Supporting Information

Polydopamine coated multifunctional lanthanide theranostic agent for vascular malformation and tumor vessel imaging beyond 1500 nm and imaging-guided photothermal therapy

Xiaolong Li,[a] *Mingyang Jiang,*[a] *Songjun Zeng* [a,]* *and Hongrong Liu* [a,]*

[a] School of Physics and Electronics and Key Laboratory of Low-dimensional Quantum Structures and Quantum Control of the Ministry of Education, Synergetic Innovation Center for Quantum Effects and Applications, Hunan Normal University, Changsha, Hunan 410081 (China)

* Address correspondence to songjunz@hunnu.edu.cn; hrliu@hunnu.edu.cn

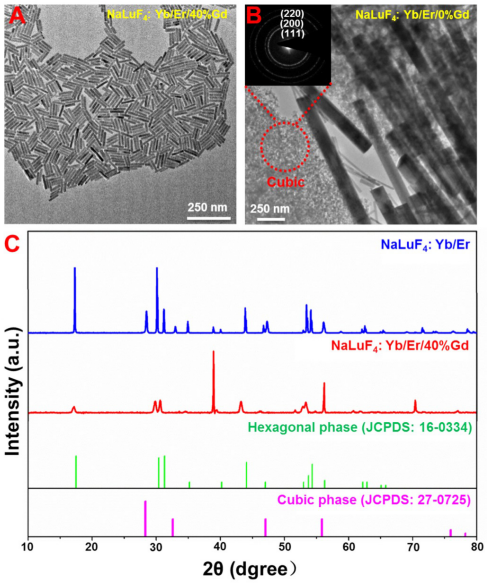

Figure S1. The typical TEM and XRD results of the as-prepared $NaLuF_4$: Yb/Er samples with/without doping Gd: (A) TEM image of $NaLuF_4$: Gd/Yb/Er. (B) TEM image of $NaLuF_4$: Yb/Er. (c) XRD patterns of the $NaLuF_4$: Yb/Er (blue line), and $NaLuF_4$: Gd/Yb/Er (red line). The inset of Figure S1B denotes the corresponding selected area electron diffraction pattern.

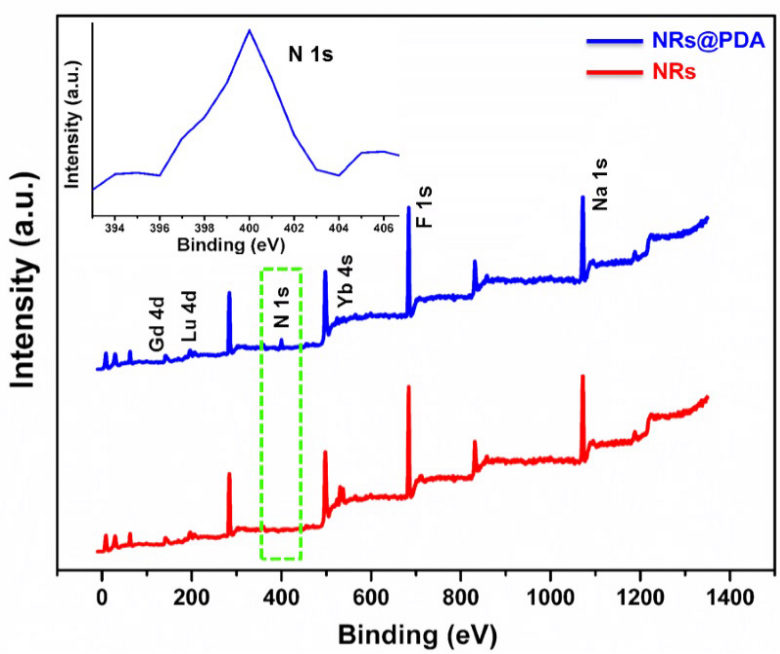

Figure **S2.** The XPS pattern of the as-prepared $NaLuF_4$: Gd/Yb/Er NRs and NRs@PDA and XPS N1s spectrum of NRs@PDA (the inset).

