Supplementary data

Lanthanide-Doped Bismuth-Based Nanophosphors for Ratiometric Upconversion Optical Thermometry

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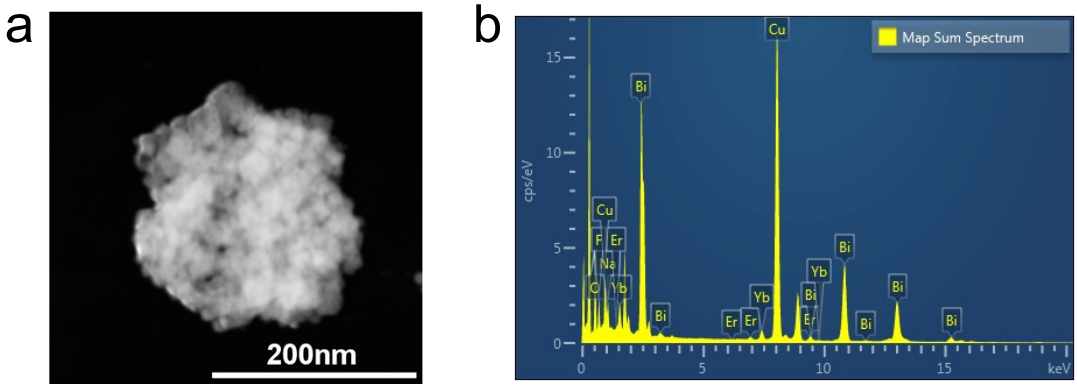

Fig. S1 HAADF-STEM image (a) and EDS spectrum (b) of UCBD.

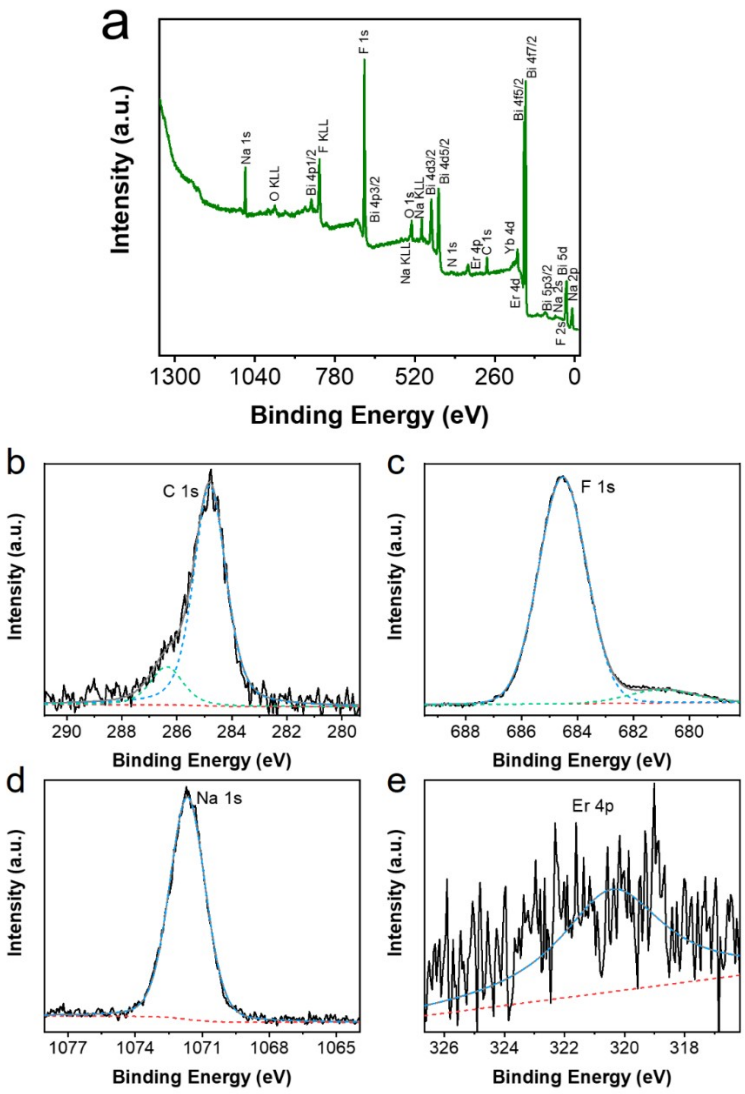

Fig. S2 XPS of UCBD doped with 10% Yb and 2% Er (a) and High-resolution XPS of C 1s (b), F 1s (c), Na 1s (d), and Er 4p (d) in UCBD.

