Supplementary information

Near-infrared light excited photodynamic anticancer therapy based on UCNP@AIEgen nanocomposite

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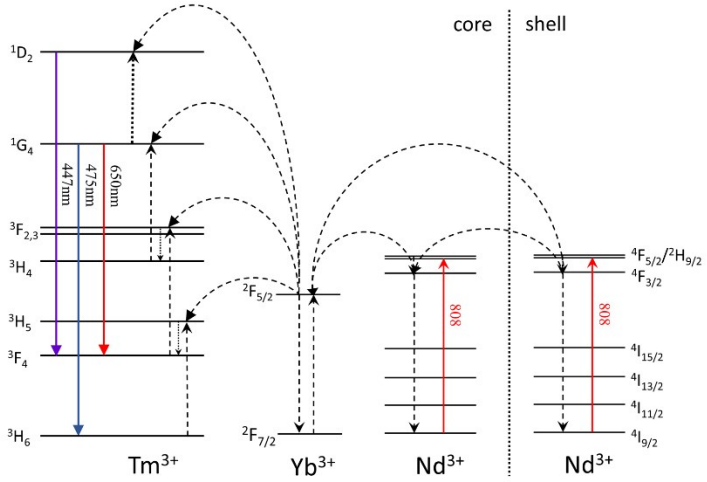

Figure S1. Simplified energy level transition diagram of the synthesized UCNP under 808 nm excitation.

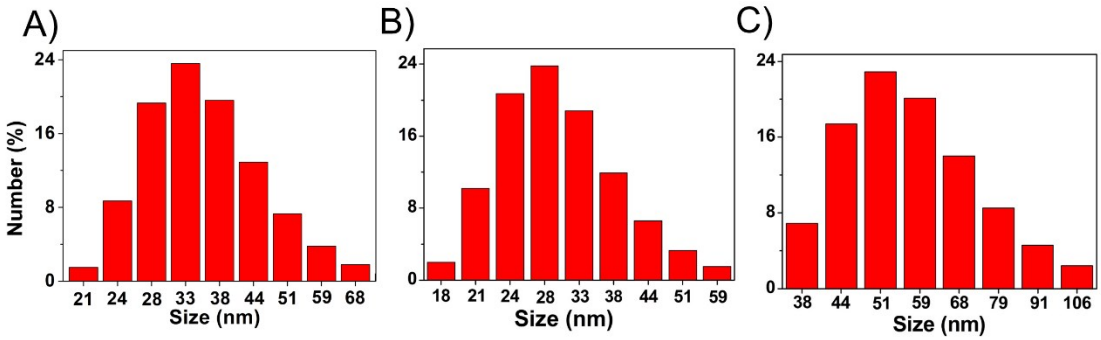

Figure S2. Size distribution of (A) UCNP, (B) TBD dots and (C) UCNP@TBD nanocomposite measured by dynamic light scattering (DLS).

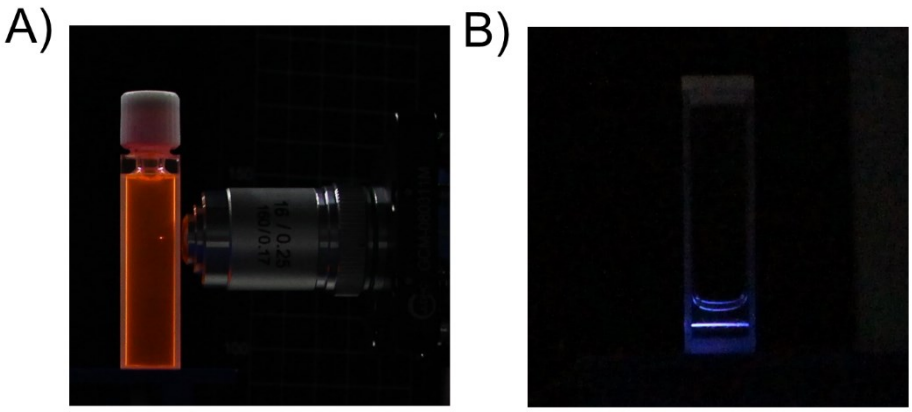

Figure S3. Excitation volume comparation of (A) two-photon excitation (Rhodamine 6G, Ex: 800 nm, 50 mW) and (B) upconversion process (NaYF4:30%Yb^{3+}, 1%Tm^{3+}, 1%Nd^{3+} @ NaYF4:20%Nd^{3+}, Ex: 808 nm, 1W).

