

Near-Infrared Excited Orthogonal Emissive Upconversion Nanoparticles for Imaging-Guided On-Demand Therapy

Ming Tang^{†,‡}, Xiaohui Zhu^{*,†}, Yuehong Zhang[†], Zeping Zhang[‡], Zhiming Zhang[†], Qingsong Mei[§], Jing Zhang[†], Minghong Wu[†], Jinliang Liu^{*,†}, Yong Zhang^{*,†,¶}

[†] School of Environmental and Chemical Engineering, Shanghai University, Shanghai, China, 200444.

[‡] School of Life Sciences, Shanghai University, Shanghai, China, 200444.

[§] School of Biological and Medical Engineering, Hefei University of Technology, Hefei, China, 230009.

[¶] Department of Biomedical Engineering, Faculty of Engineering, National University of Singapore, Singapore 117583.

Corresponding Author:

*E-mail: xhzhu@shu.edu.cn; liujl@shu.edu.cn; biezy@nus.edu.sg

Supplementary Information

Supporting Information is available free of charge on ACS Publication website. The Supporting Information PDF contains Figure S1-S6, which depict additional results.

Supporting Figure Captions

Figure S1. X-ray diffraction (XRD) patterns of NaErF₄:Yb/Tm core **(a)**, NaErF₄:Yb/Tm@NaYF₄:Yb core-shell **(b)** and NaErF₄:Yb/Tm@NaYF₄:Yb@NaNdF₄:Yb core-shell-shell **(c)** nanoparticles. The XRD patterns of β-NaErF₄ is used as reference for comparison.

Figure S2. (a-c) TEM images of NaErF₄:Yb/Tm@NaYF₄:Yb@NaYF₄:10%Yb, xNd UCNPs with different Nd³⁺ concentrations in the NaYF₄:10%Yb, x%Nd outer shell: x=0, 45, and 90. **(d)** The intensity ratio of green to red upconversion emission at 808 nm with different Nd³⁺ concentrations in the NaYF₄:10%Yb, x%Nd outer shell: x=0, 45, and 90.

Figure S3. (a). UV-Vis absorption spectra of standard ZnPc solutions with different concentrations (10μg/mL, 7.5μg/mL, 5.0μg/mL, 2.5μg/mL and 1.25μg/mL). **(b).** The calibration curve (concentration vs. absorbance) was fitted by unweighted least-squares linear regression.

Figure S4. UV-Vis absorption spectra of supernatants of UCNPs@mSiO₂-ZnPc nanophotosensitizers collected by centrifugation after they were soaked in deionized water, PBS buffer, ethanol and cell culture medium (DMEM) for 24 hours.

Figure S5. (a). Flow cytometric analysis of intracellular ROS for different groups: group 1: A549 cells with DCFH-DA (control), group 2: A549 cells incubated with UCNPs@mSiO₂-ZnPc without laser irradiation, group 3: A549 cells incubated with UCNPs@mSiO₂-ZnPc under 808 nm laser irradiation for 10 min (235 mW/cm²) and group 4: A549 cells incubated with UCNPs@mSiO₂-ZnPc under 980 nm laser irradiation for 10 min (608 mW/cm²). The generation of intracellular ROS was monitored by an increase in fluorescence of DCF **(b)**.

Figure S6. *In vivo* UCL imaging of A549 tumor-bearing mice with UCNPs@mSiO₂-ZnPc under 808 and 980 nm laser lights.

