Supporting Information

# From quencher to potent activator – Multimodal luminescence thermometry with $Fe^{3+}$ in the oxides $MAl_4O_7$ (M = Ca, Sr, Ba)

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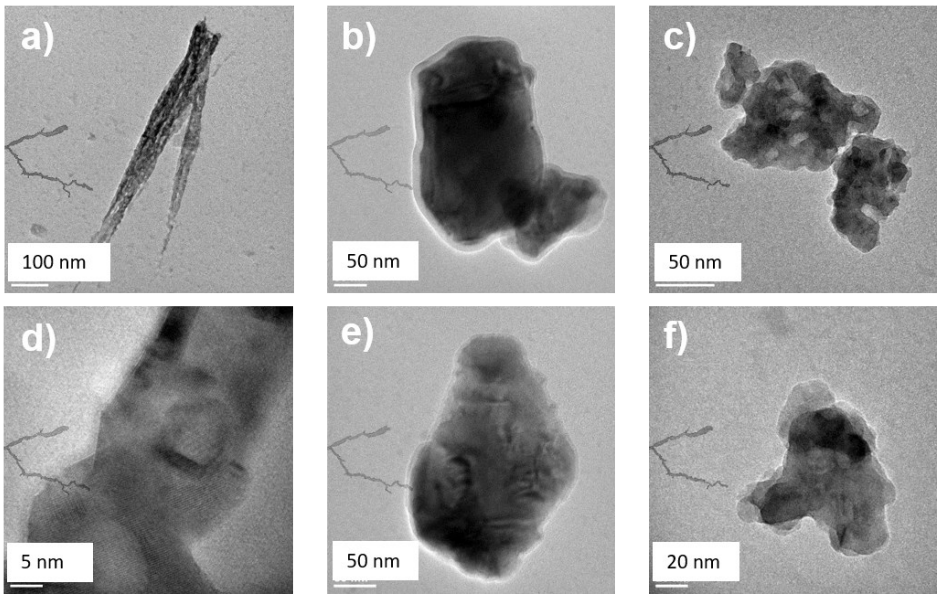


