

Supporting Information

Multi-Mode Lanthanide-Doped Ratiometric Luminescent Nanothermometer for Near-Infrared Imaging within Biological Windows

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Table S1. Comparison of optical properties of some nanomaterials and their applications in proportional nanothermometers.

Sensing materials	Temperature range	Sensor sensitivity	Reference
CdTe	80-360 K	0.007	[27]
CdSe quantum dots	300-323 K	0.0069 K ⁻¹	[28]
NaBiF ₄ :Yb ³⁺ /Er ³⁺ /20%Gd ³⁺	148-498 K	0.0037 K ⁻¹	[29]
Ba ₂ LuF ₇ :Er ³⁺ /Yb ³⁺ /Nd ³⁺	308-548 K	0.0063 K ⁻¹	This work

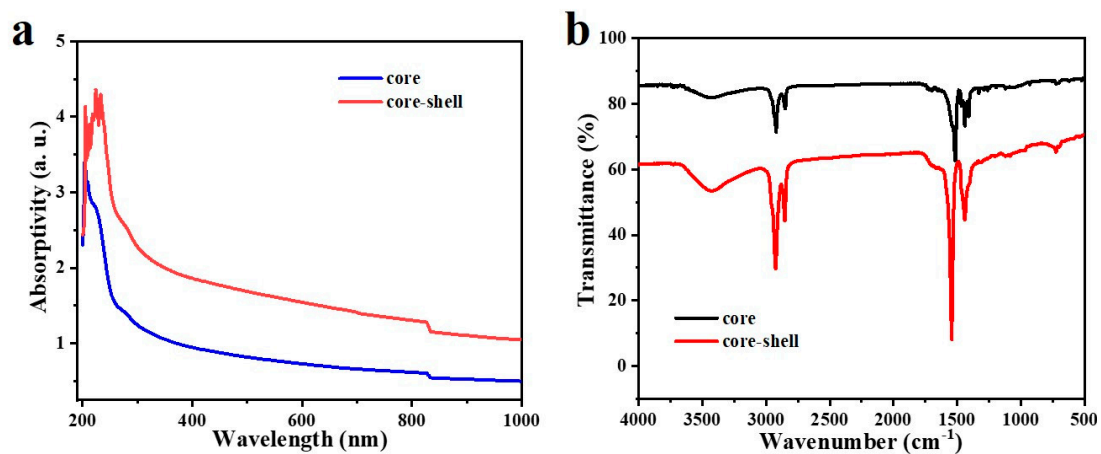


Figure S1. (a) UV absorption spectra of nanoparticles in cyclohexane. (b) Fourier infrared spectroscopy of nanoparticles.