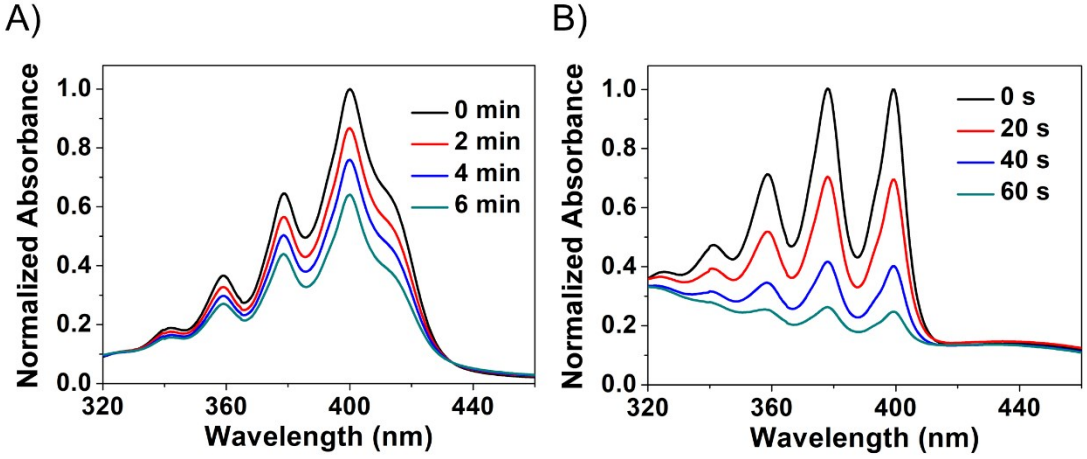

Figure S4. UV-Vis spectra variation of ABDA mixed with (A) Chlorin e6 and (B) TBD dots under white light irradiation (400 - 700 nm, 100 mW/cm^2) for different time. [Ce6] = 10 μM, [TBD dots] = 10 μM based on TBD, [ABDA] = 50 μM.

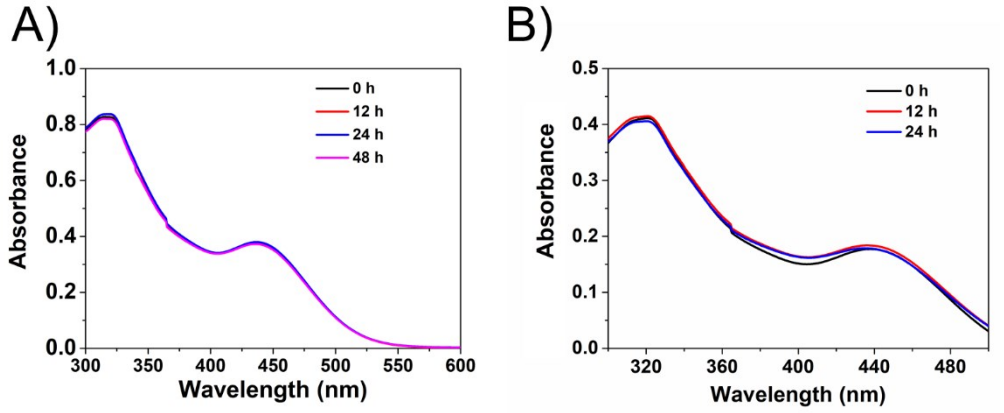

Figure S5. Long-term stability of UCNP@TBD. UV-Vis absorption spectra of UCNP@TBD in (A) aqueous solution and (B) cell lysate at different time. [UCNP@TBD] = 13 μg/mL based on TBD; 10^5 cells were lysed by ultrasonic to form cells lysate.