**Figure S1**. Representative TEM images of BAO – a, d), SAO – b, e) and CAO – c, f).

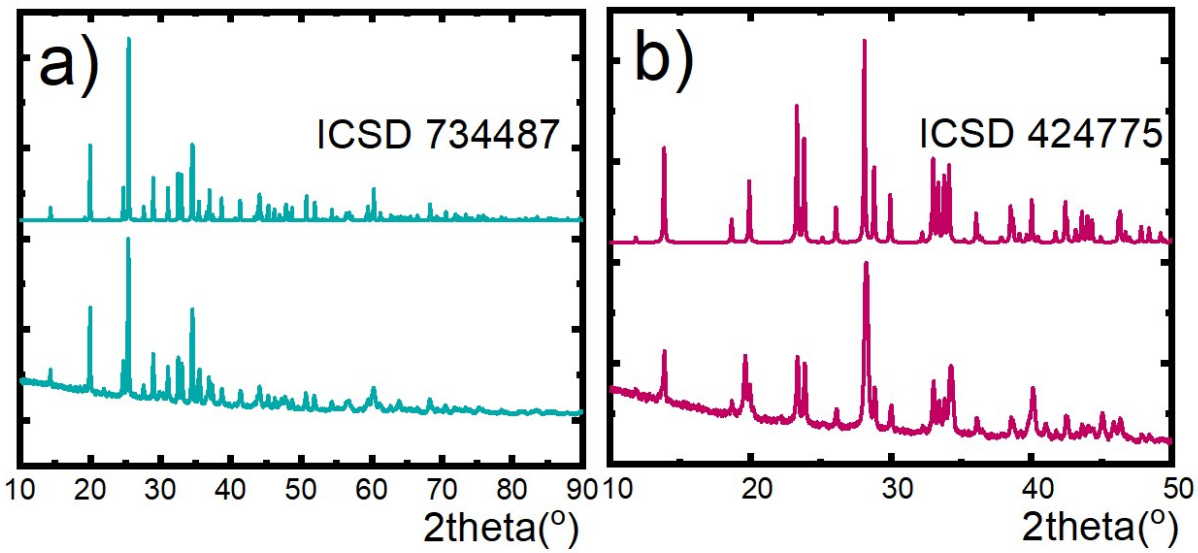


**Figure S2**. XRD patterns of $Fe^{3+}$, $Tb^{3+}$-co-doped CAO and BAO –a) and –b), respectively.

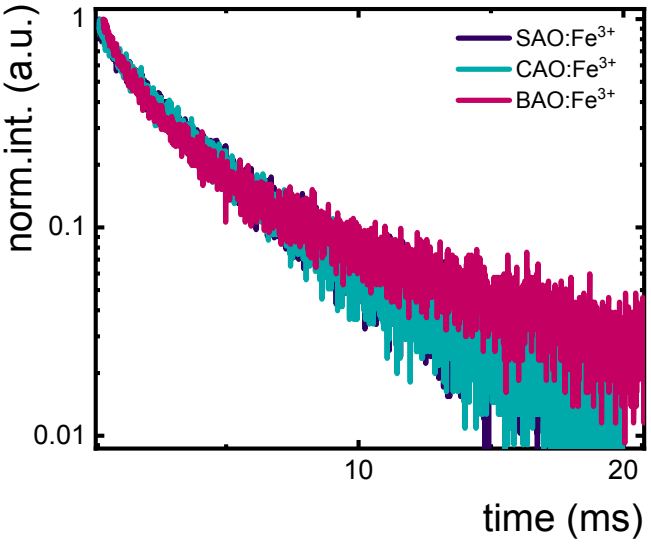


**Figure S3**. The decay profiles of $Fe^{3+}$ luminescence in different host materials (at 123 K).

Eq. S1. The double-exponential function for calculation of the average luminescence lifetime.

$$y = y_0 + A_1 \cdot \exp(-\frac{x}{t_1}) + A_2 \cdot \exp(-\frac{x}{t_2}) \qquad \text{(Eq. S1)}$$