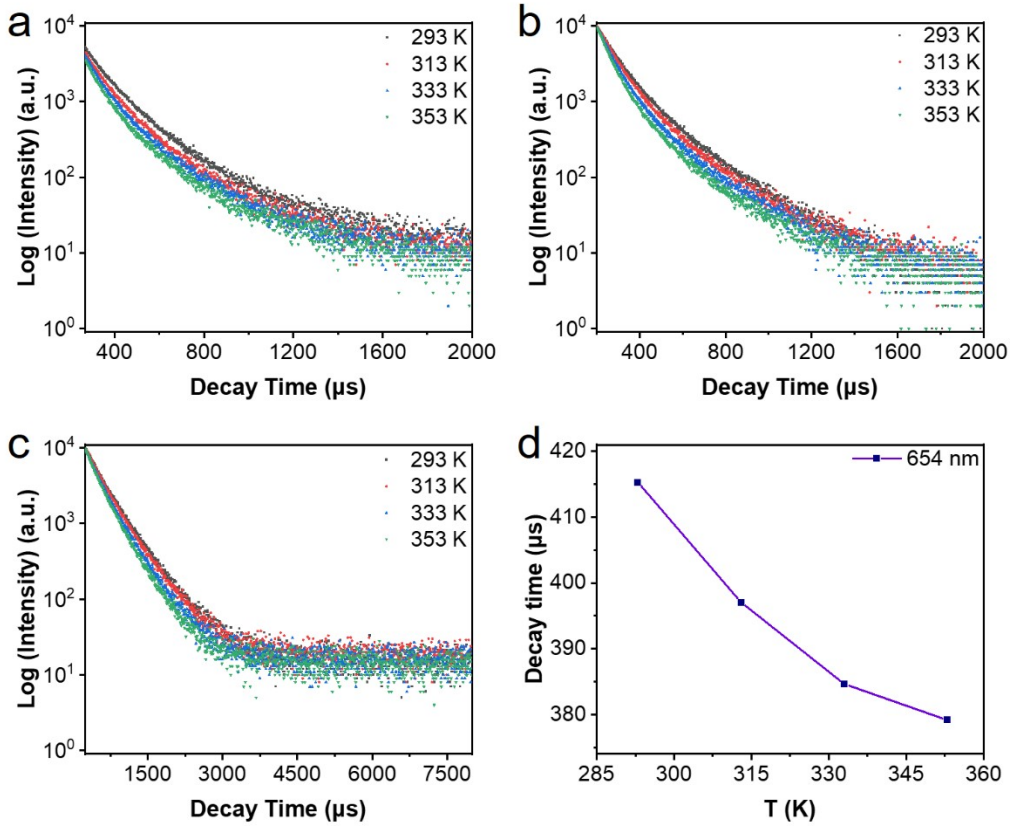

Fig. S3 Emission lifetime at 526 nm (a), 540 nm (b), and 654 nm (c) at different temperatures. (d) A plot of calculated average emission lifetime at 654 nm at different temperatures.

