

Electronic Supplementary Information for

**The explanation of abnormal thermal quenching of charge transfer band based on thermally coupled levels and the applications as temperature sensing probes**

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**Figure S1.** X-ray diffraction pattern of (a)  $\text{CaMoO}_4: 5\%\text{Eu}^{3+}$ , (b)  $\text{CaWO}_4, \text{CaWO}_4: 5\%\text{Eu}^{3+}$ , (c)  $\text{LuVO}_4$  and  $\text{LuVO}_4: 5\%\text{Eu}^{3+}$  and (d)  $\text{NaGdF}_4: 5\%\text{Er}^{3+}$ .

**Figure S2.** Excitation ( $\lambda_{\text{em}}=553$  nm) and emission ( $\lambda_{\text{ex}}=300$  nm) spectra of  $\text{CaMoO}_4: 5\%\text{Er}^{3+}$ .

**Figure S3.** Temperature-dependent excitation spectra of  $\text{NaGdF}_4: 5\%\text{Er}^{3+}$  nanoparticles by monitoring at (a) 521 and (b) 540 nm in the 310-560 K range. (c) The integral intensity of  $^4\text{I}_{15/2} \rightarrow ^4\text{G}_{11/2}$  transition.

**Figure S4.** Temperature-dependent excitation spectra of  $\text{CaWO}_4: 5\%\text{Er}^{3+}$  by monitoring at (a) 521 and (b) 553 nm in the 328-553 K range. (c) Relative integral intensities of CTB. (d) Variation in FWHM of CTB.

**Figure S5.** Temperature-dependent excitation spectra of  $\text{LuVO}_4: 5\%\text{Er}^{3+}$  by monitoring at (a) 526 and (b) 554 nm in the 303-603 K range. (c) Relative integral intensities of CTB. (d) Variation in FWHM of CTB.

**Figure S6.** Temperature-dependent excitation and emission spectra of (a)  $\text{CaMoO}_4$ , (b)  $\text{CaWO}_4$  and (c)  $\text{LuVO}_4$ .

**Figure S7.** The original excitation spectra of  $\text{CaWO}_4: 5\%\text{Eu}^{3+}$ . The excitation of CTB is weak when compared with that of f-f transitions of  $\text{Eu}^{3+}$ .

**Figure S8.** Temperature-dependent emission ( $\lambda_{\text{ex}}=327$  nm) spectra of  $\text{LuVO}_4: 5\%\text{Er}^{3+}$  inorganic phosphors in the 303-603 K range.

**Figure S9.** Temperature-dependent emission ( $\lambda_{\text{ex}}=325$  nm) spectra of  $\text{LuVO}_4: 5\%\text{Eu}^{3+}$  inorganic phosphors in the 328-553 K range.

**Figure S10.** Comparison of the diffuse reflectance spectra of the six samples at room temperature.

**Figure S11.** (a) Scatter plots of  $I_{520-534}$  and  $I_{542-554}$  with temperature in the temperature-

dependent emission ( $\lambda_{\text{ex}}=300$  nm) spectra of  $\text{CaMoO}_4: 5\%\text{Er}^{3+}$  inorganic phosphors. (b) Temperature-dependent emission intensity ratio ( $I_{520-534}/I_{542-554}$ ) and fitted curves. (c) Relative sensitivity  $S_r$ .