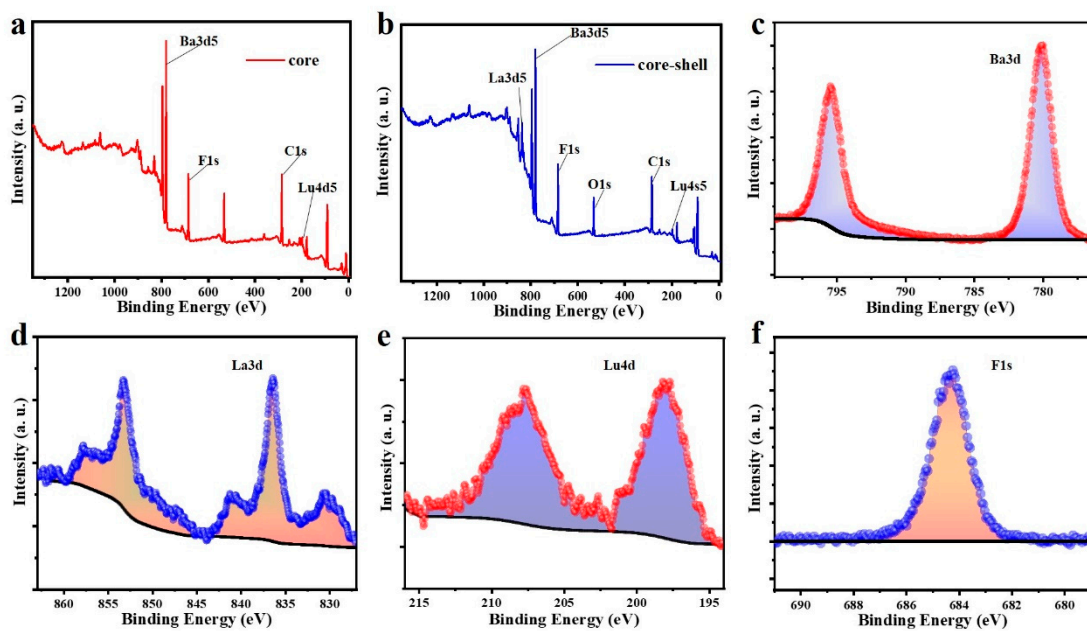


Figure S2. (a,b) XPS survey spectra of the Ba_2LuF_7 : $\text{Yb}^{3+}/\text{Nd}^{3+}/\text{Er}^{3+}$ and Ba_2LuF_7 : $\text{Yb}^{3+}/\text{Nd}^{3+}/\text{Er}^{3+}@\text{Ba}_2\text{LaF}_7$ nanoparticles, respectively. And deconvoluted spectra of (c) Ba 3d, (d) La 3d, (e) Lu 4d, and (f) F 1s region of $\text{Ba}_2\text{LuF}_7@\text{Ba}_2\text{LaF}_7$.

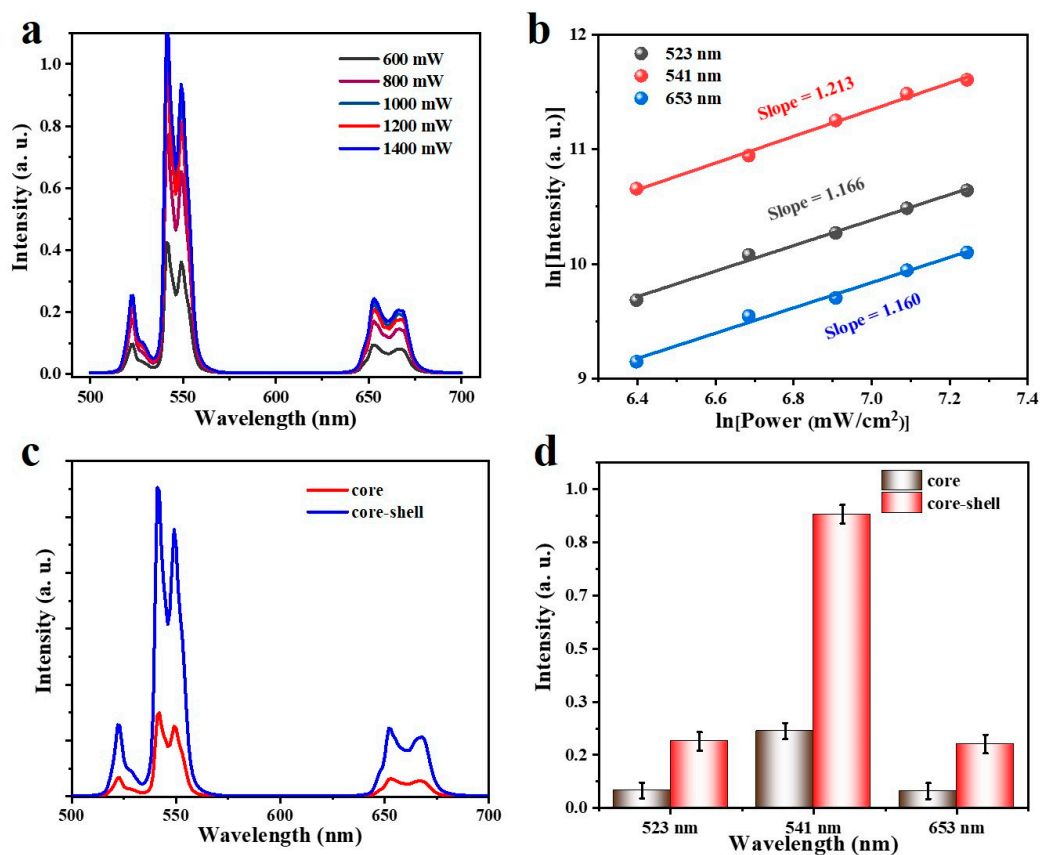


Figure S3. (a) Upconversion luminescence spectra in visible regions of nanocrystals excited at different power densities of 980 nm. (b) The relationship between emission intensity and excitation power. (c,d) Comparison of upconversion luminescence intensity between core and core-shell nanoparticles.