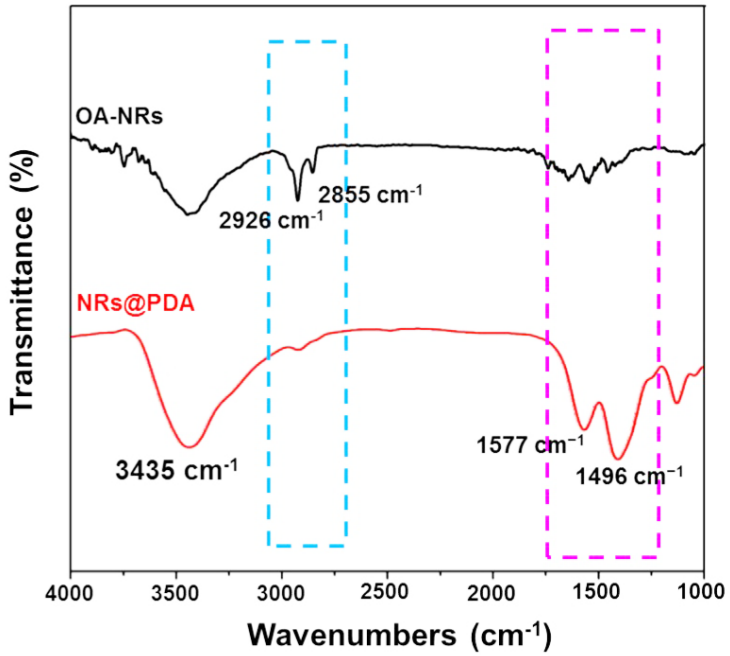

Figure S3. FTIR spectra of OA-$NaLuF_4$: Gd/Yb/Er NRs and NRs@PDA nanocrystals. The weak absorption peaks at 2926 and 2855 cm^{-1} are attributed to the asymmetric and symmetric stretching vibrations of the -CH_2 bond, respectively. The broader and stronger band centered at 3435 cm^{-1} is originated from the O-H group. The characteristic peaks at 1577 cm^{-1} and 1496 cm^{-1} are associated to the PDA.

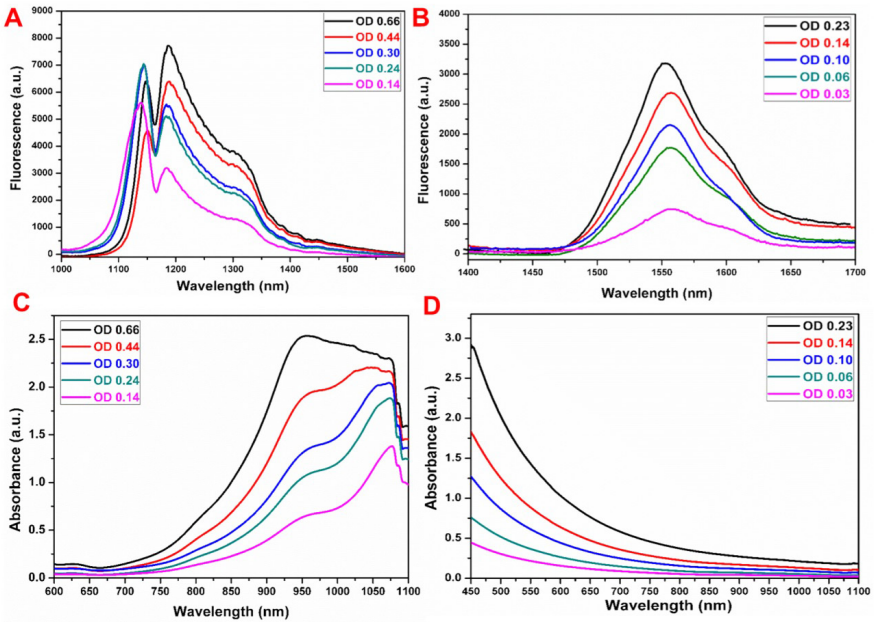

Figure S4. The emission spectra of (A) IR-26 and (B) NRs@PDA and the absorption spectra of (C) IR-26 and (D) NRs@PDA. The optical density (OD) in each absorption spectrum of IR-26 and NRs@PDA presents the absorbance value at 808 nm and 980 nm, respectively.