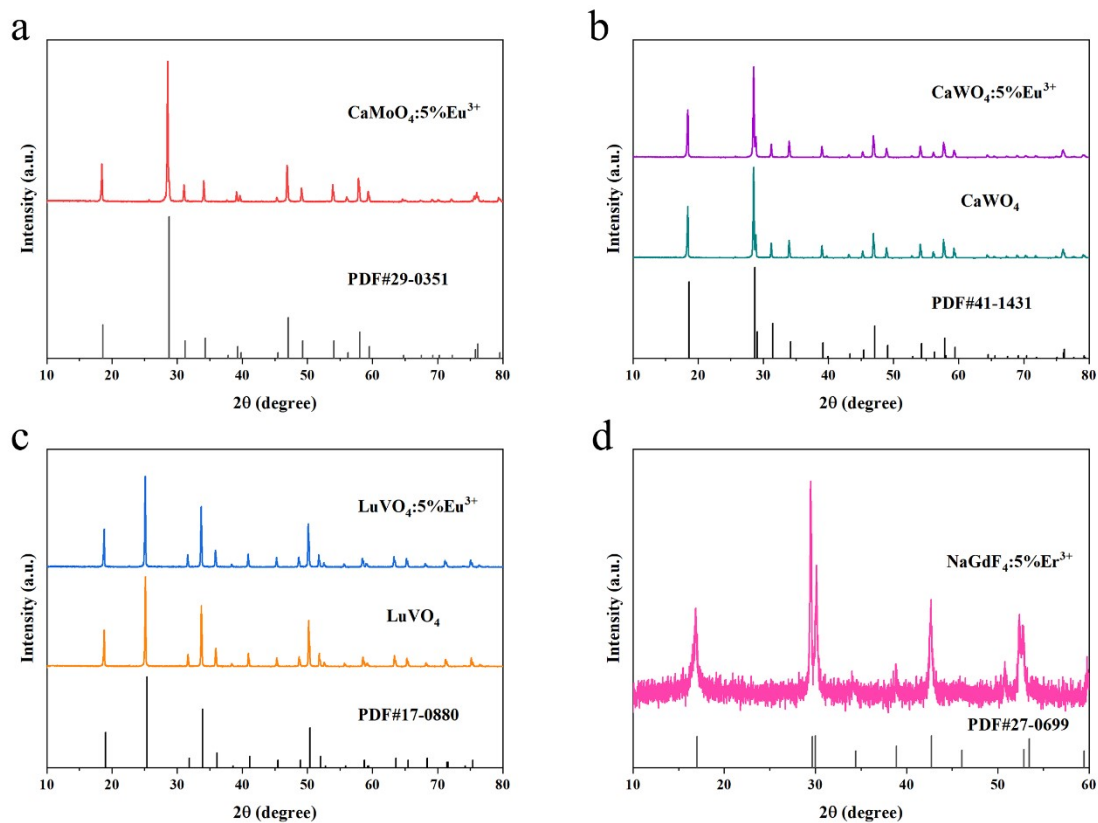


Figure S1. X-ray diffraction pattern of (a)CaMoO<sub>4</sub>: 5%Eu<sup>3+</sup>, (b) CaWO<sub>4</sub>, CaWO<sub>4</sub>: 5%Eu<sup>3+</sup>, (c) LuVO<sub>4</sub> and LuVO<sub>4</sub>: 5%Eu<sup>3+</sup> and (d) NaGdF<sub>4</sub>: 5%Er<sup>3+</sup>.

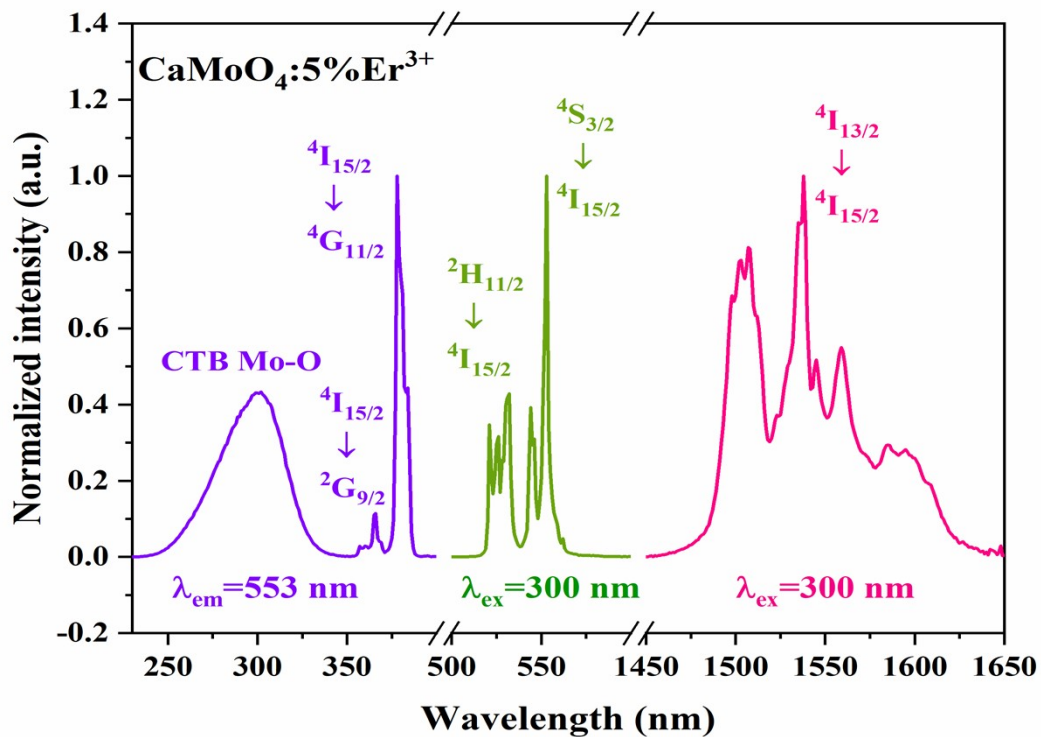


Fig. S2 Excitation ( $\lambda_{em}=553$  nm) and emission ( $\lambda_{ex}=300$  nm) spectra of CaMoO<sub>4</sub>: 5%Er<sup>3+</sup>.

