Electronic Supplementary Material (ESI) for RSC Advances.

Supporting information

$Sr_{1.7}Zn_{0.3}CeO_4F_{0.2}:Eu^{3+}$: Novel Dual-emission Temperature Sensors for Remote, Noncontact Thermometric Application

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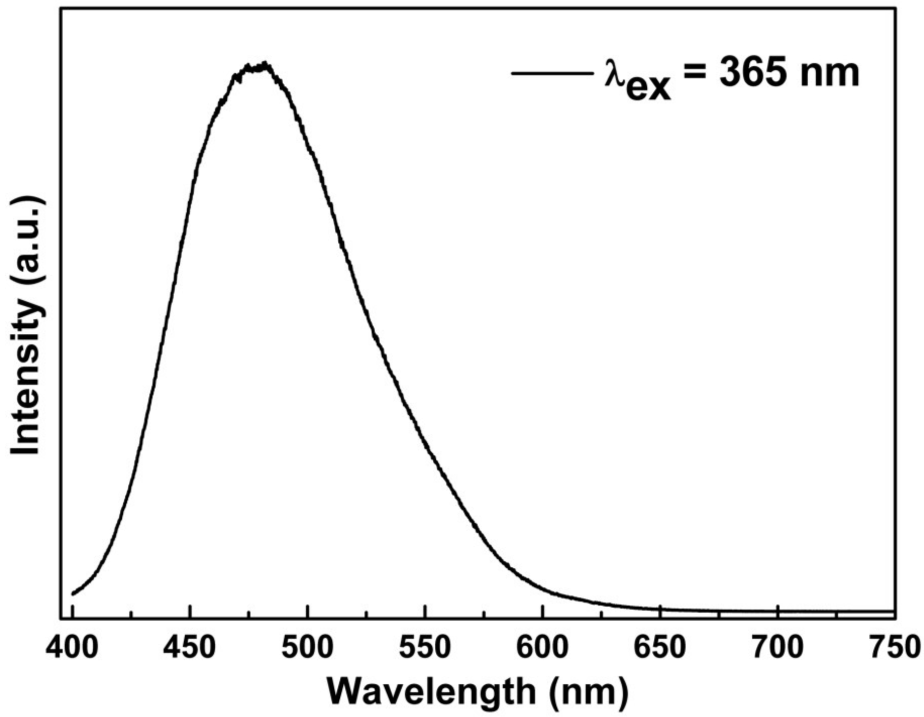

Fig. S1 PL spectrum of SZCF excited at 356 nm.

Table S1 CIE chromaticity coordinates of SZOF:Eu^{3+} with the temperature

Temperature (K)	x coordinate	y coordinate
291	0.309	0.424
311	0.329	0.431
331	0.349	0.438
351	0.368	0.443
371	0.389	0.449
391	0.408	0.454

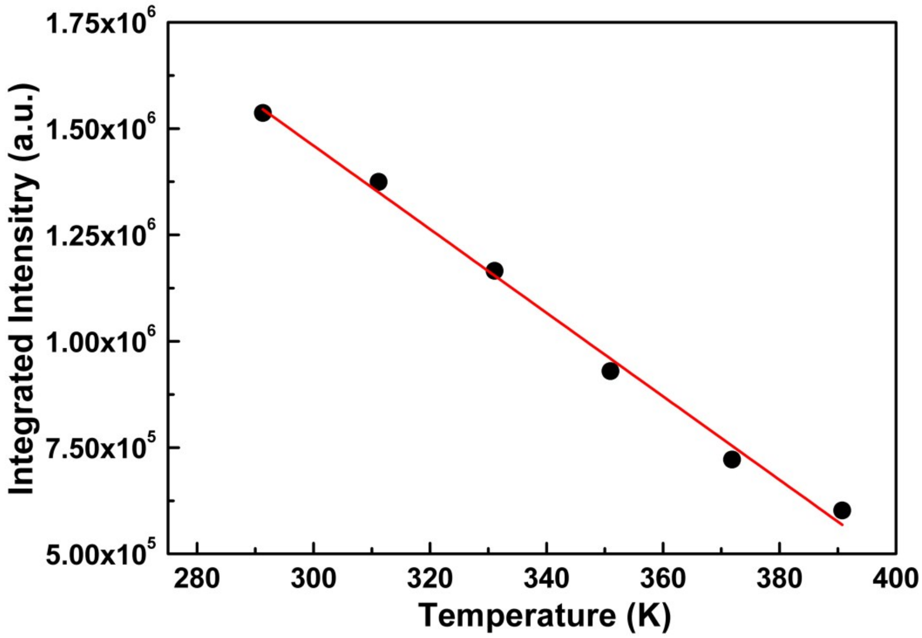

Fig. S2 Relationship of the integrated intensity of PL spectra of $Sr_{1.7}Zn_{0.3}CeO_4F_{0.2}$:0.01$Eu^{3+}$ with the temperature

Apparently, the relation of the integrated intensity with the temperature is linear within the range between 291 K and 391 K. The linear function can be fitted using the following equation:

$$I = -9.82 \times 10^3 T + 4.41 \times 10^6 \quad (1)$$

With the correlation coefficient of 0.993, where I denotes the integrated intensity of the spectrum, T represents the temperature of the detected object, and the slope of the line stands for the resolution of the intensity method.