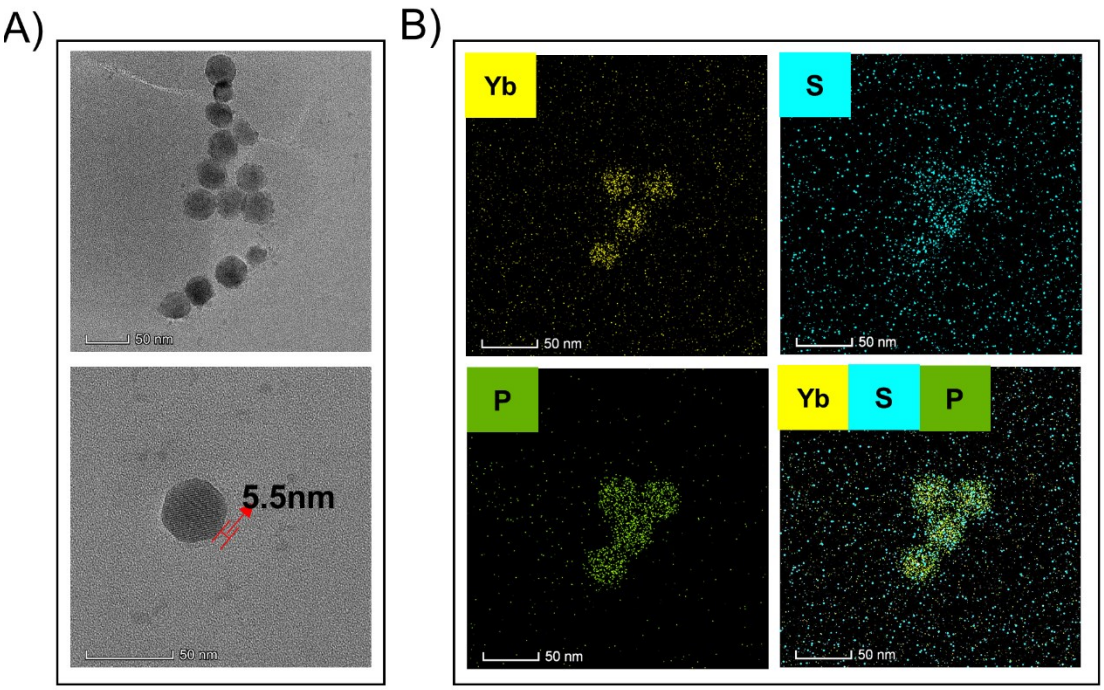

Figure S6. (A) Transmission election microscopy (TEM) images of UCNP@TBD nanocomposite. (B) Energy-dispersive spectrum (EDS) analysis of ytterbium (Yb), sulfur (S) and phosphorus (P) in UCNP@TBD nanocomposite, which are the characteristic elements of UCNP, TBD and DSPE-PEG-MAL, respectively. Scale bar: 50 nm.

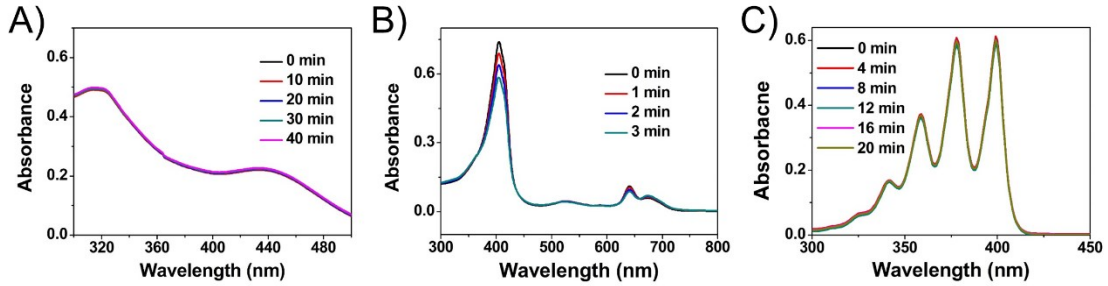

Figure S7. The photostability of different materials. The time-sequenced absorption spectra of (A) UCNP@TBD nanocomposite ([UCNP@TBD] = 15 μg/mL based on TBD) under the NIR light irradiation (808 nm, 2.5 W/cm^2), (B) Ce6 (10 μM) under the irradiation (400 - 700 nm, ~60 mW/cm^2), (C) ABDA (50 μM) under the NIR light irradiation (808 nm, 200 mW/cm^2) for different time.