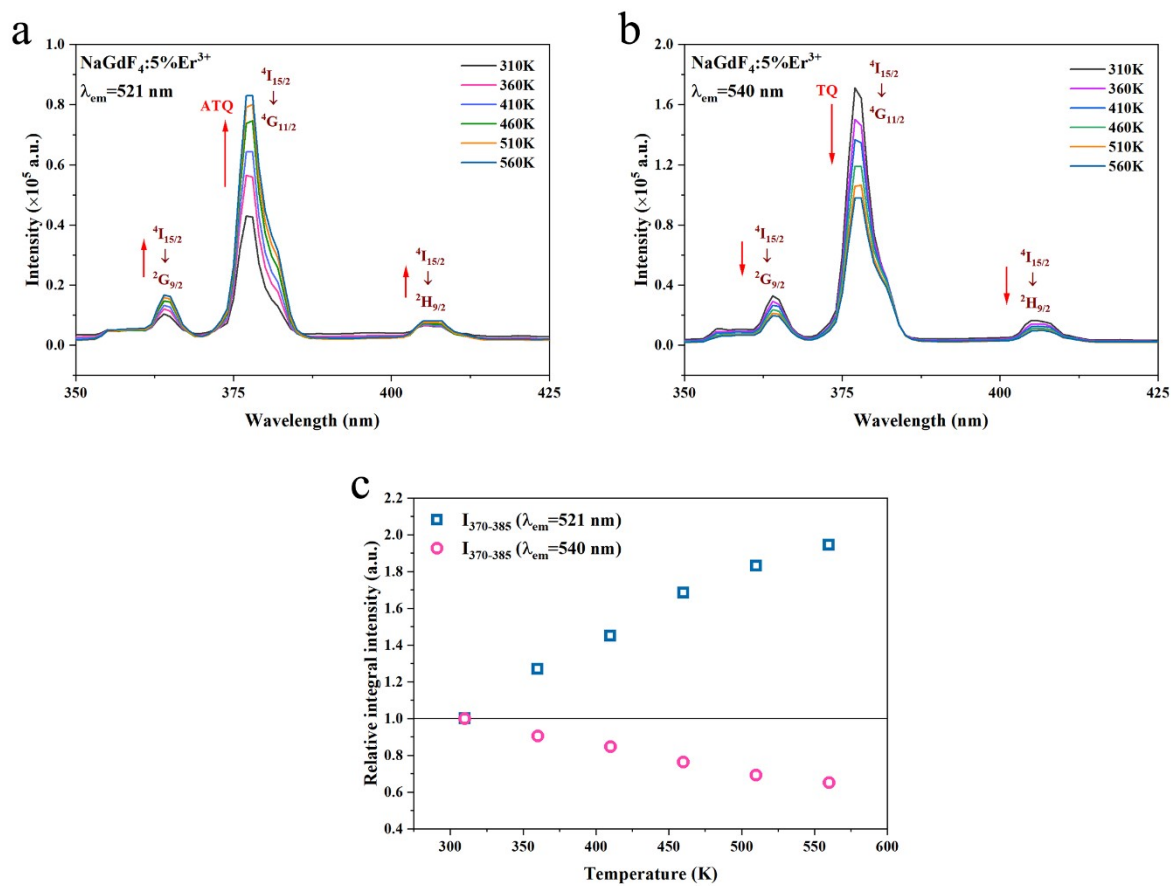
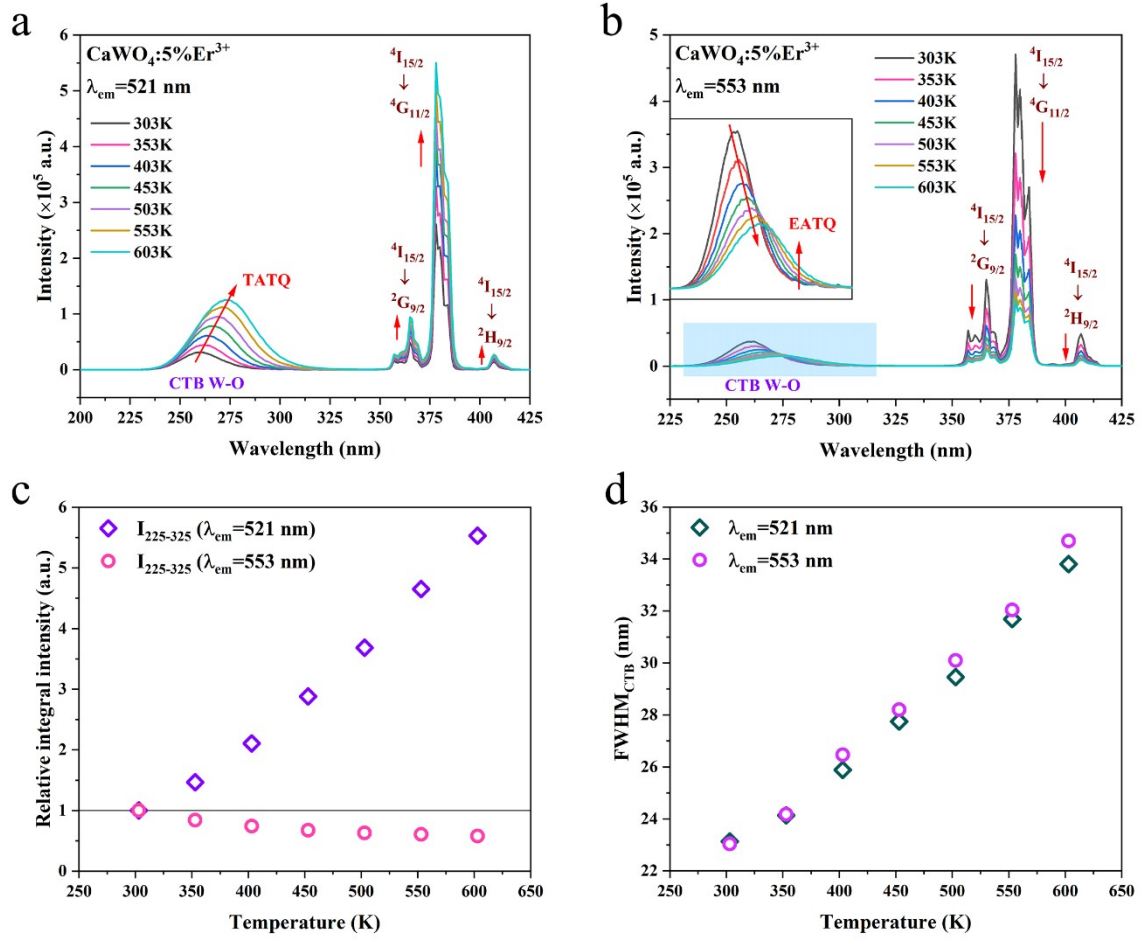