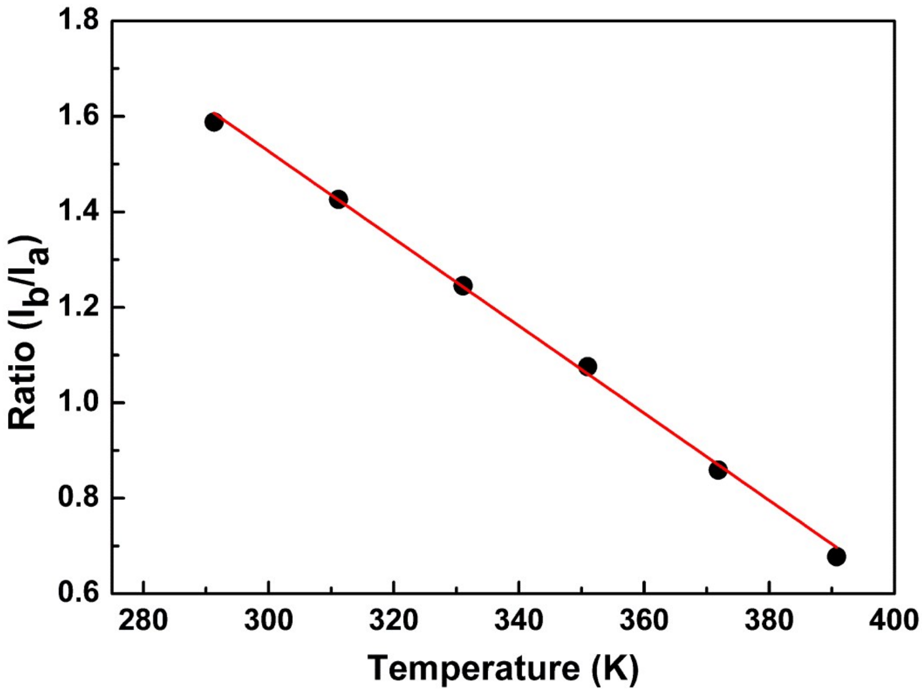

Fig. S3 Relationship of the ratio of I_b/I_a of the dual-emission thermometry phosphor $Sr_{1.7}Zn_{0.3}CeO_4F_{0.2}$:0.01$Eu^{3+}$ with the temperature.

Conspicuously, it shows that the relation of the ratio with the temperature is linear. The linear relation remains perfect in the temperature range between 291 K and 391 K, obeying the below function:

$$R = -0.009T + 4.27 \quad (2)$$

With the residual sum of squares (RSS) of 0.00283, along with the correlation coefficient of 0.994, where R stands for the ratio: I_b/I_a, T is the temperature of the object. Based on the definition of the temperature sensitivity (S), the value of S for this composition of $Sr_{1.7}Zn_{0.3}CeO_4F_{0.2}$:0.01$Eu^{3+}$ is 0.009, which demonstrates the alternation of the temperature sensitivity with the composition of the sensor. Unfortunately, a comprehensive conclusion cannot be reached due to the limited knowledge.

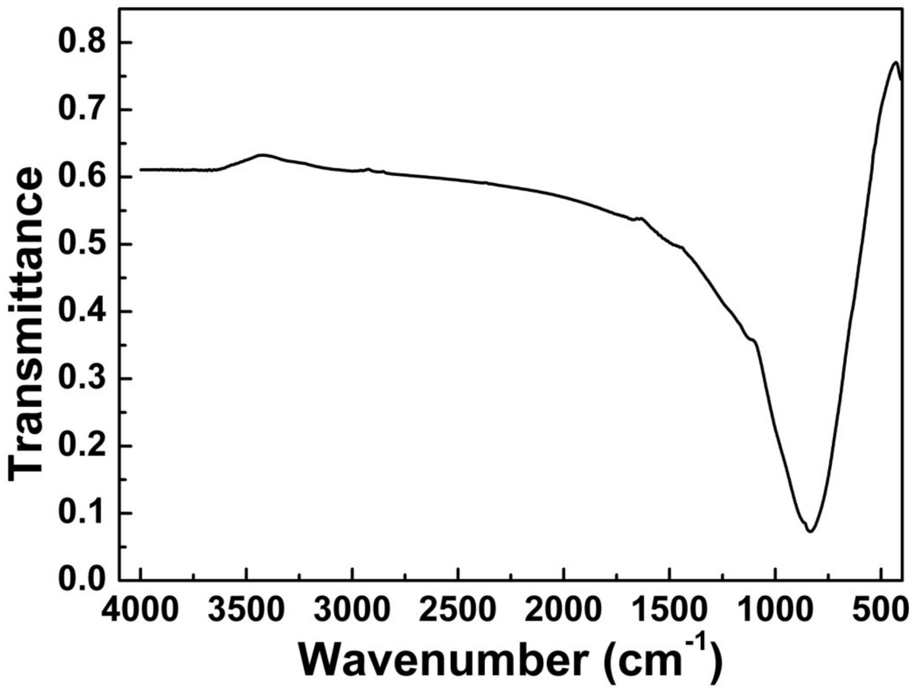

Fig. S4 FTIR spectrum of SZCF:0.005Eu^{3+} phosphor

FTIR analysis was performed to study the vibration property of the sample, as shown in Fig. S4. The wavenumber from 400 to 900 cm^{-1} derives from stretching and bending vibration of metal-oxygen (M–O) group. Remarkably, the strong peak at 835.4 cm^{-1}, along with the should peak at 880 cm^{-1}, are attributed to the stretching vibration of Ce–O group in the octahedral CeO_6. Based on this, the cutoff frequency of the phonon was calculated to be 2.64 x 10^{13} Hz which is similar as that from Arrhenius equation in terms of the order of the magnitude. The large values of the frequency implies the high thermal stability of the sample, indicating the high potential in the practical application.