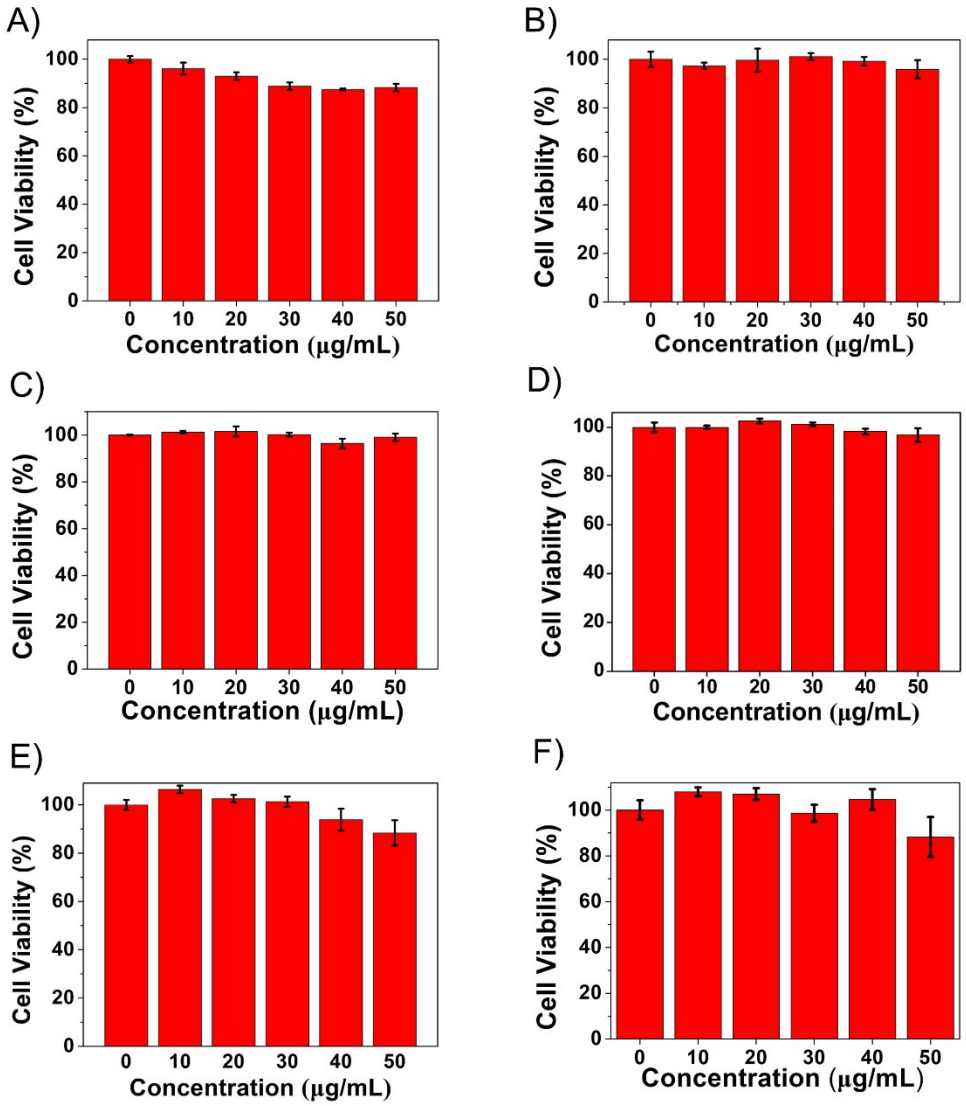

Figure S8. Assessment of biocompatibility of UCNP@TBD and cRGD-UCNP@TBD nanocomposite. Cell viability of 4T1 cells incubated with different concentrations of UCNP@TBD nanocomposite for (A) 24 h and (B) 48 h, and cell viability of HeLa cells were incubated with different concentrations of UCNP@TBD nanocomposite for (C) 24 h and (D) 48 h and cRGD-UCNP@TBD nanocomposite for (e) 24 h and (f) 48 h.

