Supporting Information

Reversible Light-controlled Fluorescence Switch of Block Polymer-Grafted Carbon Dots and Its Using in Cellular Imaging

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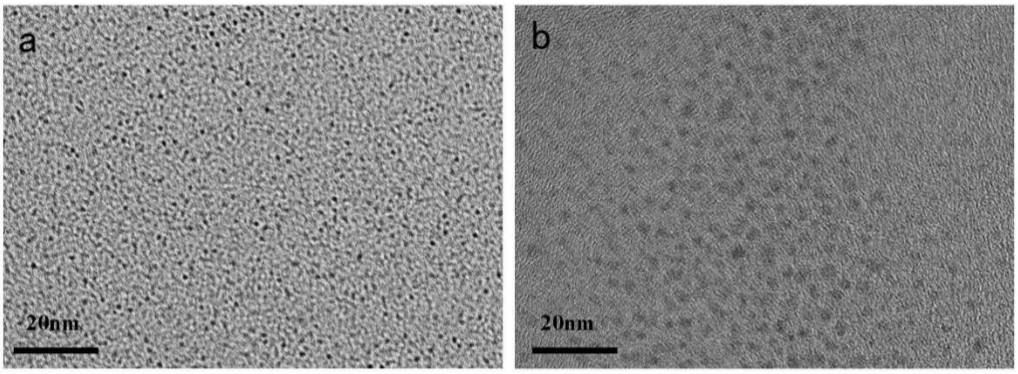


Fig. S1. The TEM images of the CDs (a) and CD-g-poly((TPE-co-SPA)-block-NIPAM) nanoparticles (b).