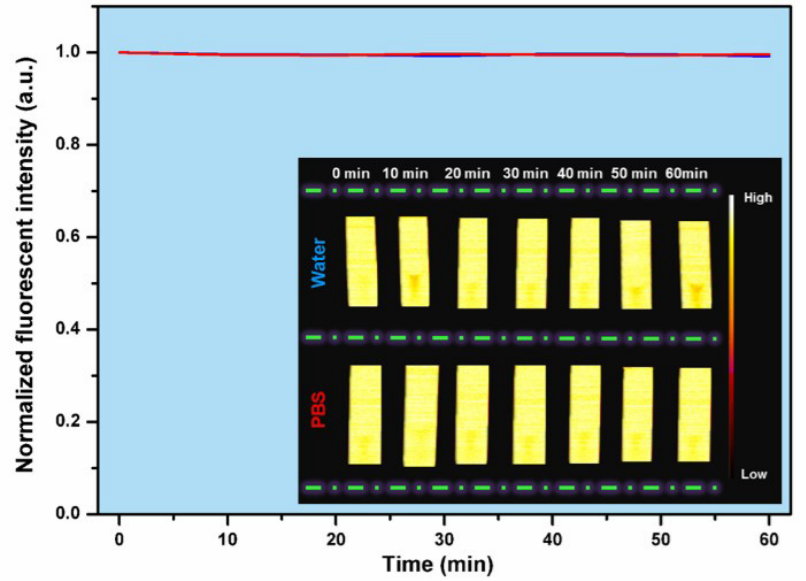

Figure S5. Photo-stability curve and in *vitro* phantom imaging (the inset picture) of $NaLuF_4$ NRs@PDA in water and PBS under continuous 980 nm laser irradiation with a power density of 0.6 W cm^{-2} at different time points.

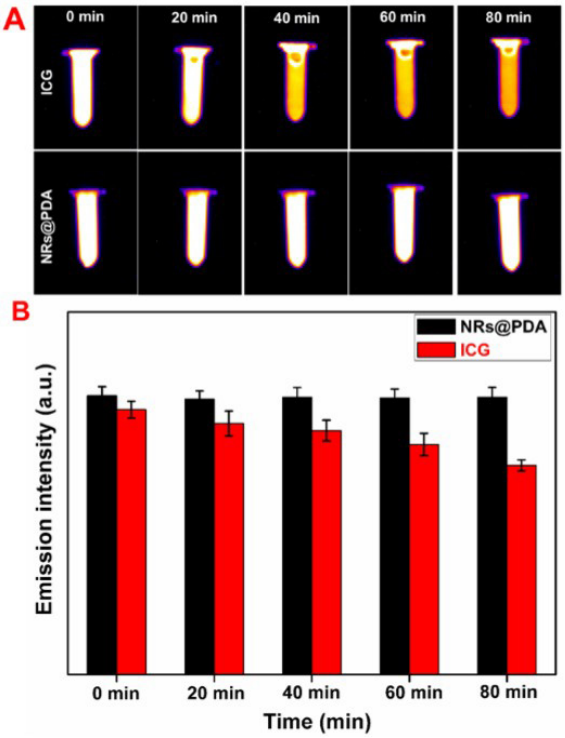

Figure S6. (A) The *in vitro* phantom imaging of ICG and NRs@PDA solutions after irradiation of 808 nm and 980 nm laser with different times, respectively. (B) The corresponding NIR-II fluorescent intensity.