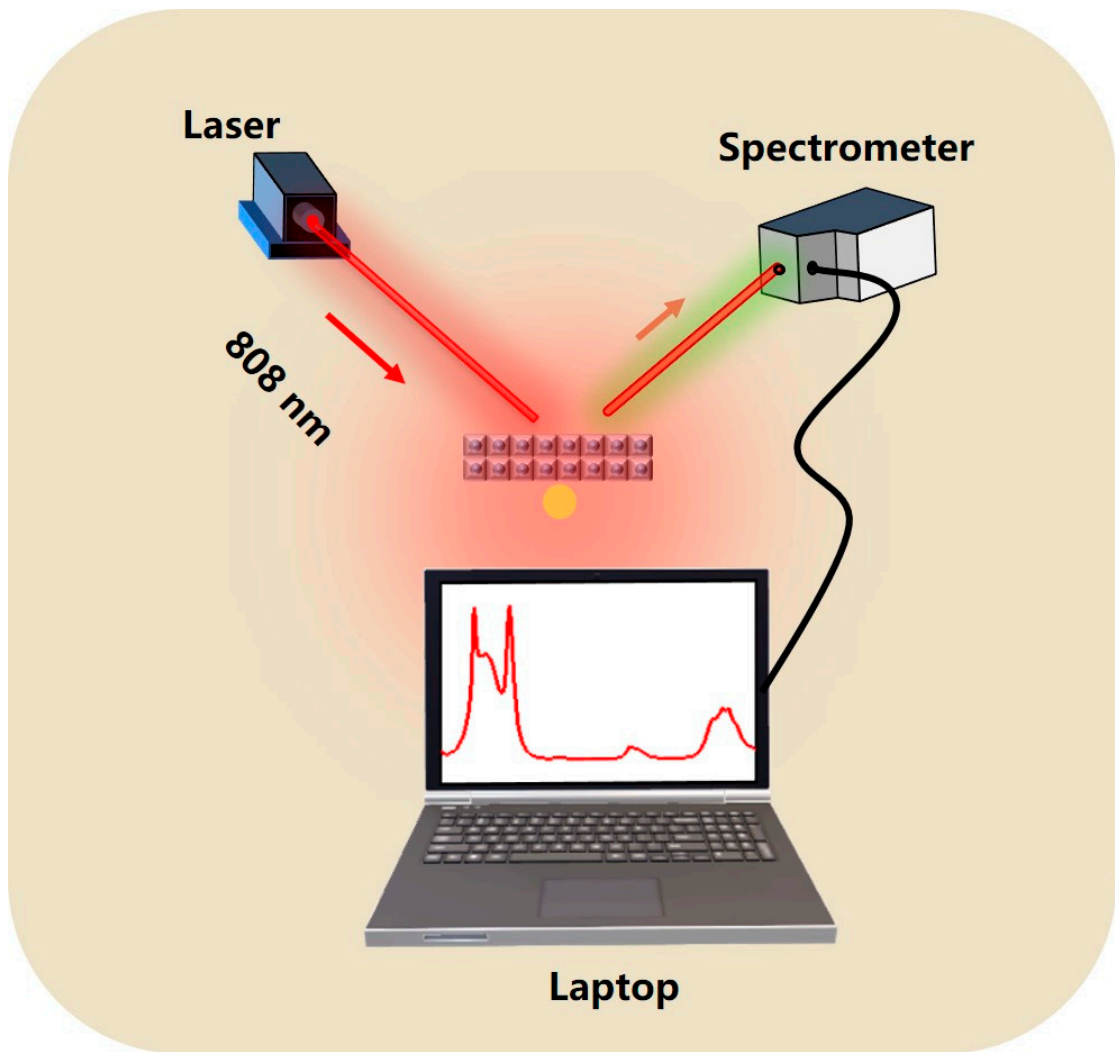


Figure S4. Diagram of the non-contact temperature measuring system.