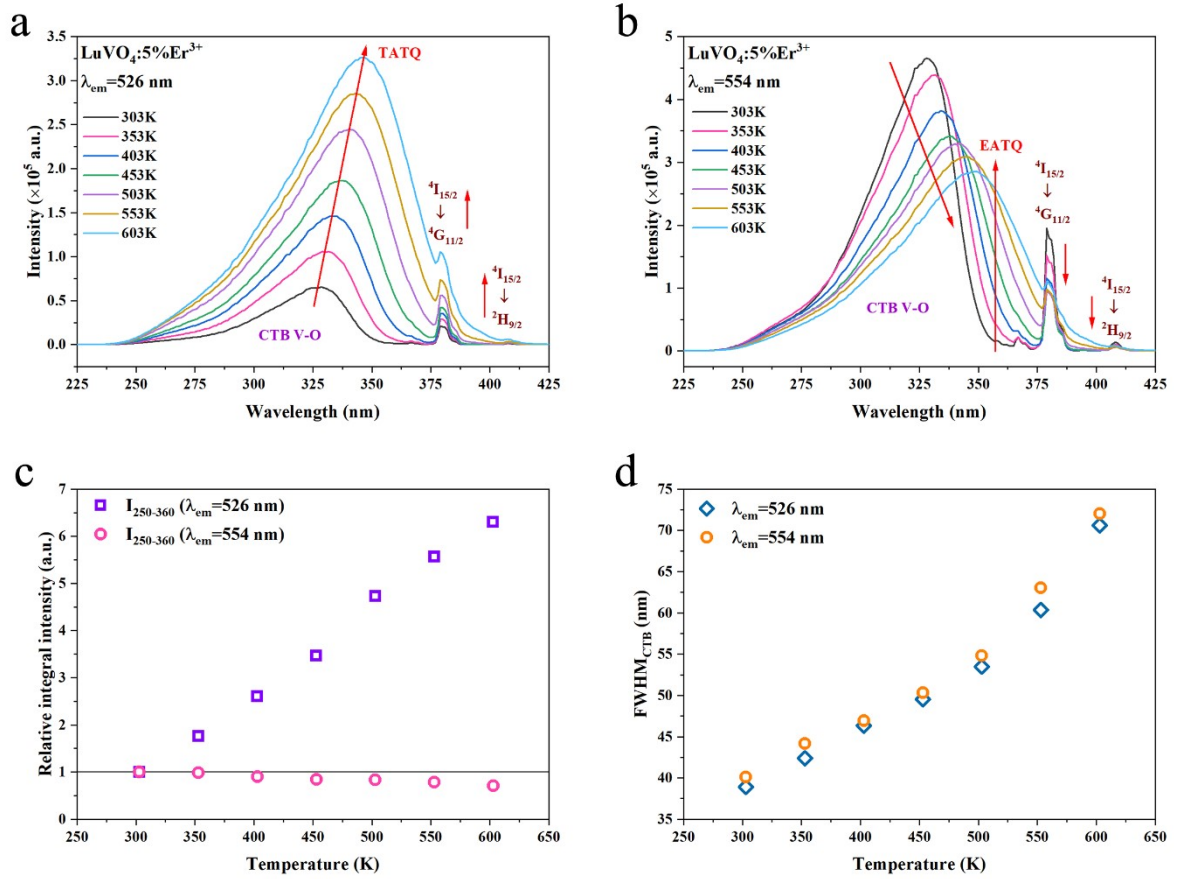