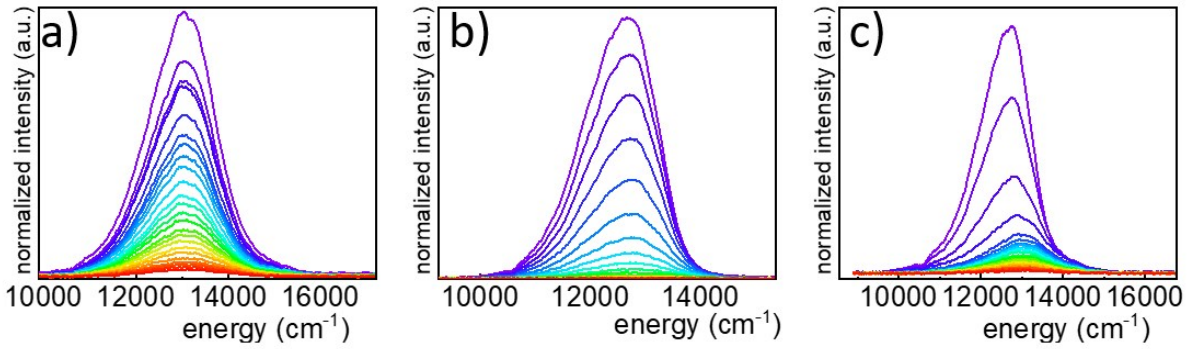


**Figure S4**. The thermal evolution of the emission spectra of SAO:$Fe^{3+}$-a), CAO:$Fe^{3+}$-b) and BAO:$Fe^{3+}$-c).

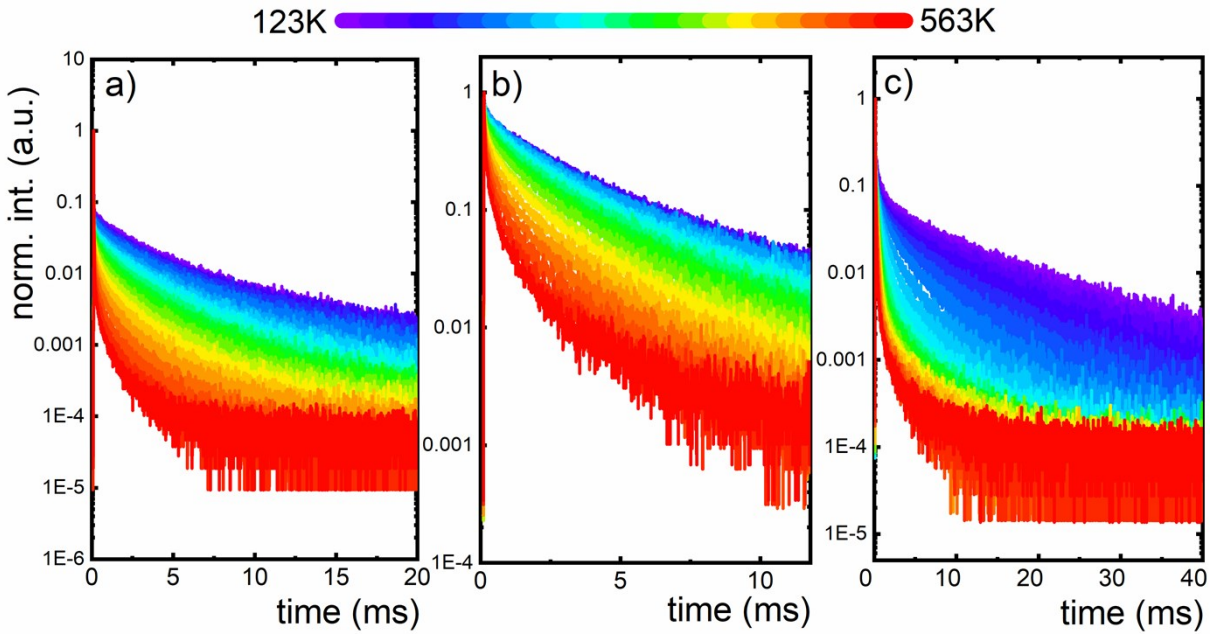

**Figure S5**. The thermal evolution of the luminescence decay profiles of SAO:$Fe^{3+}$-a), CAO:$Fe^{3+}$-b) and BAO:$Fe^{3+}$-c).

The relative precision of temperature determination ($\sigma_T/T$) using CAO:$Fe^{3+}$,$Tb^{3+}$ and BAO:$Fe^{3+}$,$Tb^{3+}$ was determined as follows:

$$\frac{\sigma_T}{T} = \pm \frac{1}{TS_r} \frac{dLIR}{LIR} \quad \text{(eq. S2)}$$

where:

$$\frac{dLIR}{LIR} \sim \sqrt{\frac{1}{I_{Tb}} + \frac{1}{I_{Fe}}} \quad \text{(eq. S3)}$$

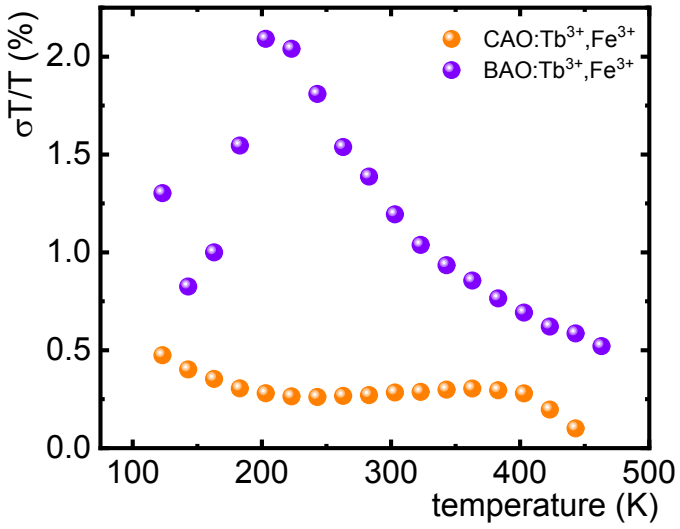


**Figure S6**. The thermal evolution of the relative temperature precision of CAO:$Fe^{3+}$,$Tb^{3+}$ and BAO:$Fe^{3+}$,$Tb^{3+}$