

Photoswitchable upconversion nanophosphors for small animal imaging *in vivo*

Tianshe Yang,^a Qian Liu,^a Jiachang Li,^a Shouzhi Pu,^{*b} Pengyuan Yang^{*c} and Fuyou Li^{*a}

^a Department of Chemistry & The State Key Laboratory of Molecular Engineering of Polymers, Fudan University, Shanghai, 200433, P. R. China. E-mail: fyli@fudan.edu.cn

^b Jiangxi Key Laboratory of Organic Chemistry, Jiangxi Science and Technology Normal University, 605 Fenglin Avenue, Nanchang, Jiangxi, 330013, P. R. China. E-mail: pushouzhi@yahoo.com.cn

^c Department of Chemistry & Institute of Biomedical Science, Fudan University, Shanghai, 200433, P. R. China. Email: pyyang@fudan.edu.cn

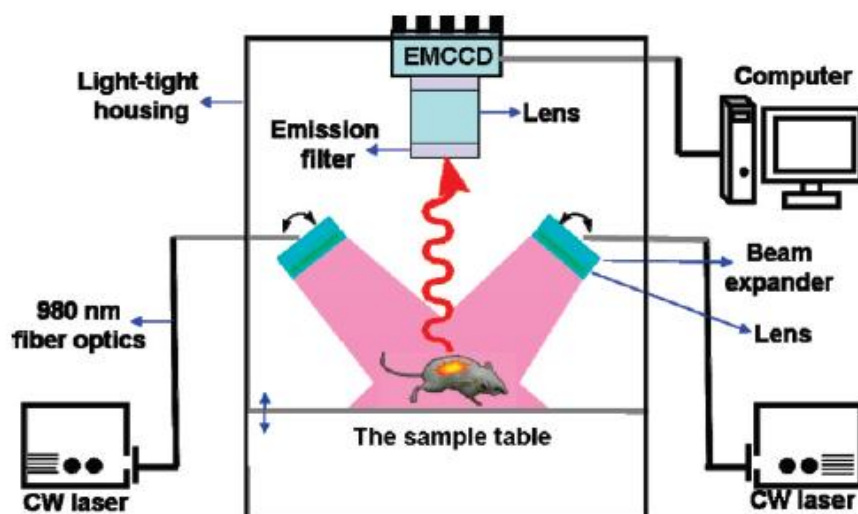


Figure S1. Diagram depicts the experimental setup for the upconversion luminescence *in vivo* imaging system designed by our group. Two external 0-5 W adjustable CW 980 nm lasers were used as the excitation sources, and an Andor DU897 EMCCD was used as the signal collector.^[1-2]

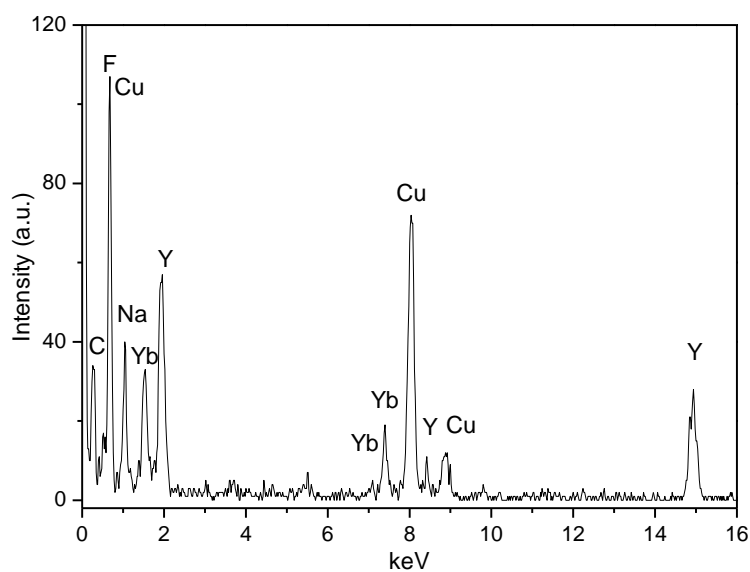


Fig. S2 EDXA of OA-NaYF₄:Yb,Er,Tm. A minor doped ion of Er³⁺ and Tm³⁺ cannot be found due to its low content (only 2 mol% Er³⁺ and 1% Tm³⁺ in rare earth elements). The presence of Cu elemental results from copper grid during TEM measurements.