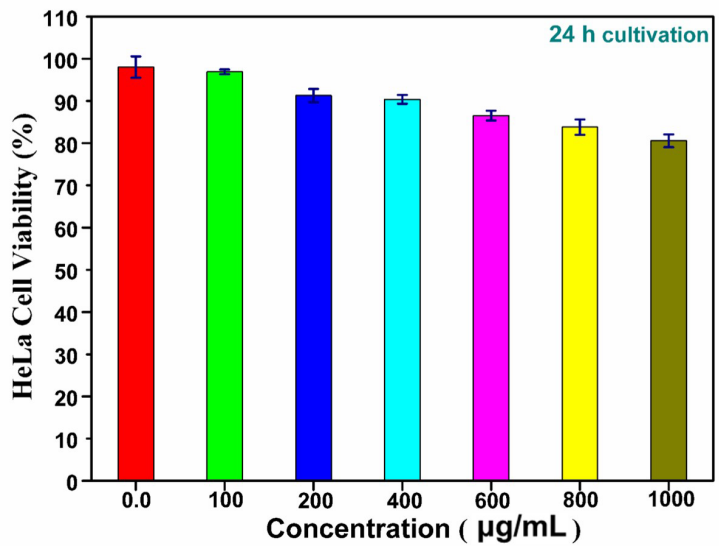

Figure S7. *In vitro* HeLa cells viability after incubated with various concentrations of $NaLuF_4$ NRs@PDA for 24 h at 37 °C under 5% CO_2.

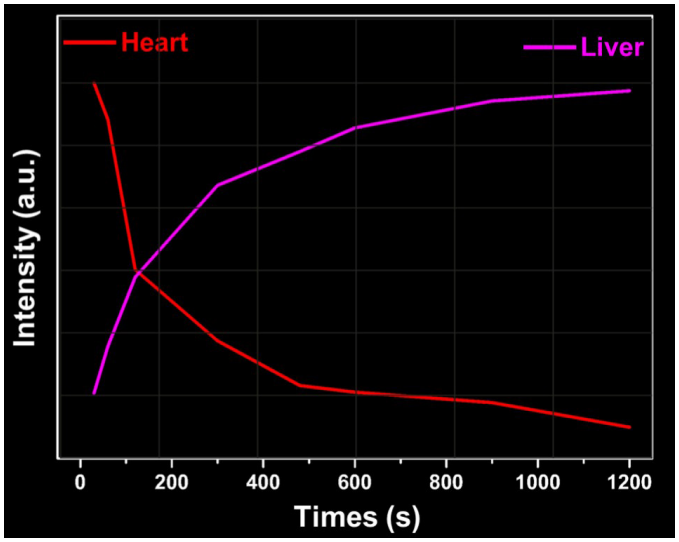

Figure S8. The time-dependent average signal intensity changes in liver and heart sites of tumor mouse.

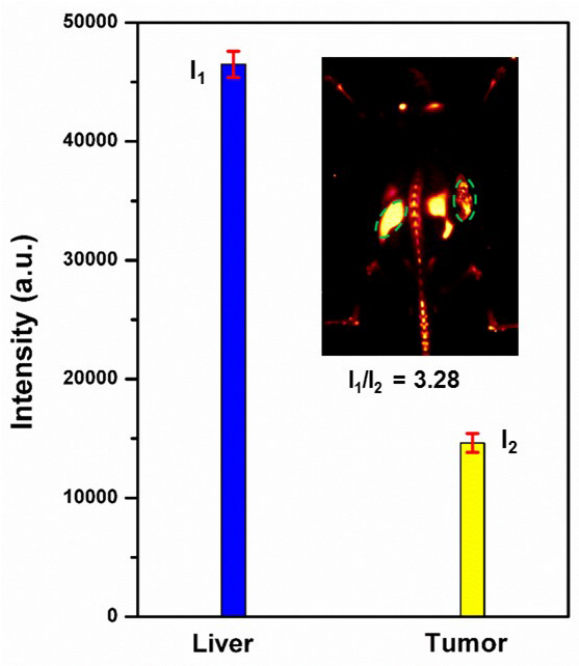

Figure S9. The corresponding NIR-II fluorescent intensity of the liver and tumor after 60 h intravenous injection with $NaLuF_4$ NRs@PDA under 980 nm laser excitation.