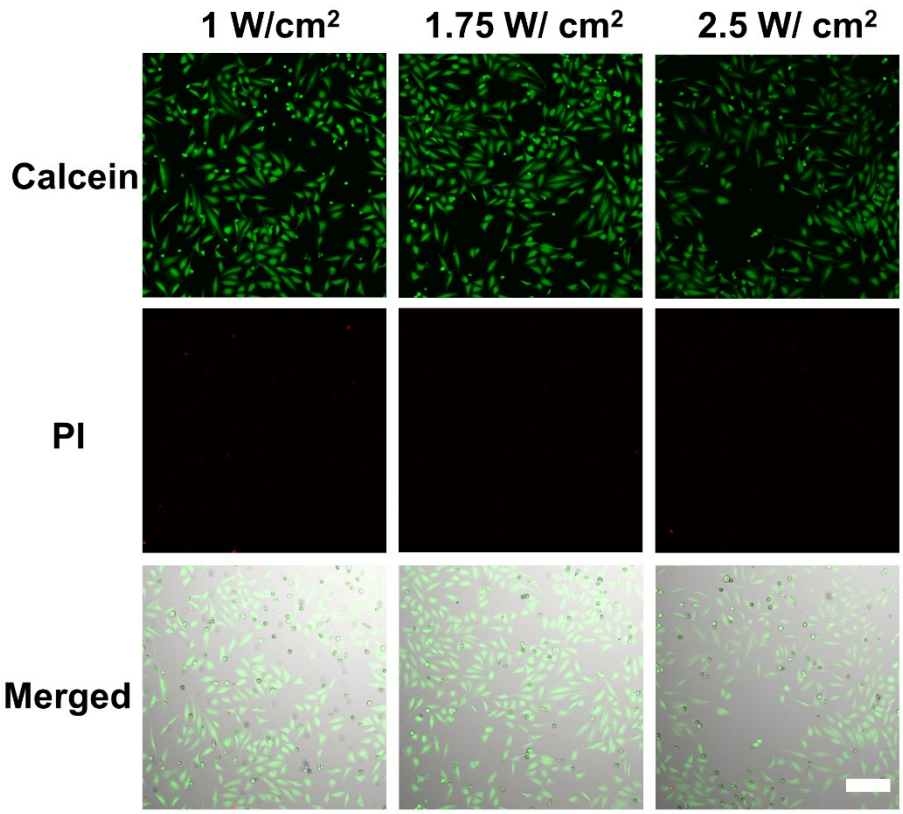

Figure S9. Viability of HeLa cells treated with NIR light irradiation of different power density (808 nm, 1 W/cm^2, 1.75 W/cm^2, 2.5 W/cm^2) for 40 min. Scale bar: 200 μm.

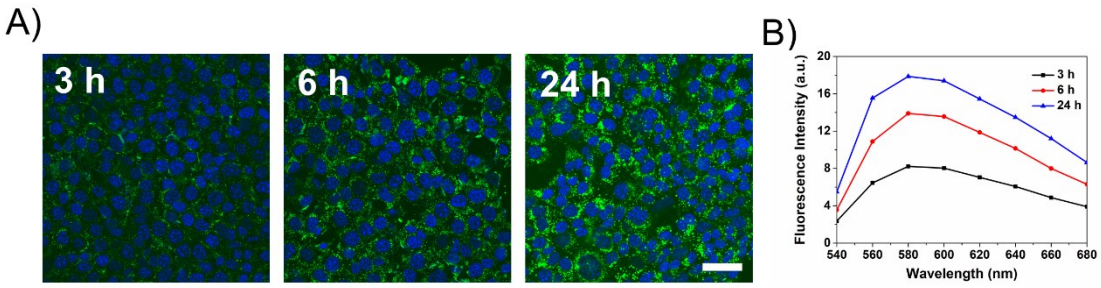

Figure S10. (A) Fluorescence imaging and (B) corresponding spectra of 4T1 cells incubated with both UCNP@TBD nanocomposite ([UCNP@TBD] = 50 μg/mL based on TBD) for 3h, 6 h and 24 h and DAPI (1 μg/mL) for 15 min, respectively. DAPI (Ex: 405 nm; Em: 420-500 nm), UCNP@TBD (Ex: 488 nm; Em: 555-625 nm). Scale bar: 200 μm.