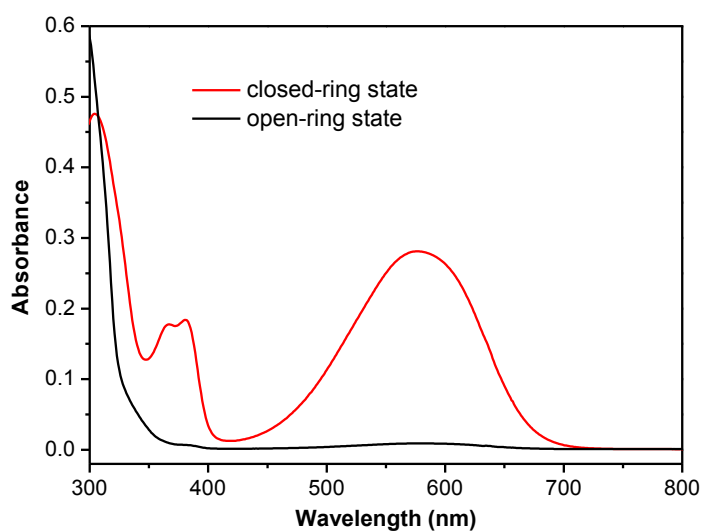


Fig. S3 Absorption spectra of the polymer embedded DTE in aqueous solution upon alternate irradiation of UV (DTE-c, red line) and visible light (DTE-o, black line).

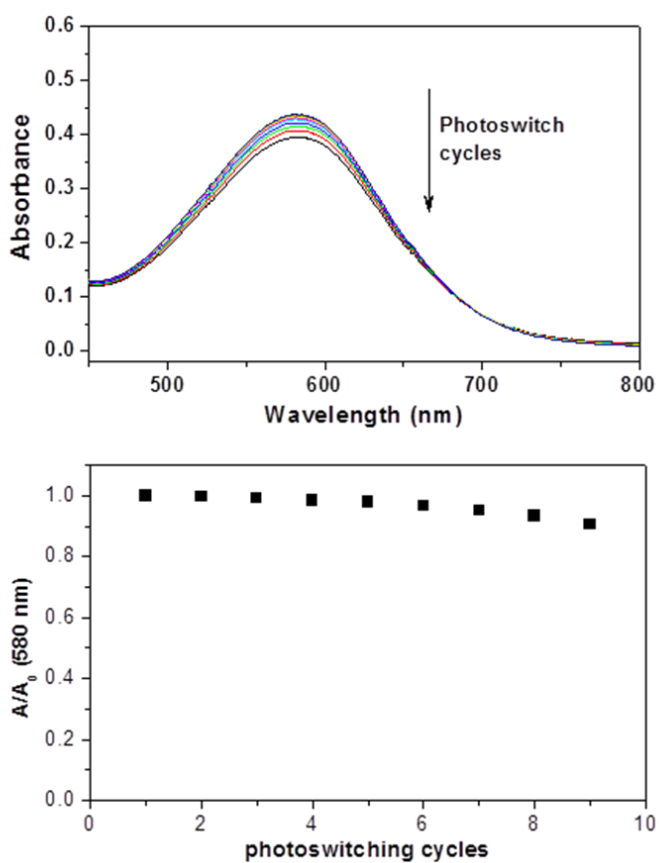


Fig. S4 The change of absorption peak at 580 nm for DTE-c in polymer NPs with the photoswitching cycles.