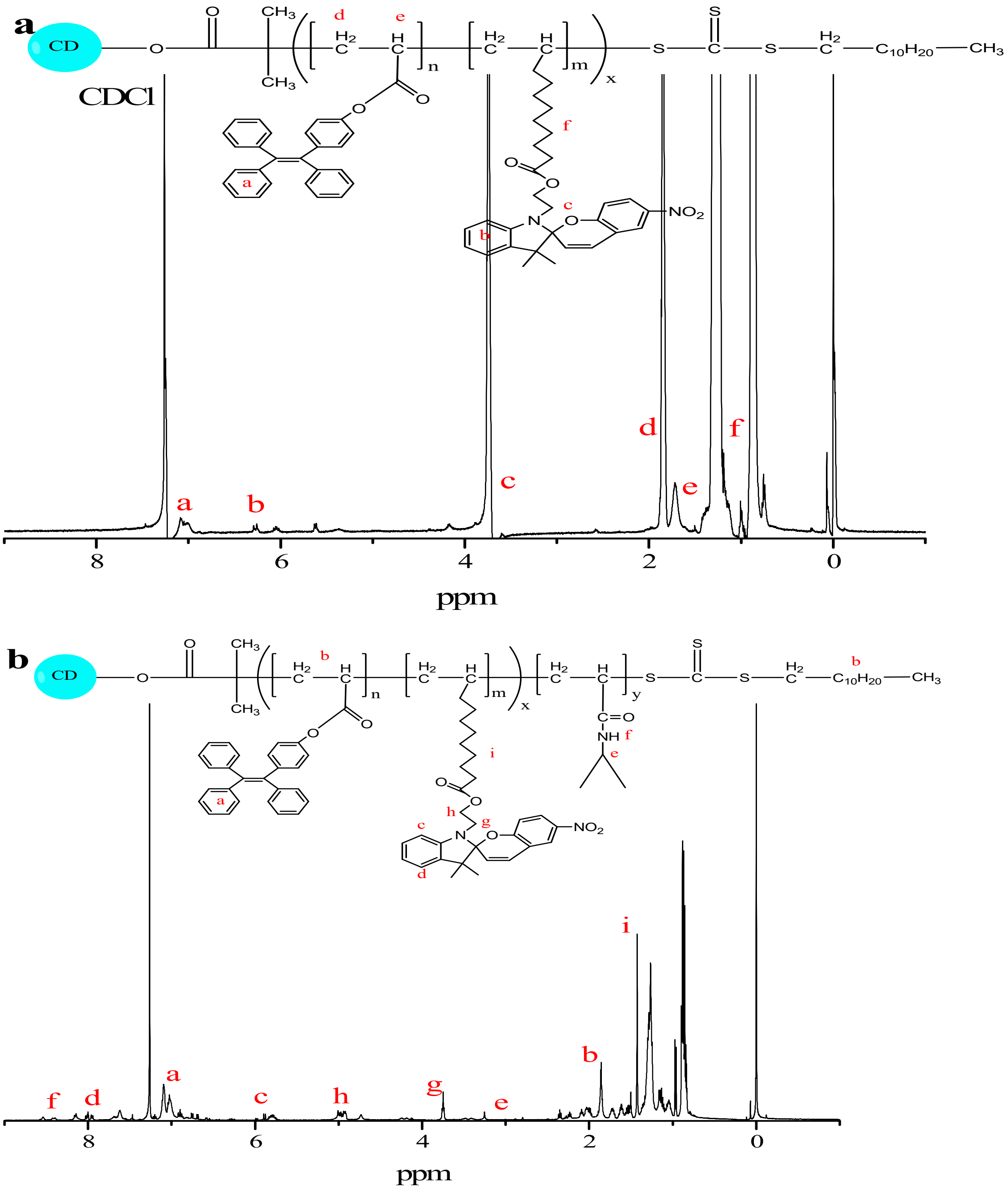


Fig. S2. The ^{1}H NMR spectrum of CD-g-poly(TPE-co-SPA) (a) and CD-g-poly((TPE-co-SPA)-block-NIPAM) (b) in CDCl.

The signals located at 6.92-7.15 ppm are attributed to the protons of benzene groups of TPE units. The peaks at 1.52-2.20 ppm and 2.11-2.31 ppm are from the protons signals on the main chain of the polymer. The signals located in 5.65-5.82 ppm, 3.63

and 4.31 ppm should be from the protons of double bonded on six-membered ring and acyloxy of SPA, respectively. While the peaks at 1.19-2.32 ppm should be from the protons of undecylenoyl chloride. The protons signals of nitrogen-hydrogen bond of NIPAM can be seen at 8.14 ppm in the CD-g-poly((TPE-SPA)-block-NIPAM) ^{1}H NMR spectrum. It indicates that the polymer of NIPAM was successfully grafted to copolymer of TPE and SPA on the surface of CD-g-poly(TPE-co-SPA).

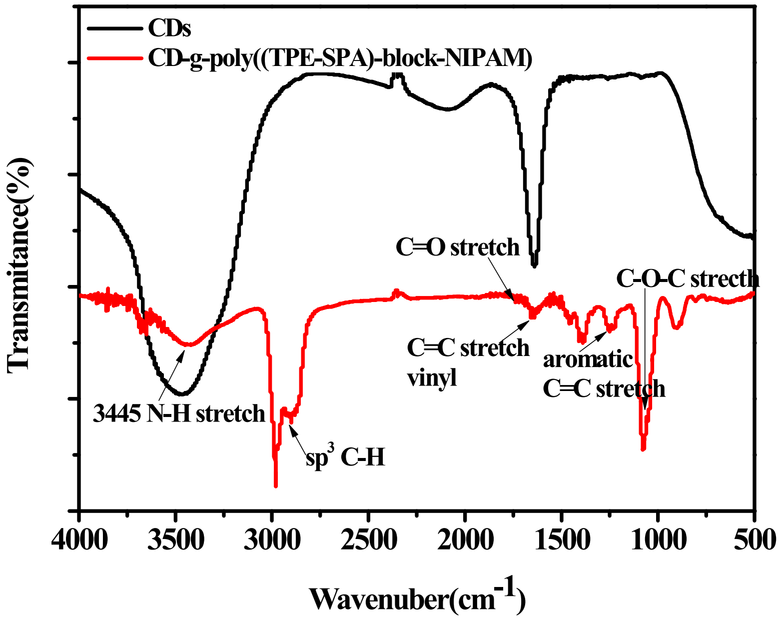


Fig. S3. The FT-IR spectra of CDs (black line) and CD-g-poly((TPE-co-SPA)-block-NIPAM) (red line).