Figure S3. Temperature-dependent excitation spectra of NaGdF<sub>4</sub>: 5%Er<sup>3+</sup> nanoparticles by monitoring at (a) 521 and (b)

540 nm in the 310-560 K range. (c) The integral intensity of <sup>4</sup>I<sub>15/2</sub> → <sup>4</sup>G<sub>11/2</sub> transition.



**Figure S4.** Temperature-dependent excitation spectra of  $\text{CaWO}_4:5\%\text{Er}^{3+}$  by monitoring at (a) 521 and (b) 553 nm in the 328-553 K range. (c) Relative integral intensities of CTB. (d) Variation in FWHM of CTB.



**Figure S5.** Temperature-dependent excitation spectra of LuVO<sub>4</sub>: 5%Er<sup>3+</sup> by monitoring at (a) 526 and (b) 554 nm in the 303-603 K range. (c) Relative integral intensities of CTB. (d) Variation in FWHM of CTB.

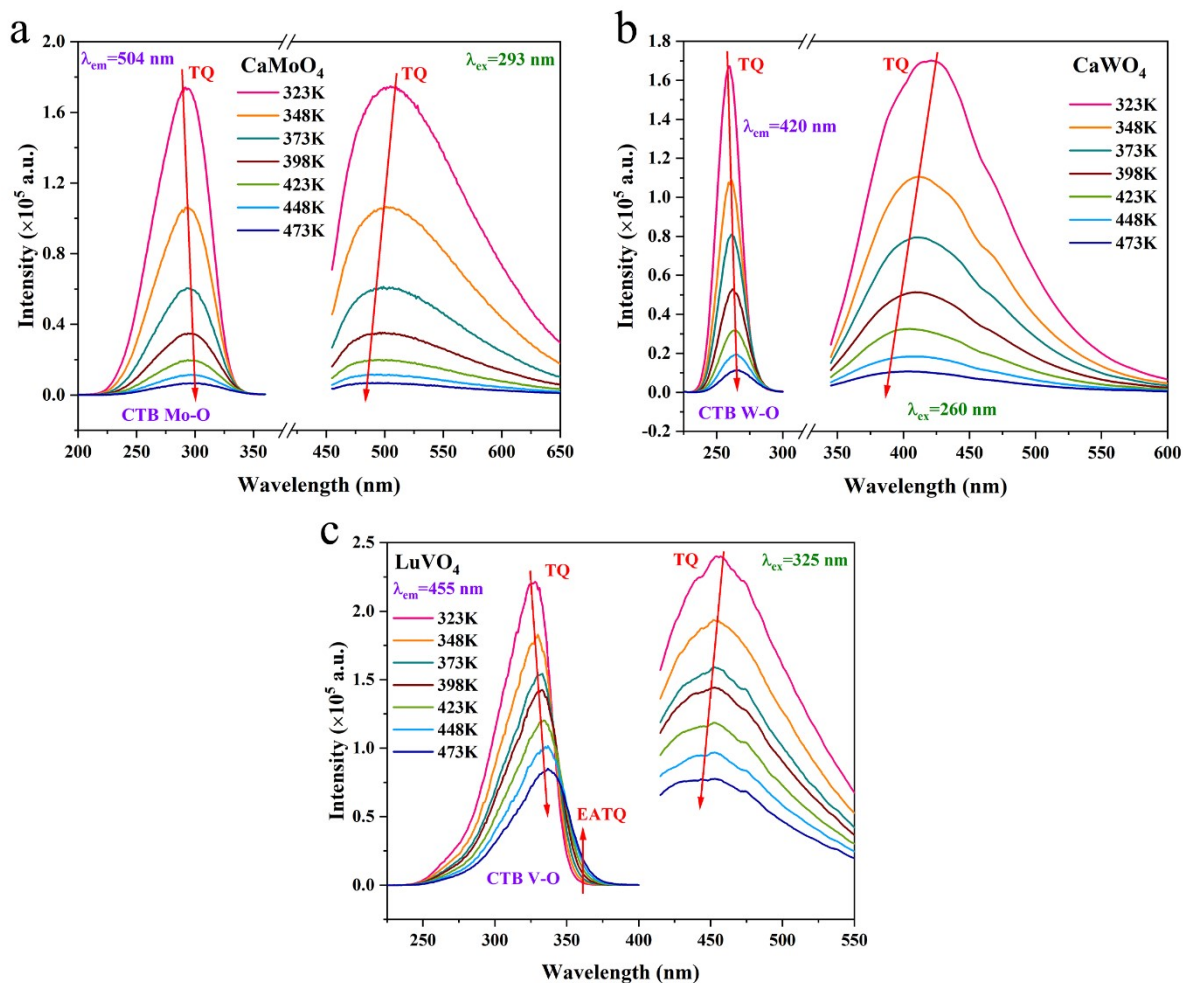


Figure S6. Temperature-dependent excitation and emission spectra of (a)  $\text{CaMoO}_4$ , (b)  $\text{CaWO}_4$  and (c)  $\text{LuVO}_4$ .

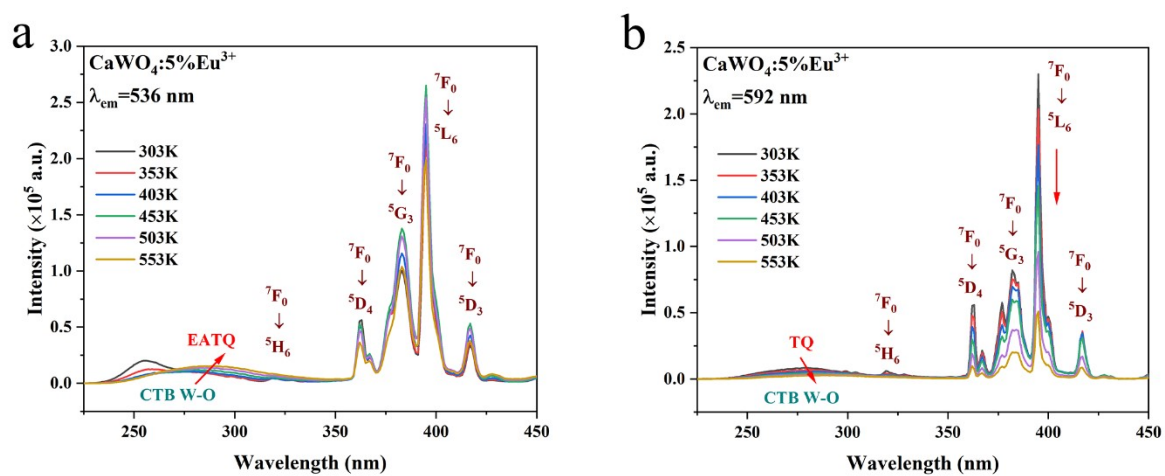


Figure S7. The original excitation spectra of  $\text{CaWO}_4:5\%\text{Eu}^{3+}$ . The excitation of CTB is weak when compared with that of f-f transitions of  $\text{Eu}^{3+}$ .