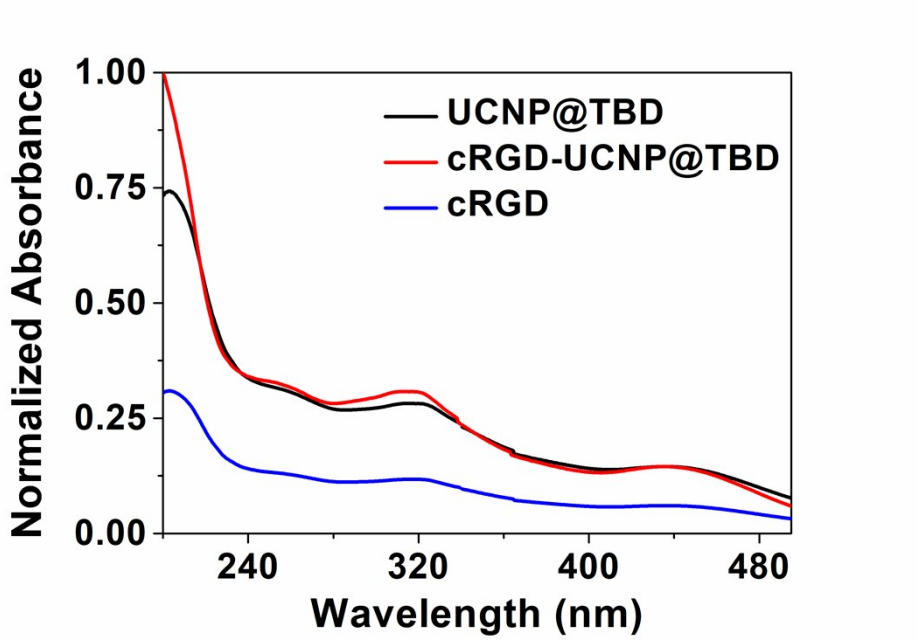

Figure S11. UV-Vis absorption spectra of UCNP@TBD ([UCNP@TBD] = 13 μg/mL based on TBD), cRGD-UCNP@TBD ([cRGD-UCNP@TBD] = 13 μg/mL based on TBD) and cRGD (0.2 mg/mL).