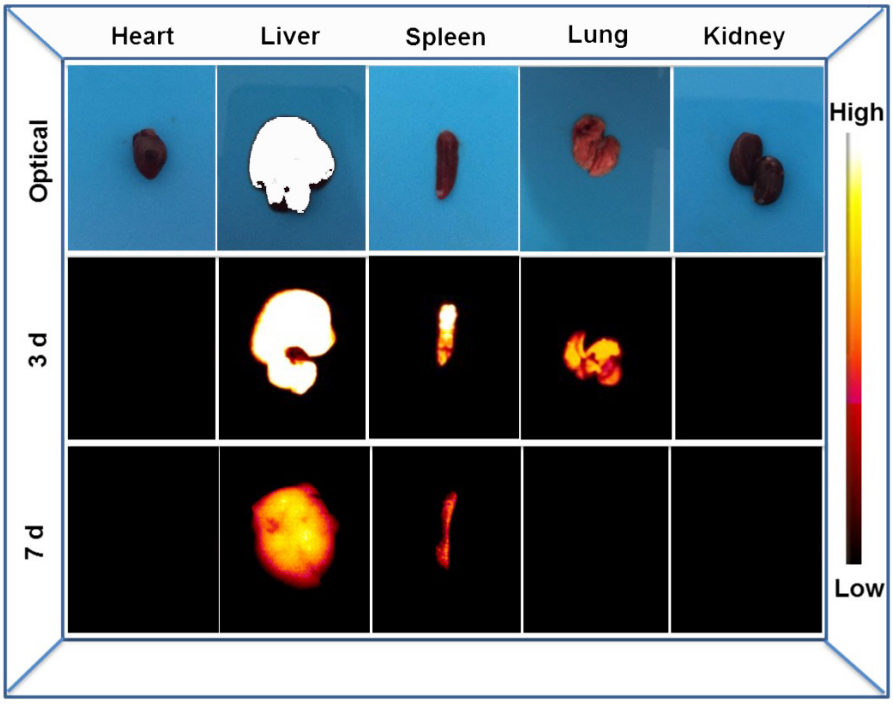

Figure S10. *Ex vivo* bioimaging of the isolated organs, including heart, liver, spleen, lung, and kidney after 3 and 7 days injection with $NaLuF_4$ NRs@PDA.

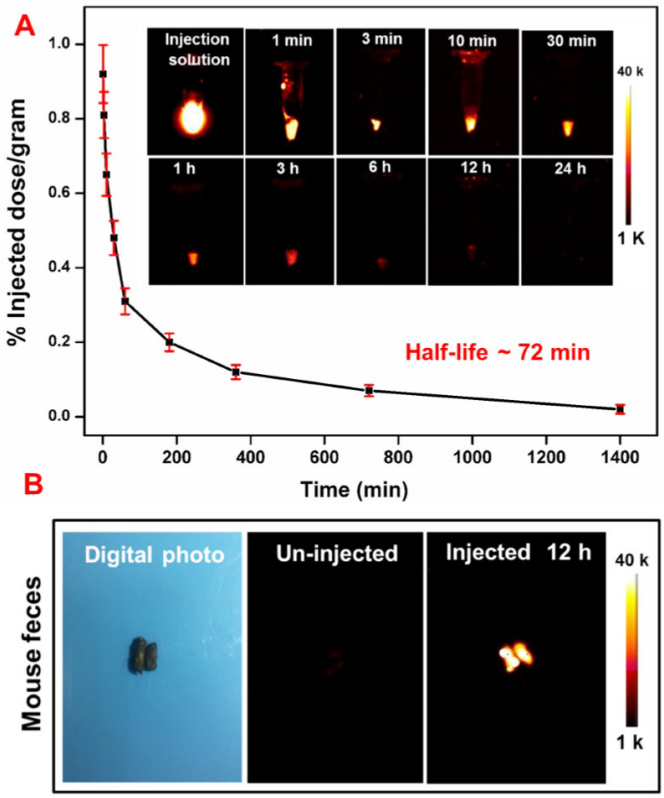

Figure S11. (A) Time dependent $NaLuF_4$ NRs@PDA contents in blood (based on the tested fluorescence intensity). The inset presents the corresponding *in vitro* NIR-II imaging of blood after intravenous injection of $NaLuF_4$ NRs@PDA in 24 h under 980 nm laser excitation (100 mW/cm^2). (B) Digital photography, *in vitro* imaging of feces from un-injected and injected mouse.