Figure S1

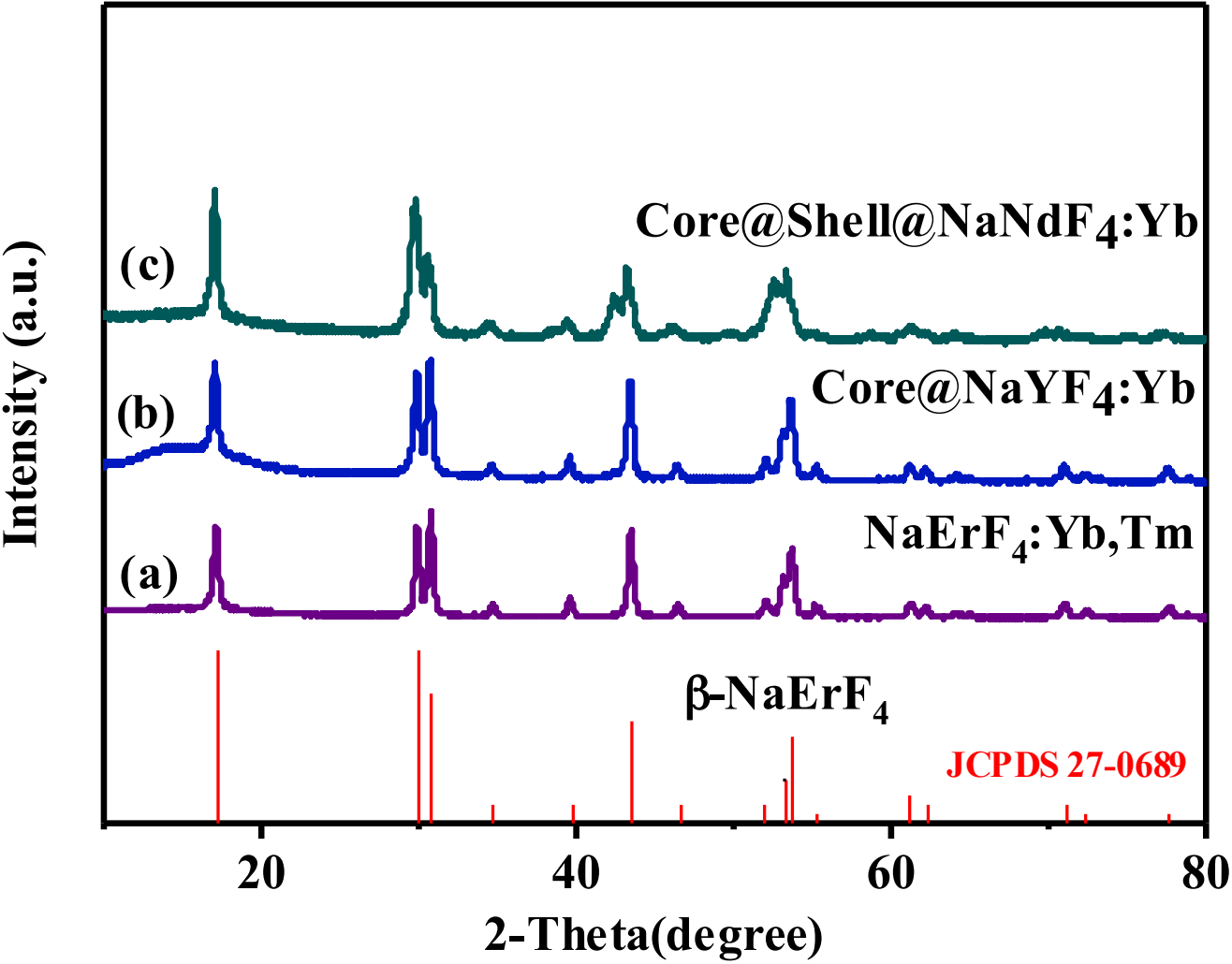


Figure S2