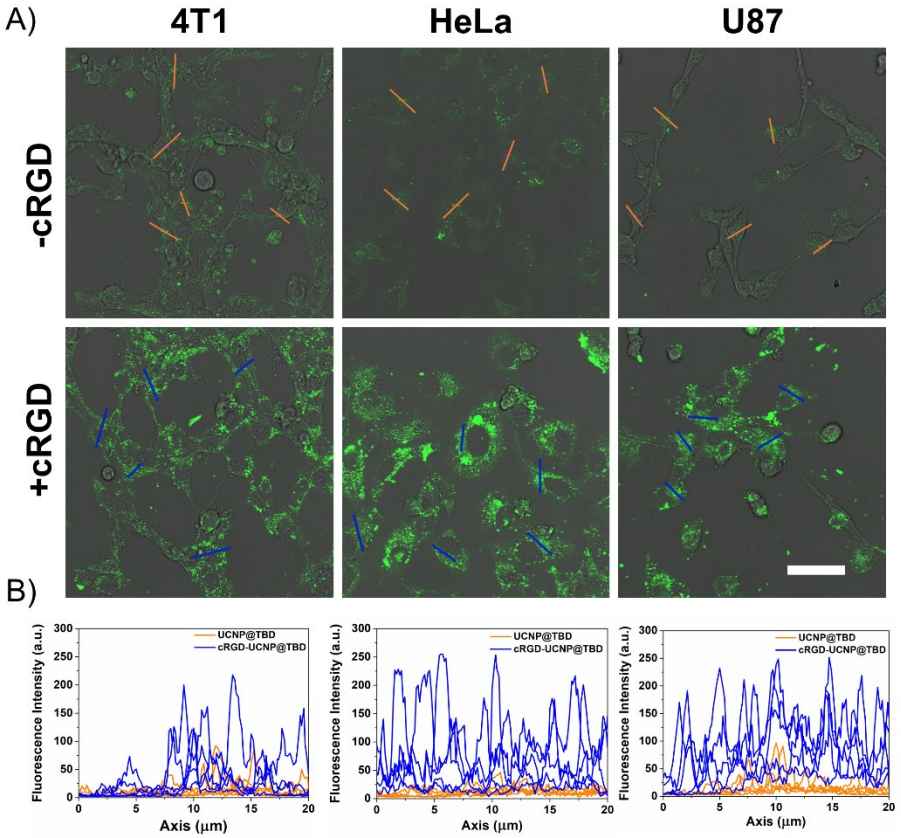

Figure S12. (A) Fluorescence images of and (B) fluorescence intensity line distributions of the marked lines (n = 5) in 4T1, U87 and HeLa cells incubated with UCNP@TBD and cRGD-UCNP@TBD nanocomposites ([nanocomposites] = 50 μg/mL based on TBD) for 6 h. Fluorescence imaging (Ex: 488 nm; Em: 555-625 nm). Scale bar: 200 μm.

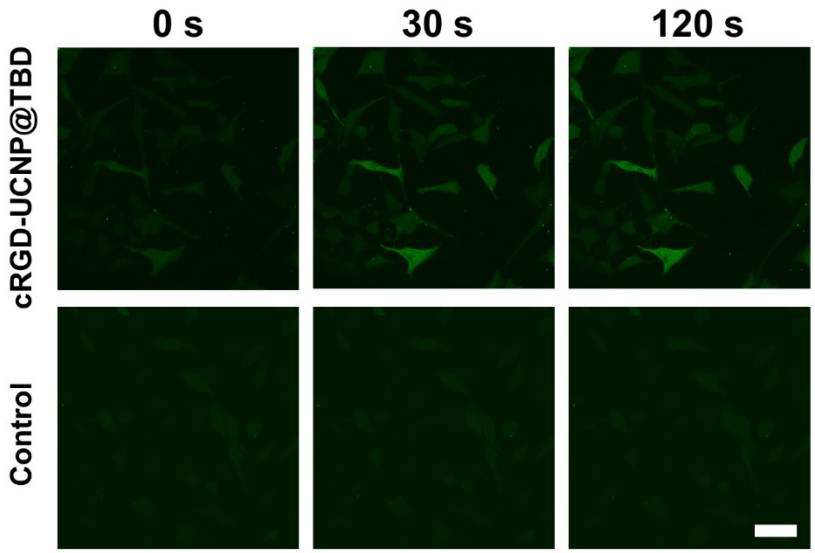

Figure S13. The intracellular ROS generation capability of UCNP@TBD nanocomposite under light irradiation (Ex: 808 nm, 2.5 W/cm^2). [nanocomposite] = 50 μg/mL based on TBD. DCF (Ex: 488 nm; Em: 500-550 nm). [DCFH-DA] = 5 μM. Scale bar: 200 μm.

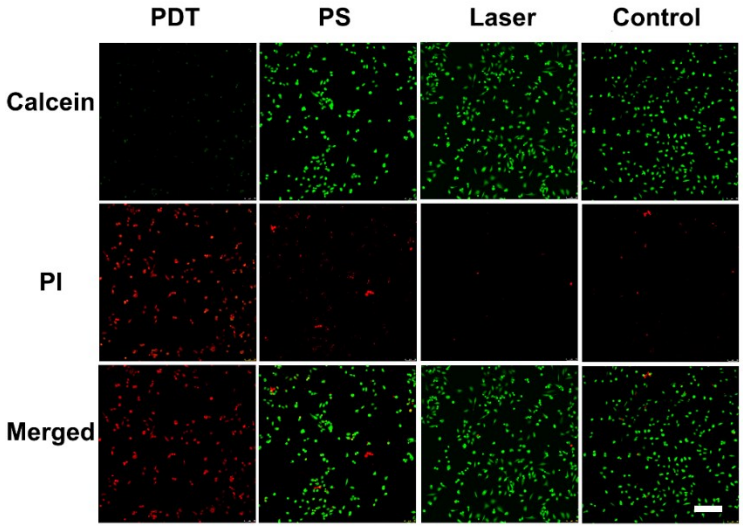

Figure S14. Viability of HeLa cells treated with/without cRGD-UCNP@TBD nanocomposite followed by light irradiation for 40 min (808 nm; 2.5 W/cm2) or only treated with cRGD-UCNP@TBD nanocomposite. [cRGD-UCNP@TBD] = 50 μg/mL based on TBD, [Calcein-AM] = 2 μM, [PI] = 2 μM. Calcein-AM (Ex: 488 nm; Em: 505-525 nm) and propidium iodide (PI) (Ex: 552 nm; Em: 605-625 nm). Scale bar: 200 μm.