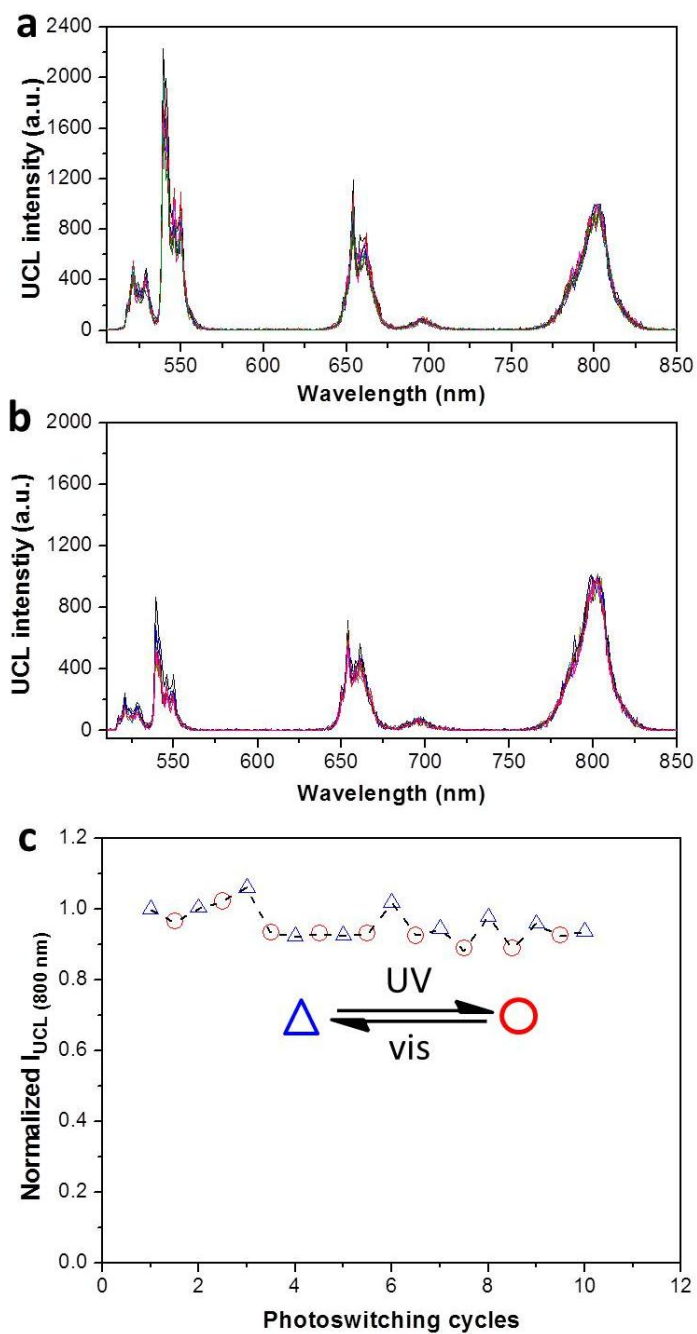


Fig. S5. (a-b) UCL spectra of ps-UCNPs in aqueous solution under 980 nm excitation after alternate irradiation of visible (a, DTE-o) and UV light (b, DTE-c), (c) UCL at 800 nm maintained unchanged under reversible photoswitching experiments.

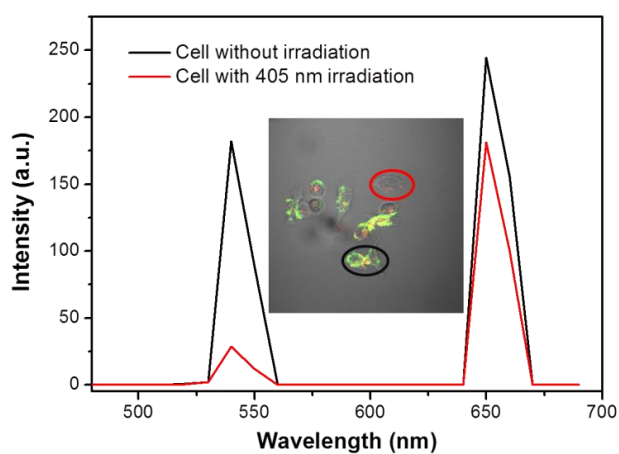


Fig. S6 Upconversion luminescence spectra obtained from live KB cells incubated with ps-UCNPs for the selected cell with and without UV illumination.