The peaks located at 3445 cm^{-1} are attribute to the stretch of -NH of NIPAM unit. The peaks located in 2995-2855 cm^{-1} are from the stretch of sp^3 C-H of SPA unit. The signals located at 1725 cm^{-1} and 1142 cm^{-1} should be from the stretch of C=O and C-O-C of SPA unit. The aromatic C=C stretch of TPE unit could be observed at 1265 cm^{-1} and 1243 cm^{-1} .While the peaks located at 1605 cm^{-1} are from C=C stretch vinyl of TPE [1]. It demonstrate the block polymer have grafted at the surface of CDs.

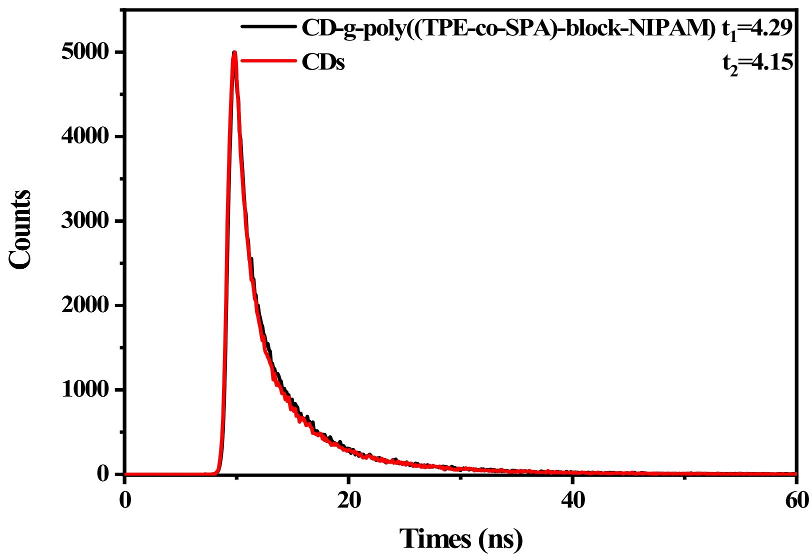


Fig. S4. Time resolved fluorescence spectra of CDs and CD-g-poly((TPE-co-SPA)-block-NIPAM) nanoparticles dispersed in THF with the excitation wavelength at 405 nm and the emission wavelength at 465 nm.

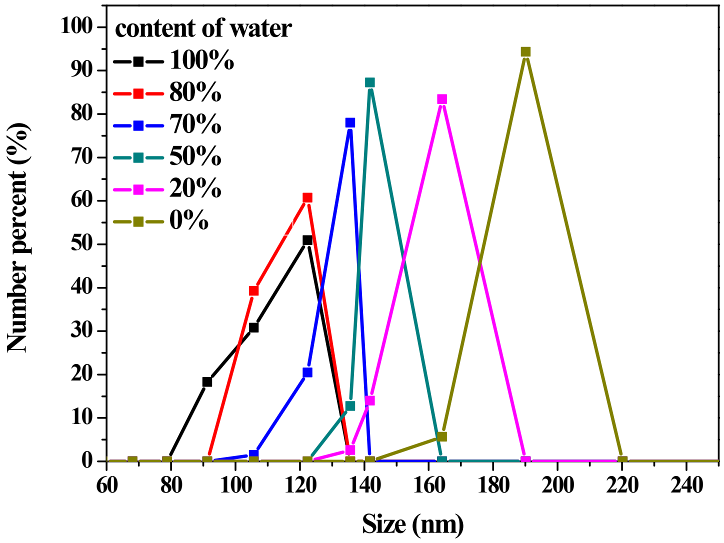


Fig. S5. The hydrodynamics size distribution of the CD-g-poly(TPE-co-SPA)-block-NIPAM) nanoparticles dispersed in water/THF with different content of water.