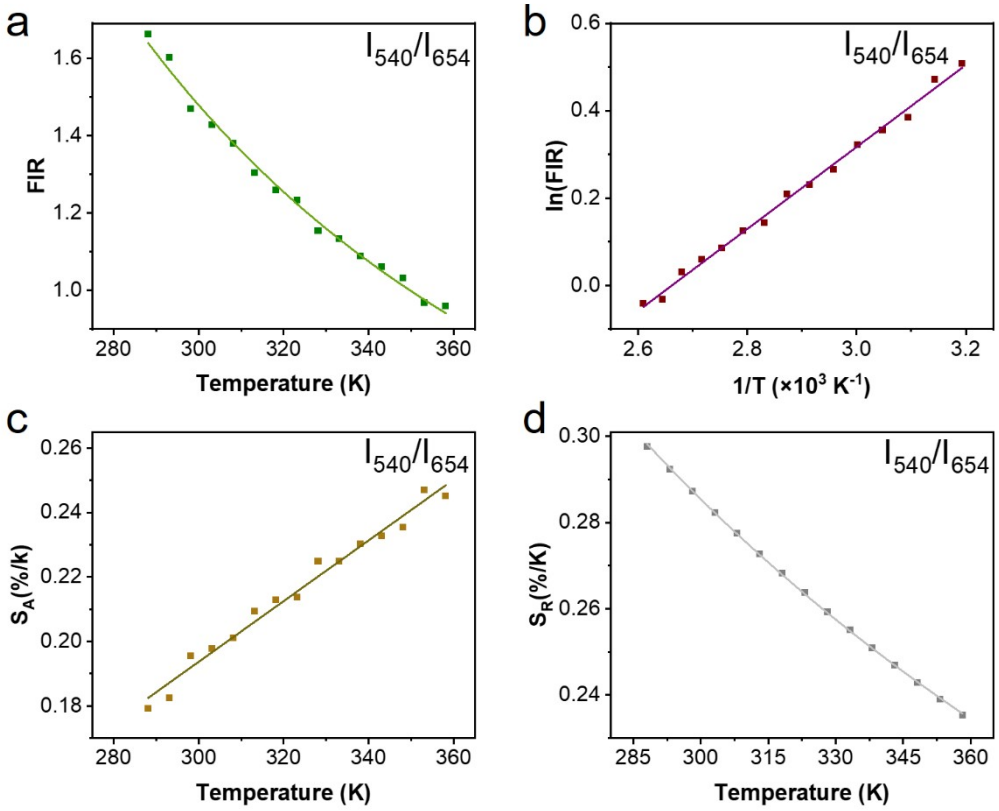

Fig. S4 Properties of the UCBD nanothermometers. (a) Fluorescence intensity ratios (FIRs) were calculated by 540 nm emission and 654 nm emission. (b) ln (FIR) calculated by (a). (c) Absolute sensitivities based on the FIRs in (b). (d) Relative sensitivities on basis of the FIRs in (b).

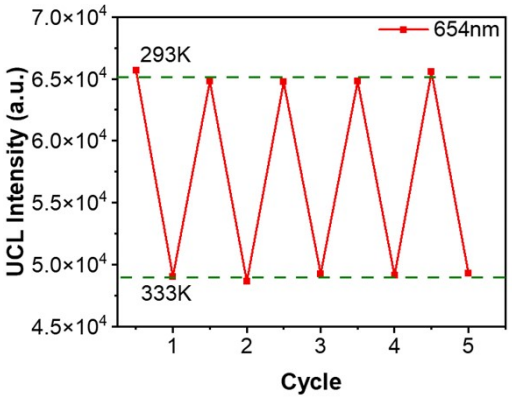

Fig. S5 Repeatability of the UCBD nanothermometer in 40 K heating−cooling cycles. The emission intensity of 654 nm was recorded from 293 to 333 K at each cycle.

Table S1 The comparison of Sr value of different nanomaterials.

Materials	Sr [% K^{-1}]	Reference
$Y_2O_3:Eu^{3+}$	7.8×10^{-2}	1
$Y_2O_3:Yb^{3+}/Ho^{3+}$	1.6	2
$TiO2:Tm^{3+}$	3.0×10^{-4}	3
$NaYbF_4:Tm^{3+}@SiO_2$	5.6×10^{-2}	4
$NaYF_4: Yb^{3+}/Er^{3+}@SiO_2$	1.0	5
$Y_2O_3:Tb^{3+}/Tm^{3+}$	0.33	6
$NaGdF_4:Er^{3+}/Ho^{3+}/Yb^{3+}@SiO_2$	1.1	7
$YVO_4:Nd^{3+}$	0.54	8
$Na_{0.20}Bi_{0.80}O_{0.35}F_{1.91}:Yb^{3+}/Er^{3+}$ (UCBD)	1.24	This work

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