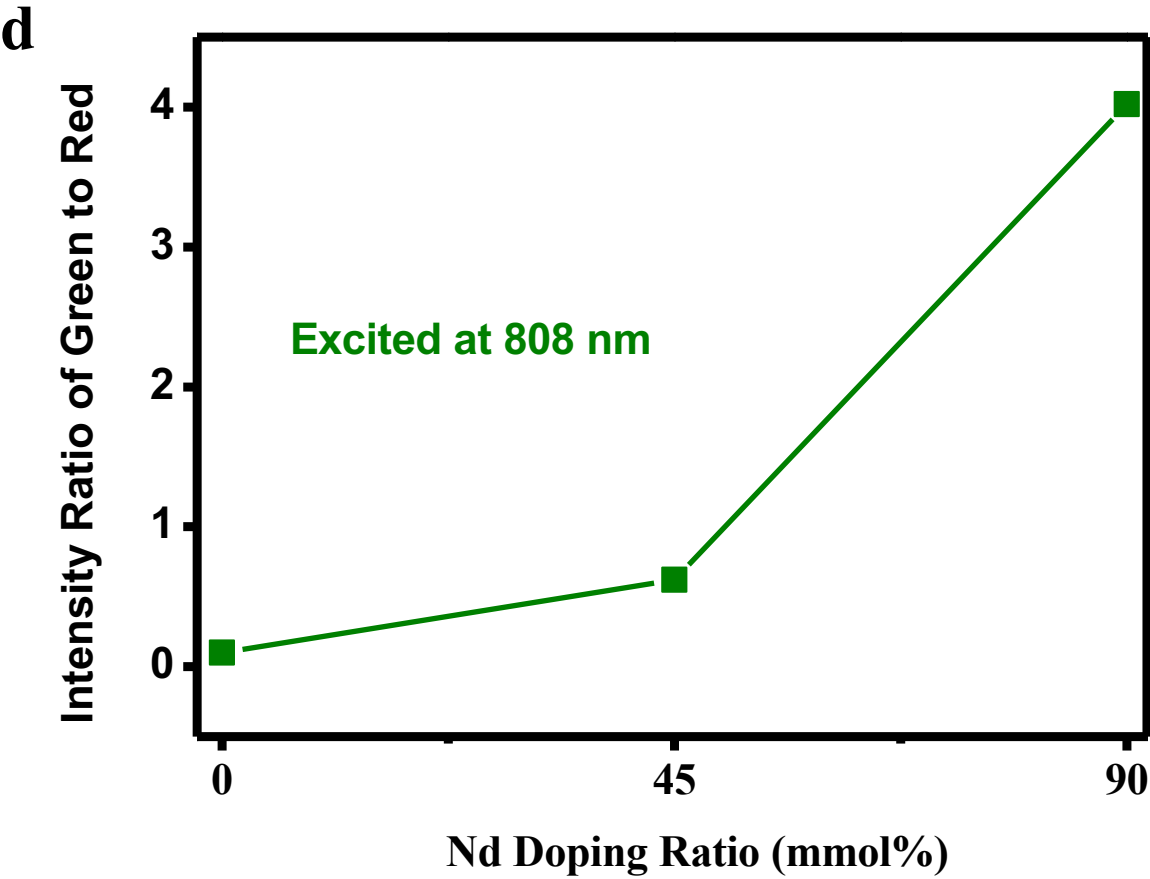
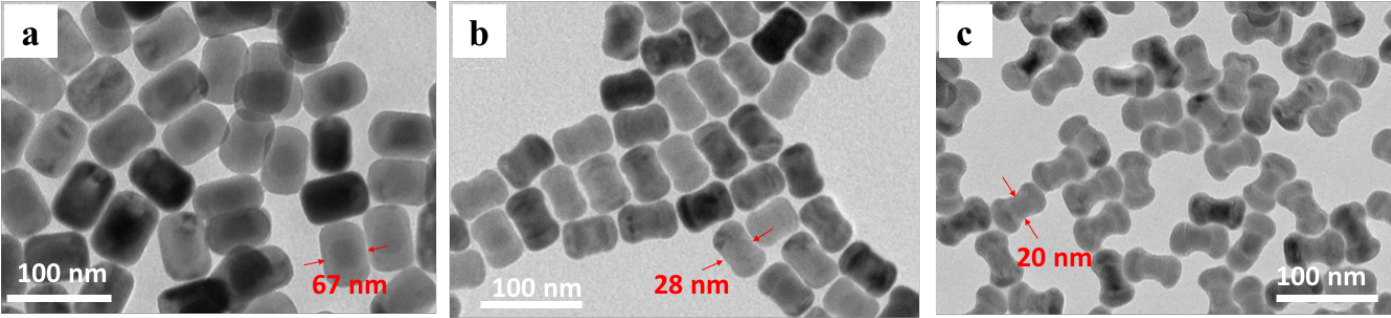