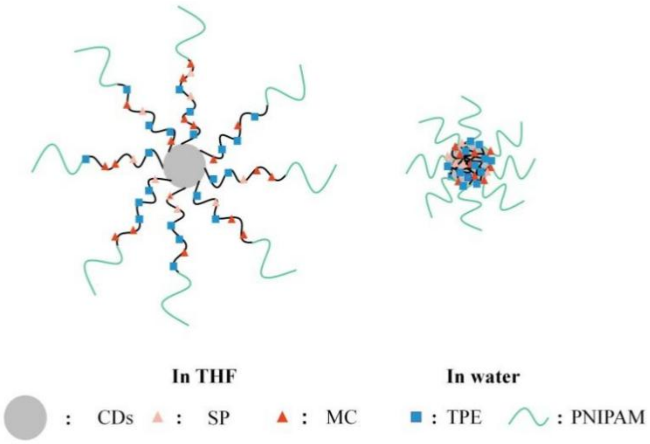


Fig. S6. Schematic representation of the structure of the CD-g-poly(TPE-co-SPA)-block-NIPAM) nanoparticle dispersed in THF and water, respectively.

When the CD-g-poly((TPE-co-SPA)-block-NIPAM) nanoparticles are in THF, the polymers on the CDs surface can be dissolved well and the TPE units can rotate freely without fluorescence. However, when CD-g-poly((TPE-co-SPA)-block-NIPAM) dispersed in water, the inner TPE and SPA copolymer block will aggregate on the surface of CD, while the outer NIPAM block will be dissolved in water. Then the CD-g-poly((TPE-co-SPA)-block-NIPAM) nanoparticles will form a structure similar to micelle, and the TPE units in aggregated state can show AIE.

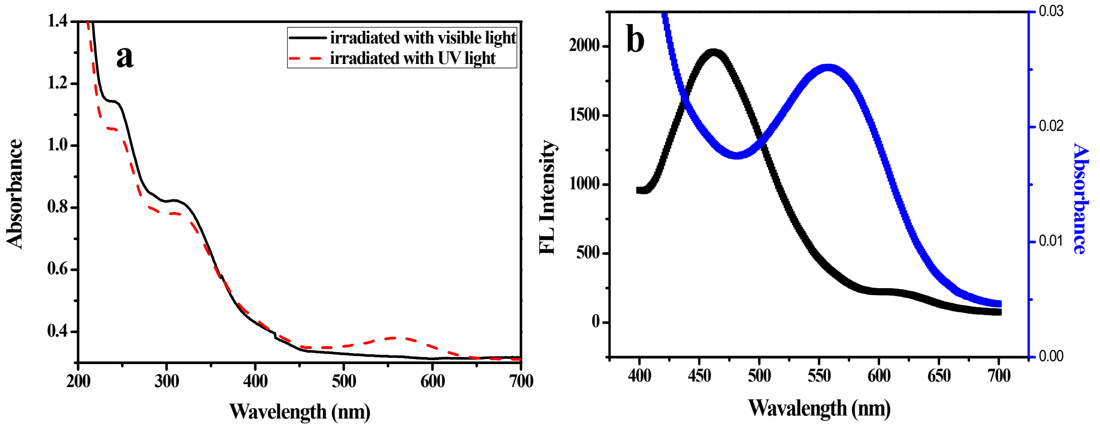


Fig. S7. (a) The UV-visible absorption spectra of CD-g-poly((TPE-co-SPA)-block-NIPAM) nanoparticles dispersed in water under UV-light (red line) and visible-light (black line) irradiation. (b) The fluorescence emission spectrum (black) excited at 380 nm and the UV-vis absorption spectrum (blue) at the range 400-700 nm of CD-poly((TPE-co-SPA)-block-NIPAM) nanoparticles in water.

The UV-visible absorption spectra of the CD-g-poly((TPE-co-SPA)-block-NIPAM) nanoparticles dispersed in water before and after irradiated with UV light (a). Before irradiated with UV light, an absorption peak at 323 nm can be seen, which is from SP form of SPA. After irradiated with UV light, a new absorption peak located at 562 nm appears (b), which is from ring-open MC. After irradiated with visible light, the absorption spectrum revert to the state of before being irradiated with UV light. From the fluorescence emission spectrum (black line in b), the clear new peak at 625 nm originates from the ring-open MC units. The result indicates SPA units in SP forms can isomerize into ring-open MC form by being irradiated with UV light, though the CD-g-poly((TPE-co-SPA)-block-NIPAM) nanoparticles dispersed in water.