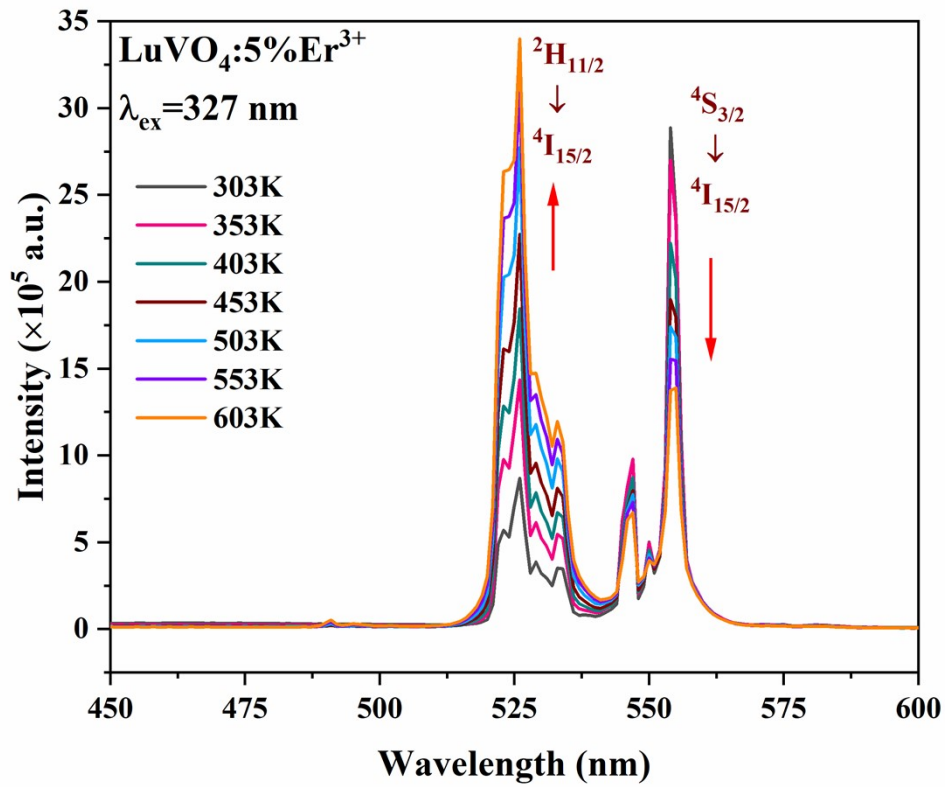
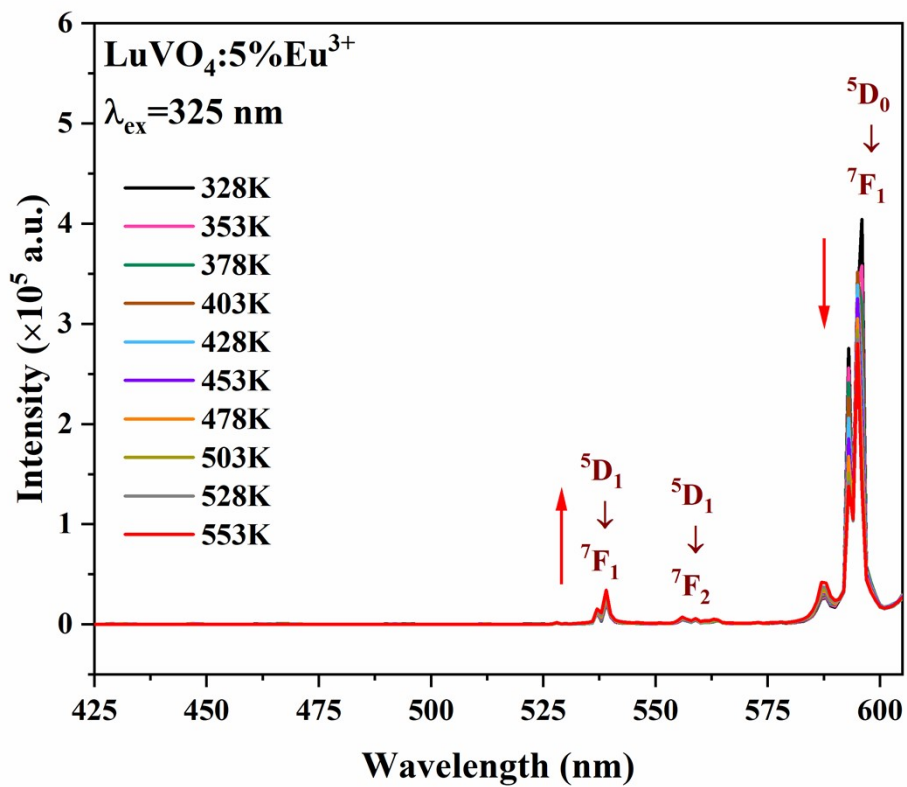