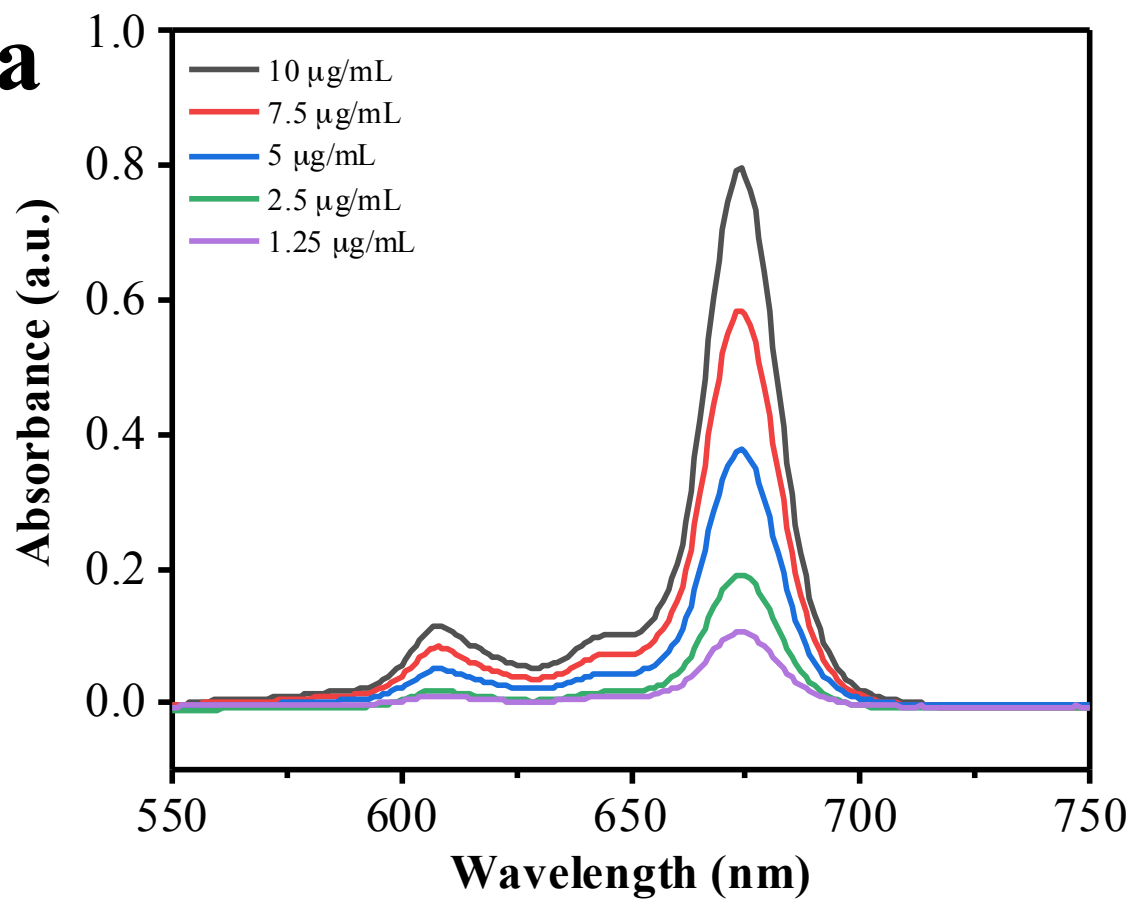