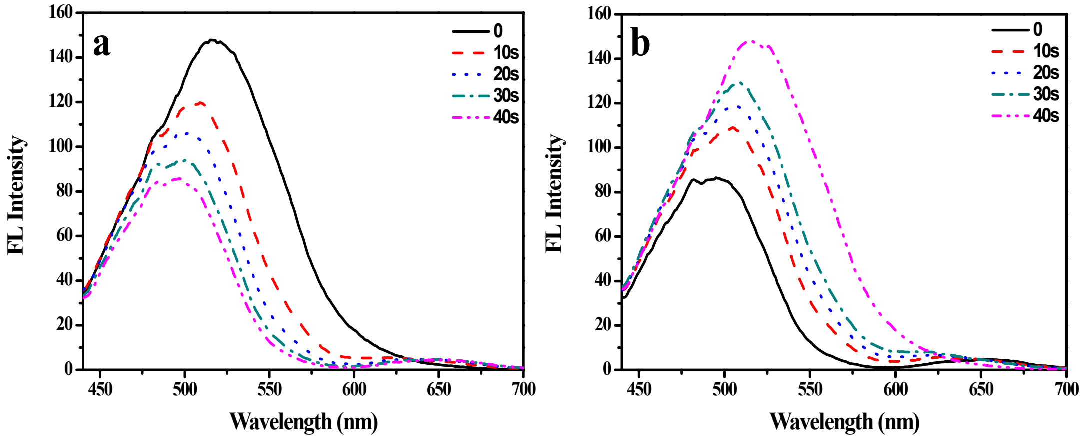


Fig. S8. Fluorescence spectra (excited at 420 nm) of the CD-g-poly((TEP-co-SPA)-block-NIPAM) nanoparticles dispersed in THF upon irradiation with UV (a) or visible light (b) at the different irradiation time.

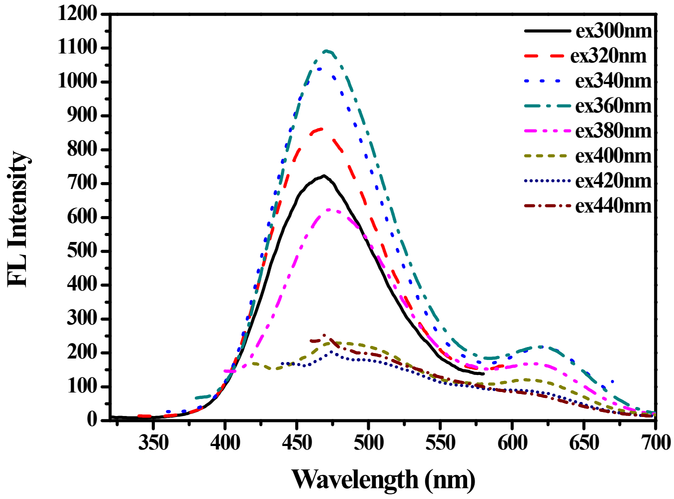
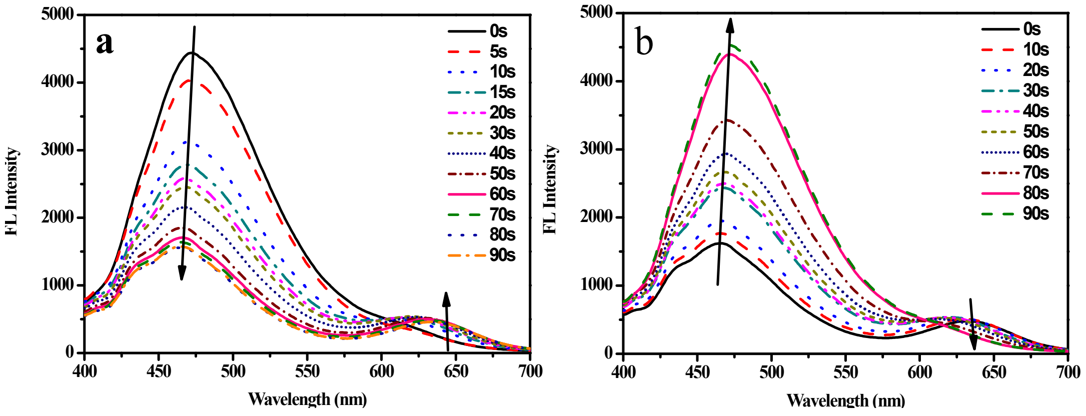


Fig. S9. Fluorescence emission spectra of the CD-g-poly((TPE-co-SPA)-block-NIPAM) nanoparticles film excited at different excitation wavelengths.



