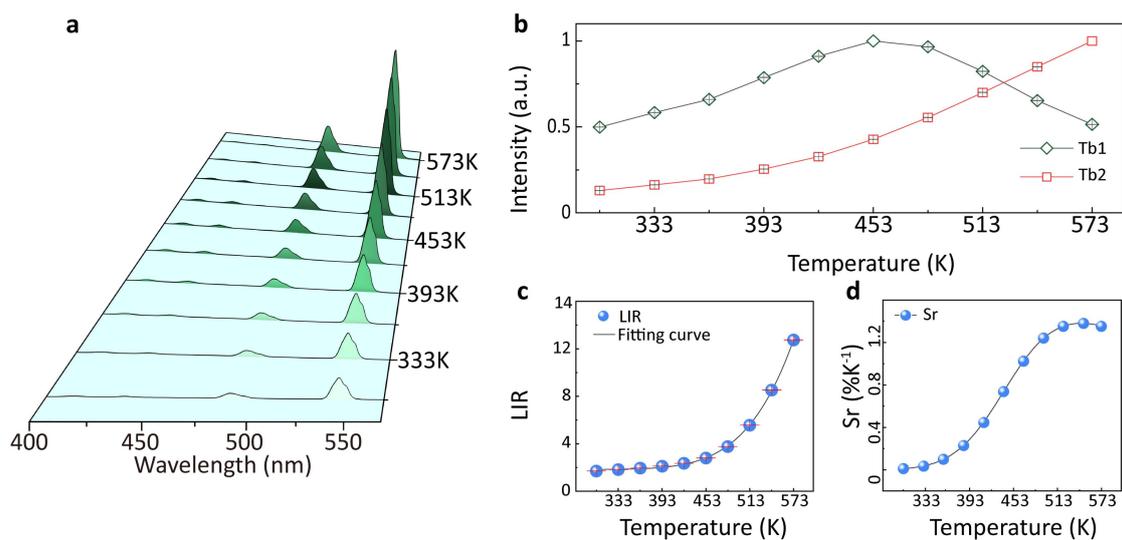
**Fig. S6.** (a) Temperature-dependent emission spectra of  $\text{CaWO}_4:3\%\text{Tb}^{3+}$  under 270 nm excitation, (b) Integrated emission intensities of 438 nm and 488 nm emission, (c) Fitting curve of  $\text{LIR}_{(\text{Tb}2/\text{Tb}1)}$ , (d) Relative sensitivity of  $\text{CaWO}_4:3\%\text{Tb}^{3+}$  as a function of temperature in the 303-573 K range.



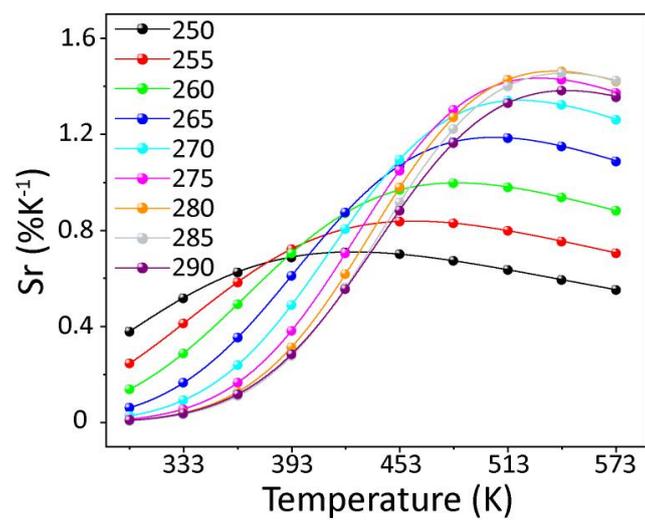
**Fig. S7.** (a) Temperature-dependent emission spectra of  $\text{CaWO}_4:3\%\text{Tb}^{3+}$  under 275 nm excitation, (b) Integrated emission intensities of 438 nm and 488 nm emission, (c) Fitting curve of  $\text{LIR}_{(\text{Tb}2/\text{Tb}1)}$ , (d) Relative sensitivity of  $\text{CaWO}_4:3\%\text{Tb}^{3+}$  as a function of temperature in the 303-573 K range.