Figure S3

a



b

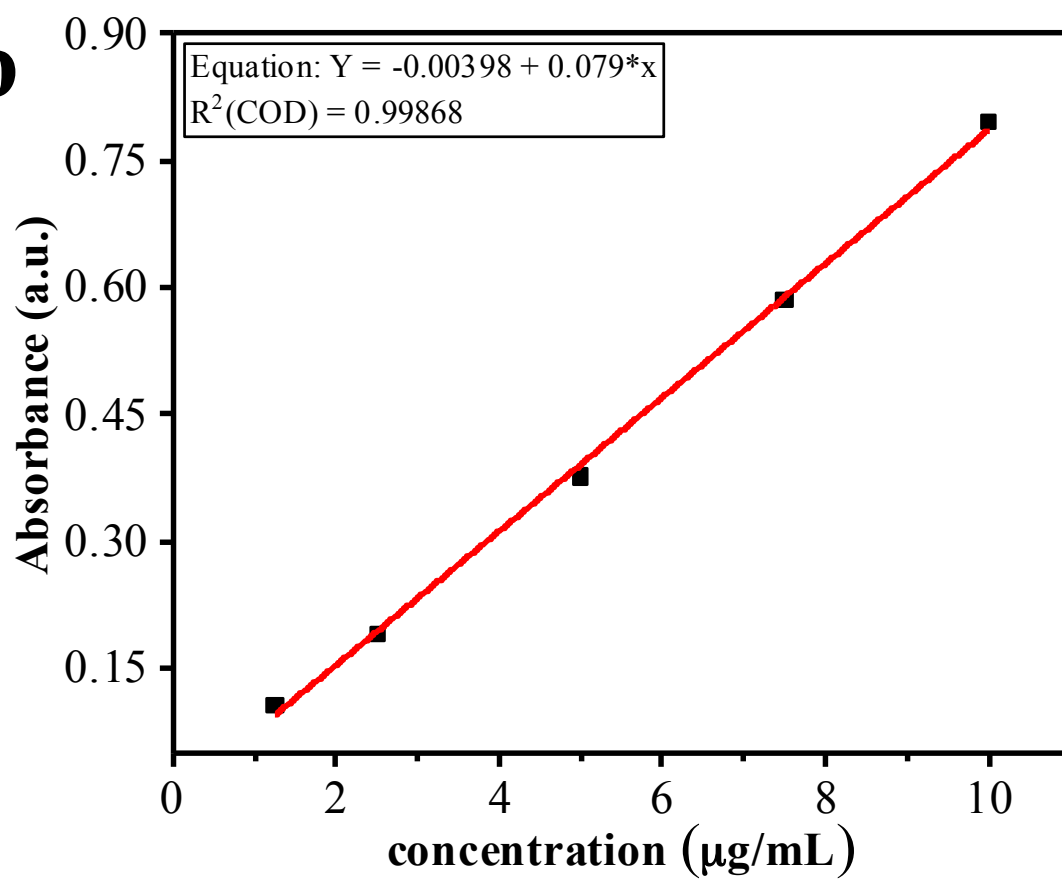


Figure S4