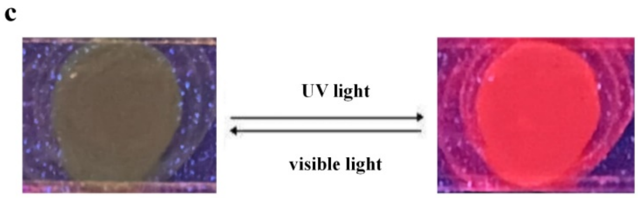


Fig. S10. The fluorescence spectra (excited at 380 nm) of the CD-g-poly((TPE-co-SPA)-block-NIPAM) film upon irradiation with UV light (a) or visible light (b) at the different irradiation time, and the fluorescence photographs of CD-g-poly((TPE-co-SPA)-block-NIPAM) nanoparticles film under UV (365nm) lamp (c).

The results confirm that the CD-g-poly((TPE-co-SPA)-block-NIPAM) nanoparticles film can be realized fluorescence reversible conversion between cyan and red with UV and visible light irradiation.

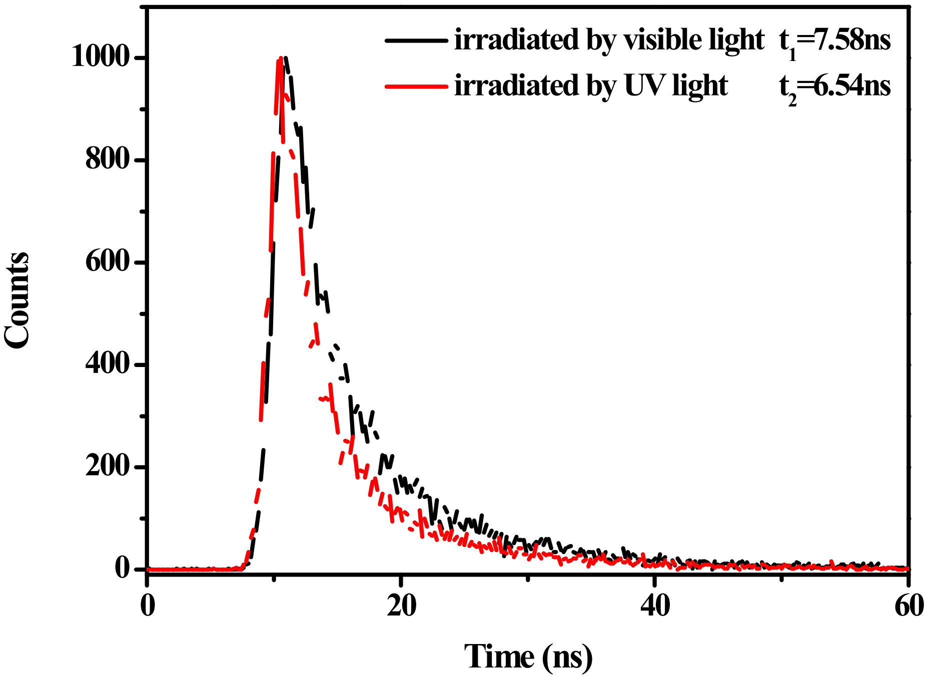


Fig. S11. Time resolved fluorescence spectra of CD-g-poly((TPE-co-SPA)-block-NIPAM) nanoparticles in water with the excitation wavelength at 405 nm and the emission wavelength at 465 nm.

Notes and References

[1] S. Ahmadi, M. Nasiri, A.P. Miandoab, Polym. Advan. Technol., 2020, 31(11).