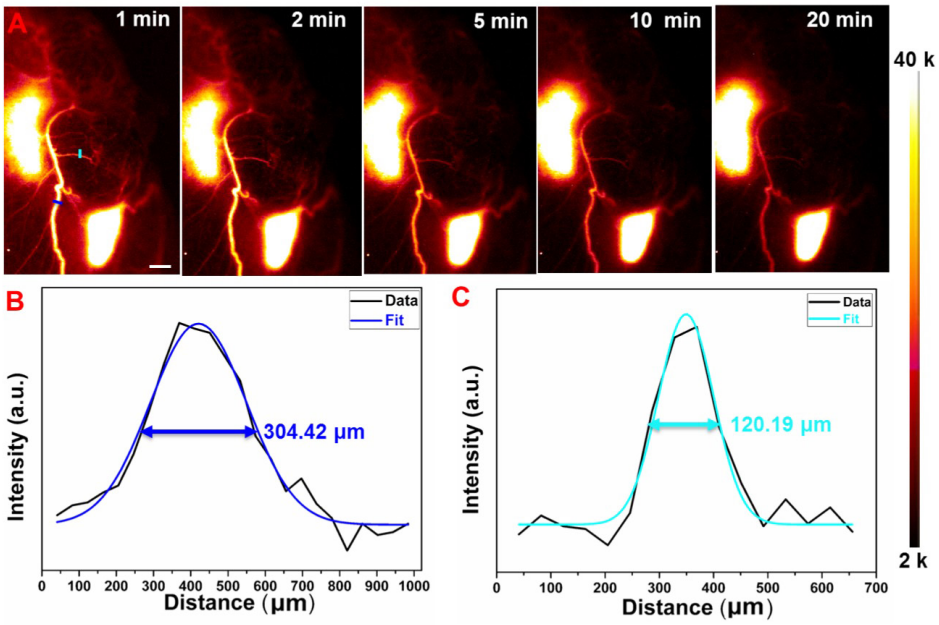

Figure S12. (A) A time course of high-magnification tumor vascular imaging with FOV of 26 mm × 21 mm. (B) and (C) Cross-sectional intensity profiles along the colour lines marked in (A). The scale bar is 2 mm.