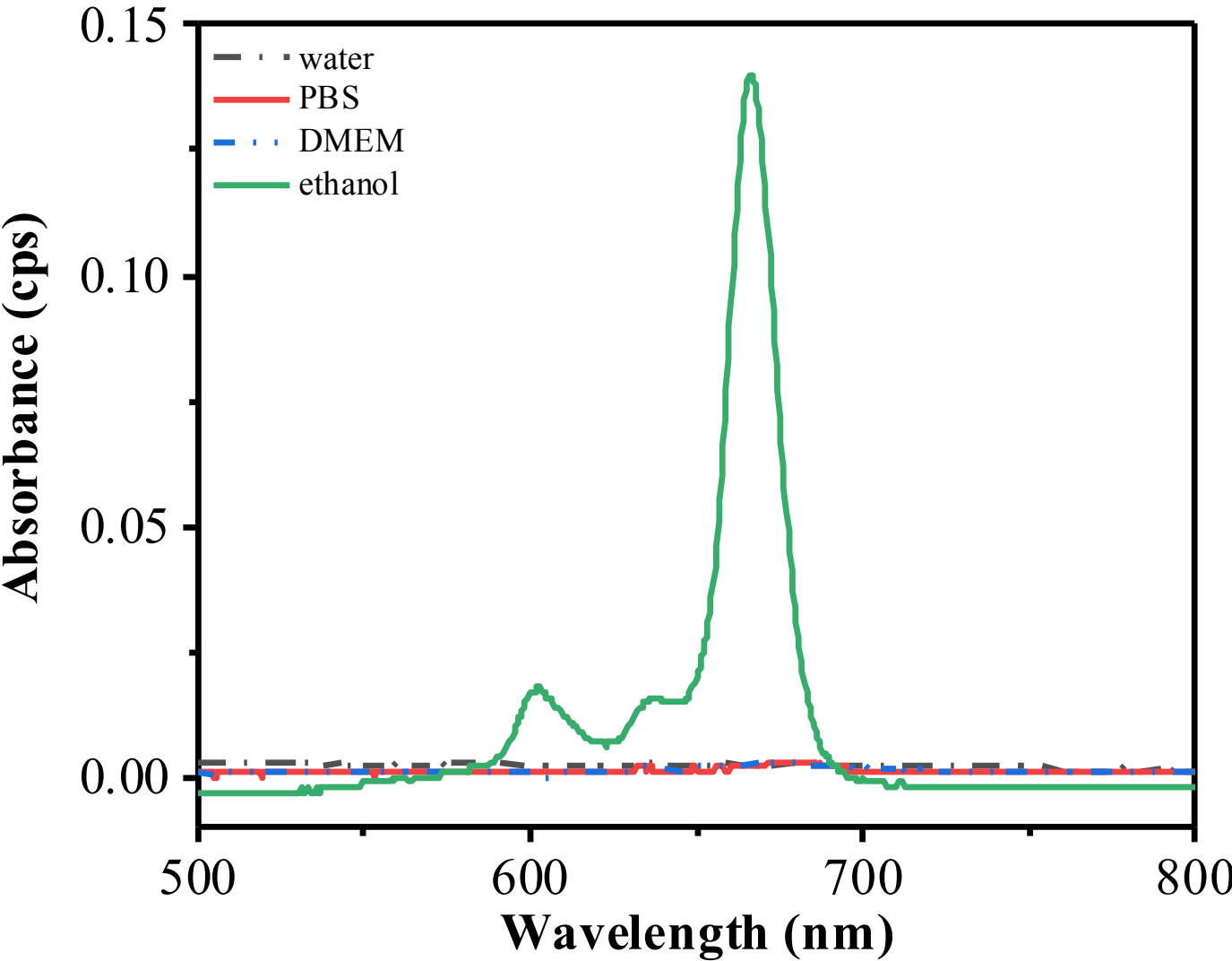
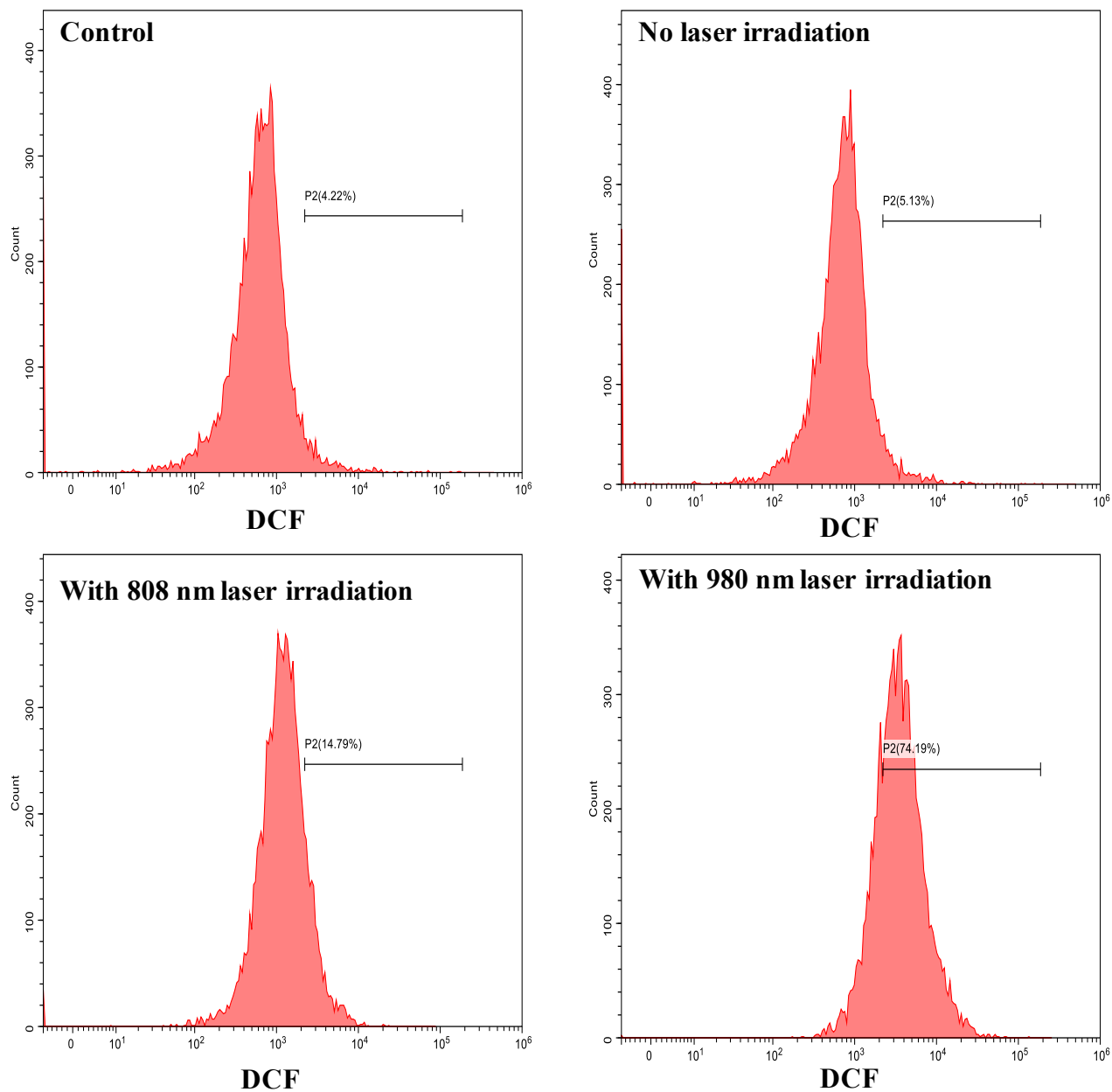


