



The Upconversion Luminescence of $\text{Ca}_3\text{Sc}_2\text{Si}_3\text{O}_{12}:\text{Yb}^{3+},\text{Er}^{3+}$ and Its Application in Thermometry

Junyu Hong ¹, Feilong Liu ², Miroslav D. Dramićanin ³, Lei Zhou ^{1,*} and Mingmei Wu ¹

¹ School of Chemical Engineering and Technology, Sun Yat-sen University, Zhuhai 519082, China; hongjy23@mail.sysu.edu.cn (J.H.); ceswmm@mail.sysu.edu.cn (M.W.)

² School of Marine Sciences, Sun Yat-sen University, Zhuhai 519082, China; liufelong3@mail2.sysu.edu.cn

³ Center of Excellence for Photoconversion, Vinča Institute of Nuclear Sciences-National Institute of the Republic of Serbia, University of Belgrade, PO Box 522, 11,001 Belgrade, Serbia; dramican@vinca.rs

* Correspondence: zhoul8@mail.sysu.edu.cn

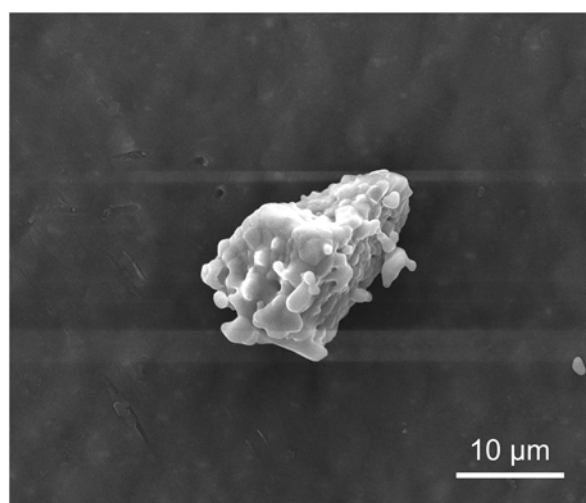


Figure S1. SEM image of $\text{CSS:0.2Yb}^{3+},0.02\text{Er}^{3+}$.

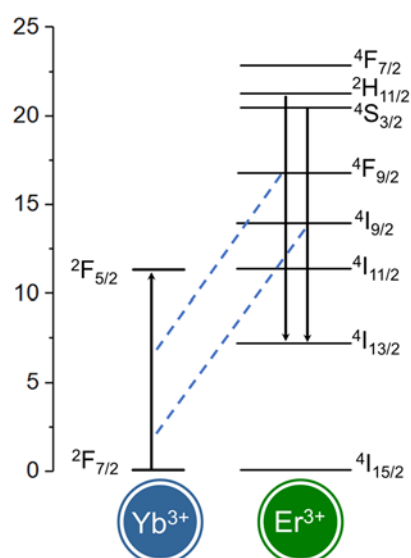


Figure S2. the cross-relaxation of ${}^2\text{H}_{11/2}/{}^4\text{S}_{3/2} (\text{Er}^{3+}) + {}^2\text{F}_{7/2} (\text{Yb}^{3+}) \rightarrow {}^4\text{I}_{13/2} (\text{Er}^{3+}) + {}^2\text{F}_{5/2} (\text{Yb}^{3+})$.

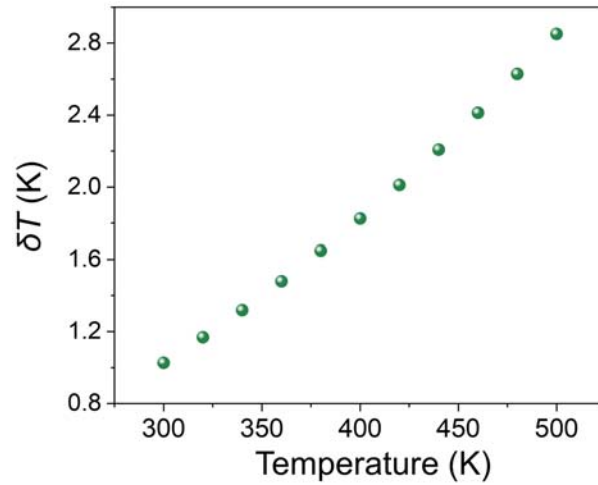


Figure S3. The temperature resolution of CSS:0.2Yb³⁺,0.02Er³⁺.

Temperature resolution (δT) is an important parameter to characterize the performance of optical thermometer, which is defined as:¹⁻²

$$\delta T = \frac{1}{S_r} \frac{\delta FIR}{FIR} \quad (S1)$$

Where $\delta FIR/FIR$ represents the relative standard deviation of the measurement. According to Equ. (1), the calculated temperature resolution δT is shown in Figure. S3 and the minimum value of δT is 1.03 K at 300 K.

References

1. Liu, S.; Cui, J.; Jia, J.; Fu, J.; You, W.; Zeng, Q.; Yang, Y.; Ye, X. High sensitive Ln³⁺/Tm³⁺/Yb³⁺ (Ln³⁺=Ho³⁺, Er³⁺) tri-doped Ba₃Y₄O₉ upconverting optical thermometric materials based on diverse thermal response from non-thermally coupled energy levels. *Ceram. Int.* **2019**, *45*, 1–10.
2. Wu, H.; Hao, Z.; Zhang, L.; Zhang, X.; Xiao, Y.; Pan, G.-H.; Wu, H.; Luo, Y.; Zhang, L.; Zhang, J. Er³⁺/Yb³⁺ codoped phosphor Ba₃Y₄O₉ with intense red upconversion emission and optical temperature sensing behavior. *J. Mater. Chem. C* **2018**, *6*, 3459–3467.