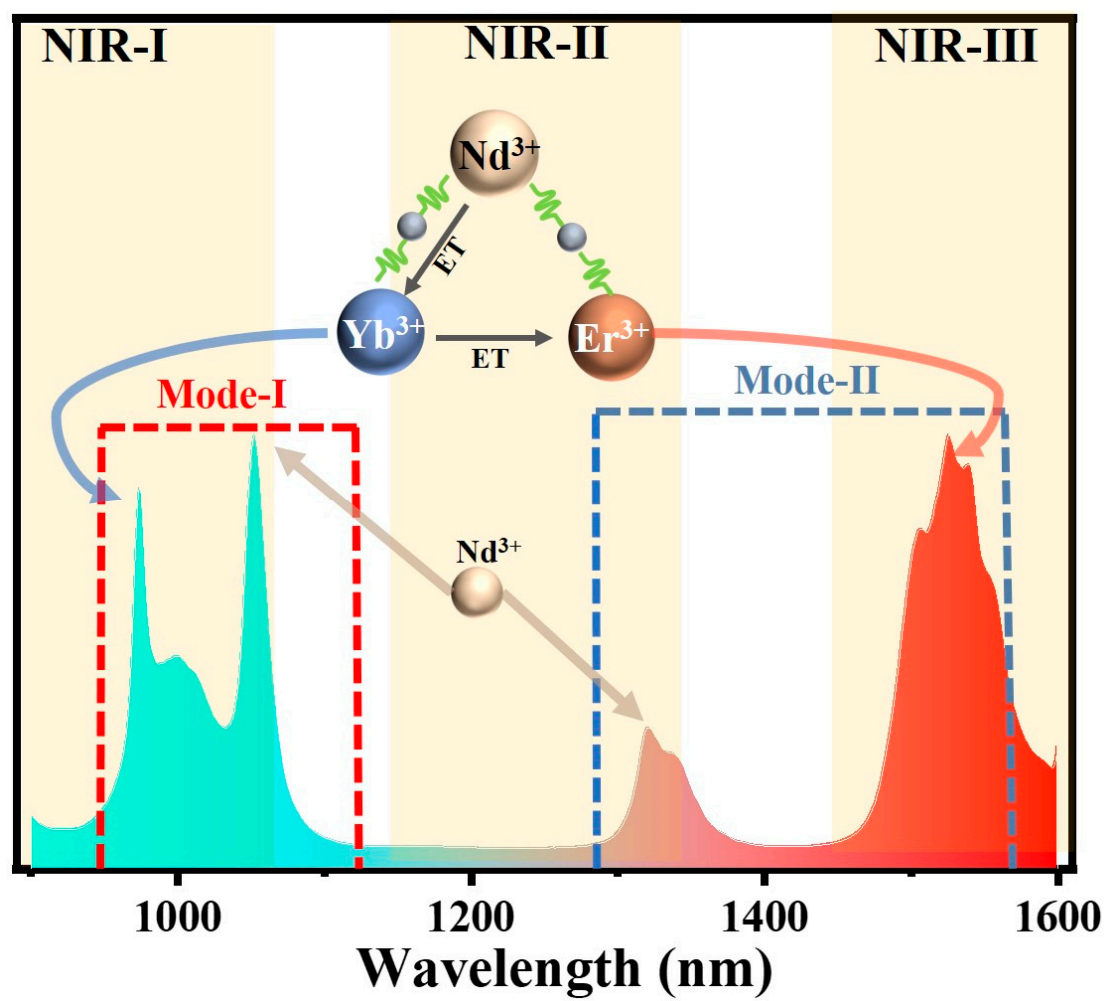


Figure S5. Schematic diagram of multi-mode temperature measurement principle.