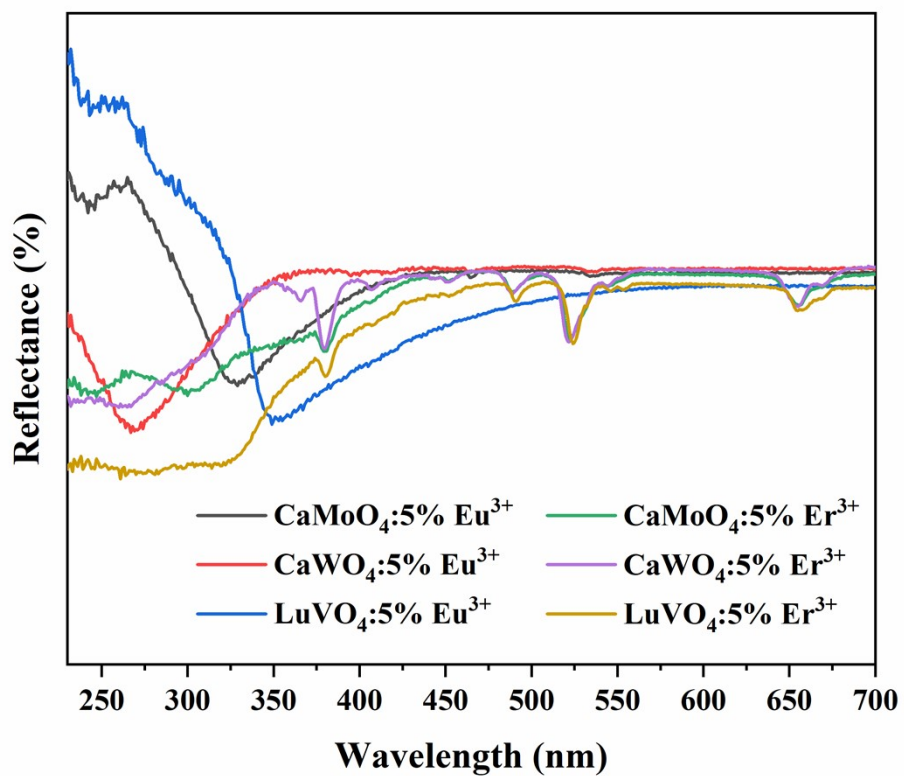