Figure S5

a



b

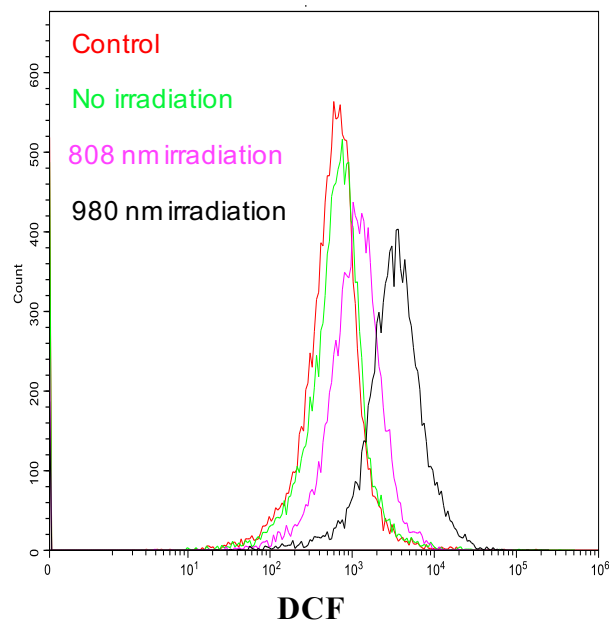


Figure S6