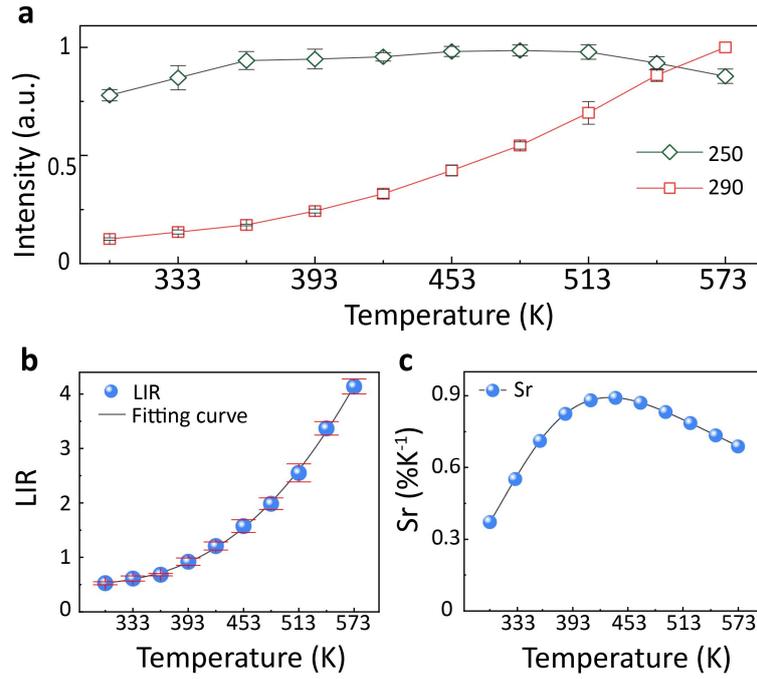
**Fig. S8.** (a) Temperature-dependent emission spectra of  $\text{CaWO}_4:3\%\text{Tb}^{3+}$  under 285 nm excitation, (b) Integrated emission intensities of 438 nm and 488 nm emission, (c) Fitting curve of  $\text{LIR}_{(\text{Tb}2/\text{Tb}1)}$ , (d) Relative sensitivity of  $\text{CaWO}_4:3\%\text{Tb}^{3+}$  as a function of temperature in the 303-573 K range.



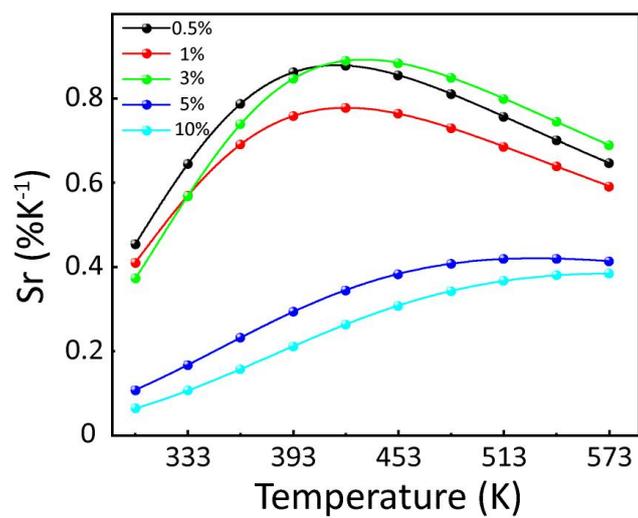
**Fig. S9.** (a) Temperature-dependent emission spectra of  $\text{CaWO}_4:3\%\text{Tb}^{3+}$  under 290 nm excitation, (b) Integrated emission intensities of 438 nm and 488 nm emission, (c) Fitting curve of  $\text{LIR}_{(\text{Tb}2/\text{Tb}1)}$ , (d) Relative sensitivity of  $\text{CaWO}_4:3\%\text{Tb}^{3+}$  as a function of temperature in the 303-573 K range.



**Fig. S10.** The relative sensitivity of  $\text{CaWO}_4:3\%\text{Tb}^{3+}$  as a function of temperature in the 303-573 K range.



**Fig. S11. SBR thermometry performance of CaWO<sub>4</sub>:3%Tb<sup>3+</sup>.** (a) Integrated emission intensity of 545 nm line under 250 and 290 nm excitation. (b) LIR of the 545 nm emission intensity under 250 and 290 nm excitation. (c) Sr of the LIR thermometry in (b) as a function of temperature in the 303-573 K range.



**Fig. S12.** Comparison of relative sensitivity of SBR thermometry depending on  $\text{CaWO}_4:x\%\text{Tb}^{3+}$  ( $x = 0.5, 1, 3, 5$  and  $10$ ) as a function of temperature in the 303-573 K range.