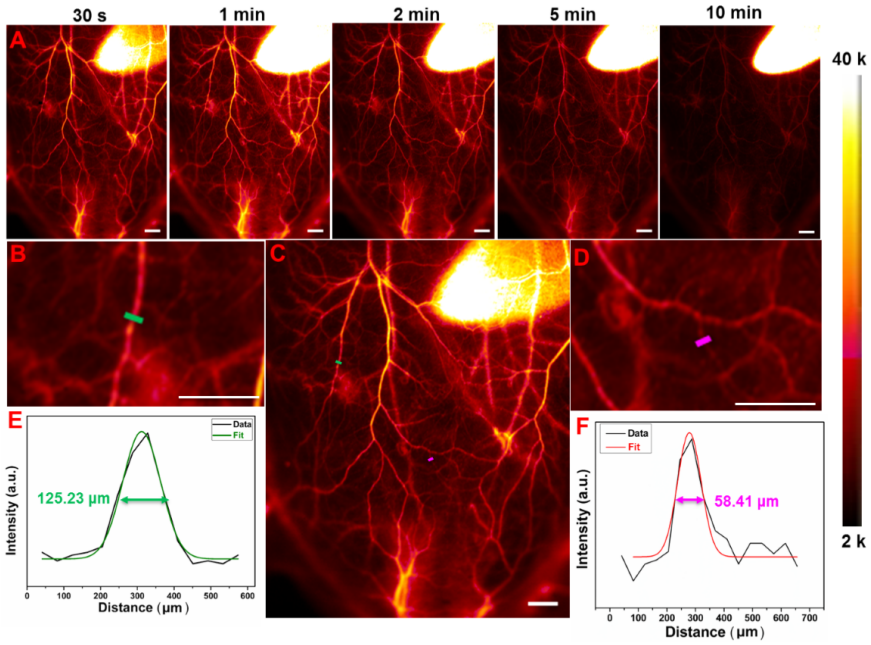

Figure S13. (A) High-magnification NIR-II vessel image of mouse abdomen under the 980 nm laser excitation (FOV: 21 mm × 26 mm, 512 × 640 pixels, 41 μm/pixel). (C) A typical abdomen vessel image taken from (A). (B) and (D) The corresponding zoom-in images of the chosen vessels. (E) and (F) Cross-sectional intensity profiles measured along the colorized lines from the images of (B) and (D), respectively. All scale bars are 2 mm.

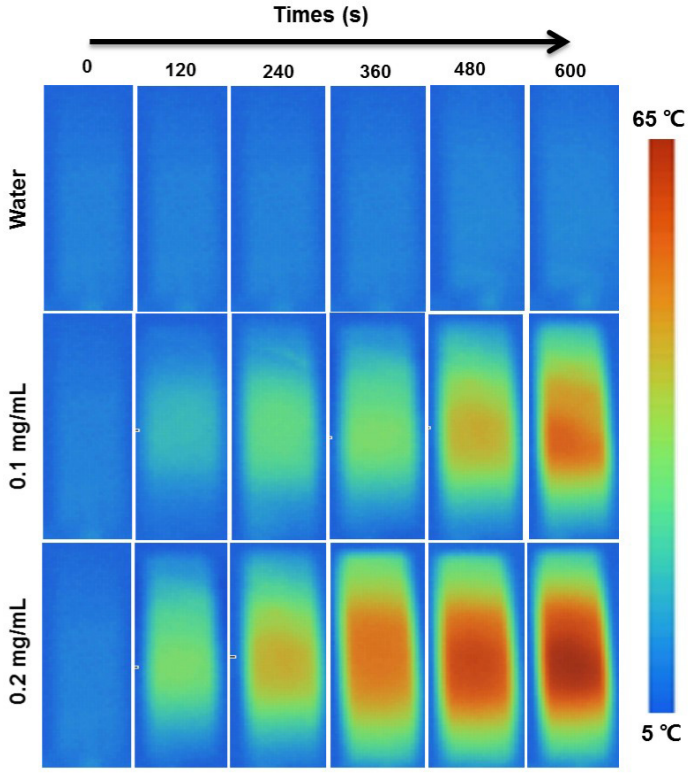

Figure S14. *In vitro* thermal images based on NRs@PDA solution with different concentrations under the irradiation of 808 nm laser.

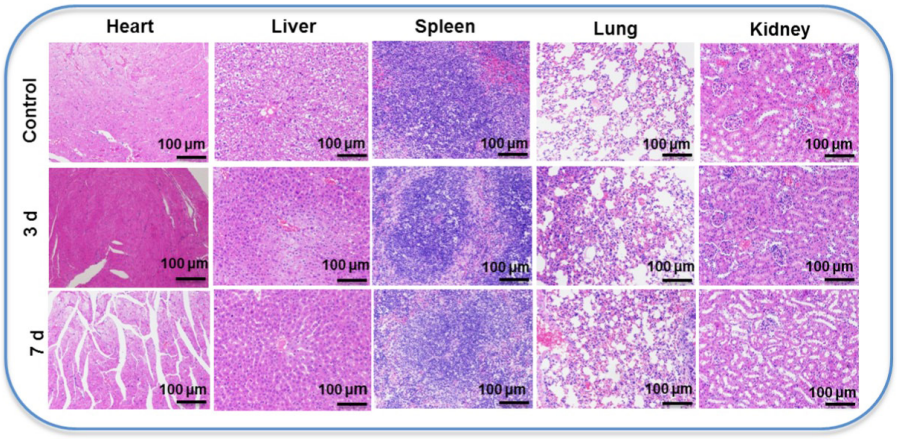

Figure S15. H&E stained main tissues collected from control and experiment mouse injected with NRs@PDA solution for 3 and 7 days.