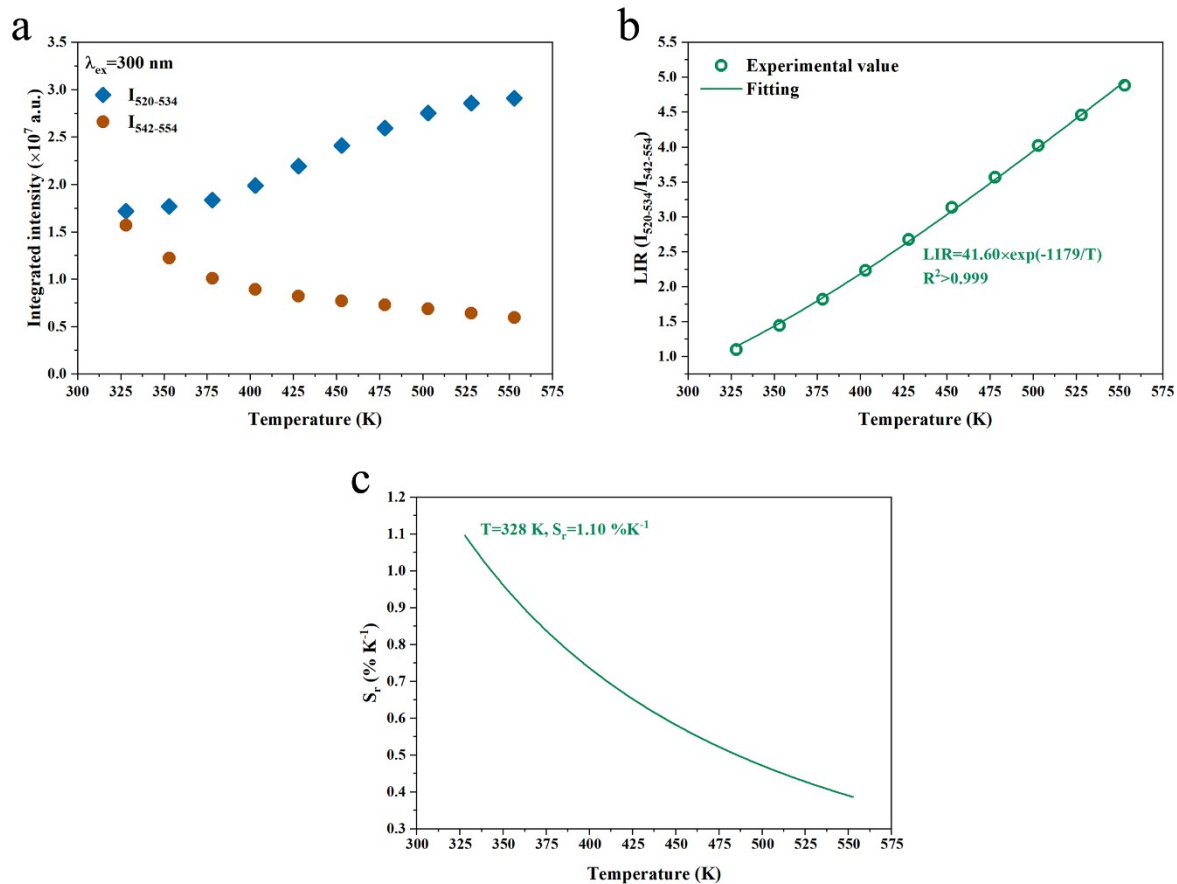
Figure S8. Temperature-dependent emission ( $\lambda_{\text{ex}}=327 \text{ nm}$ ) spectra of LuVO<sub>4</sub>: 5%Er<sup>3+</sup> inorganic phosphors in the 303-603 K range.



**Figure S9.** Temperature-dependent emission ( $\lambda_{\text{ex}}=325$  nm) spectra of  $\text{LuVO}_4: 5\% \text{Eu}^{3+}$  inorganic phosphors in the 328-553 K range.



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**Figure S11.** (a) Scatter plots of  $I_{520-534}$  and  $I_{542-554}$  with temperature in the temperature-dependent emission ( $\lambda_{\text{ex}}=300$  nm) spectra of  $\text{CaMoO}_4: 5\% \text{Er}^{3+}$  inorganic phosphors. (b) Temperature-dependent emission intensity ratio ( $I_{520-534}/I_{542-554}$ ) and fitted curves. (c) Relative sensitivity  $S_r$ .