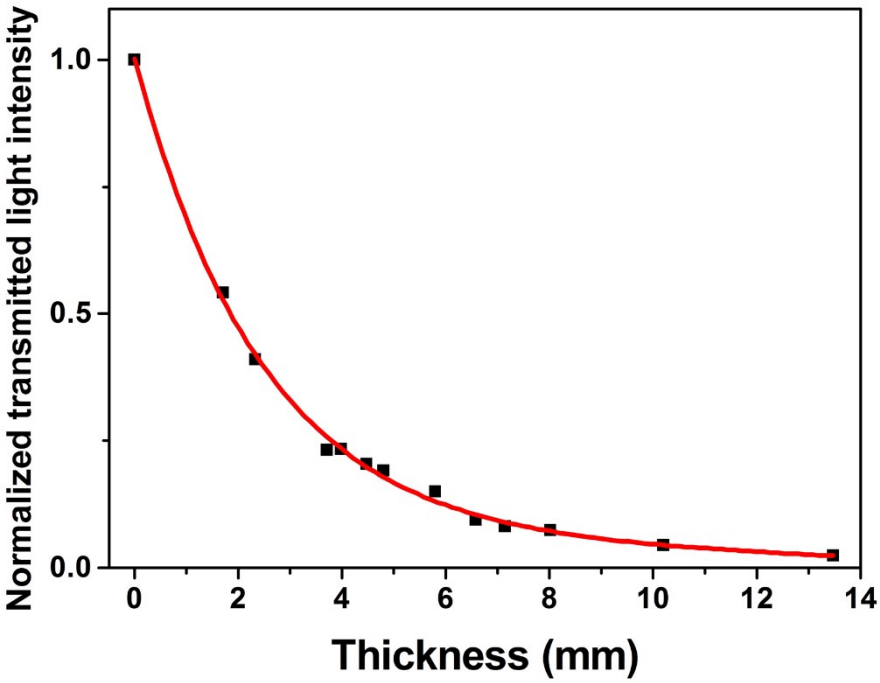

Figure S15. The normalized transmitted NIR light (808 nm) intensity at different thickness of chicken tissues.

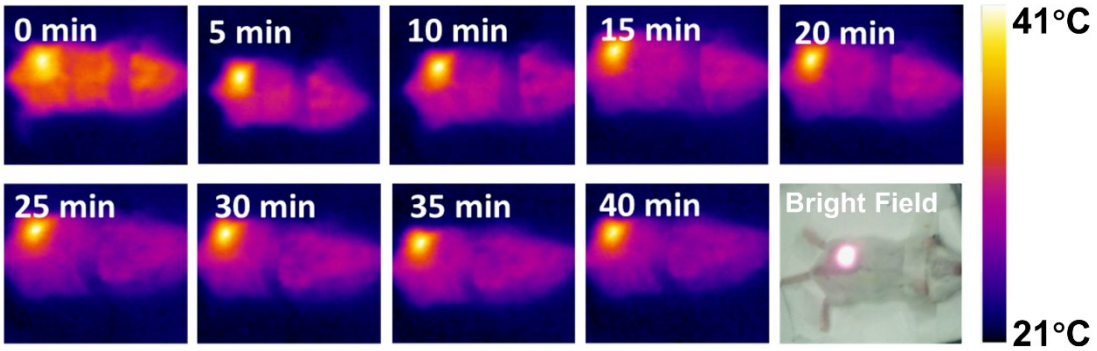

Figure S16. Temperature distribution of tumor-bearing mice treated with UCNP@TBD nanocomposite (10 mg/kg) and continuous laser irradiation (808 nm, 2.5 W/cm2). Max temperature: 40.4°C, min temperature: 21.7 °C.