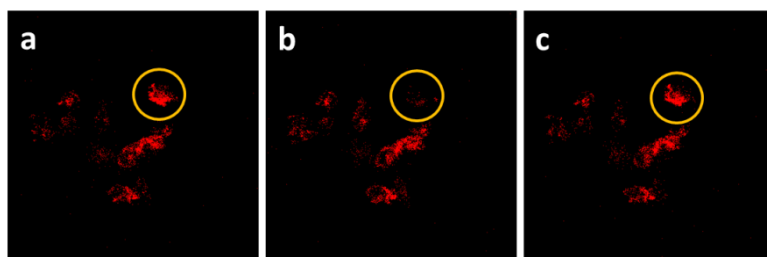


Fig. S7 UCL images of living KB cells showed the signal change of the red channel (630-670 nm) with photoswitchable modulation, (a) Initial UCL images of living cells; (b) UCL images of living cells with 405 nm light irradiation for selected cell (orange loop); (c) UCL images of living cells with 543 nm visible light irradiation for selected cell (orange loop).

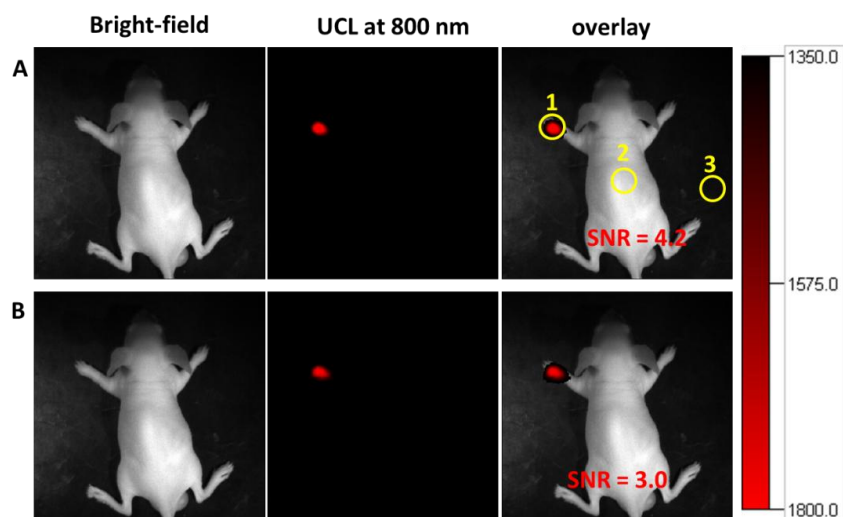


Fig. S8. *In vivo* imaging displayed the UCL at 800 nm emission maintain stable with visible light photoreversion of DTEs, with photochromism of ps-UCNPs. $SNR = [(mean\ fluorescence\ intensity\ of\ the\ specific\ uptake, 1) - (mean\ fluorescence\ intensity\ of\ background, 3)] / [(mean\ fluorescence\ intensity\ of\ the\ nonspecific\ uptake, 2) - (mean\ fluorescence\ intensity\ of\ background\ 3)]$.

Reference

1. L. Q. Xiong, Z. G. Chen, Q. W. Tian, T. Y. Cao, C. J. Xu, F. Y. Li, *Anal. Chem.*, 2009, **81** (21), 8687.
2. Q. Liu, W. Feng, T. S. Yang, T. Yi, F. Y. Li, *Nat. Protoc.*, 2013, **8** (10), 2033