Supporting information

A Light-Responsive Release Platform by Controlling the Wetting Behavior of Hydrophobic Surface

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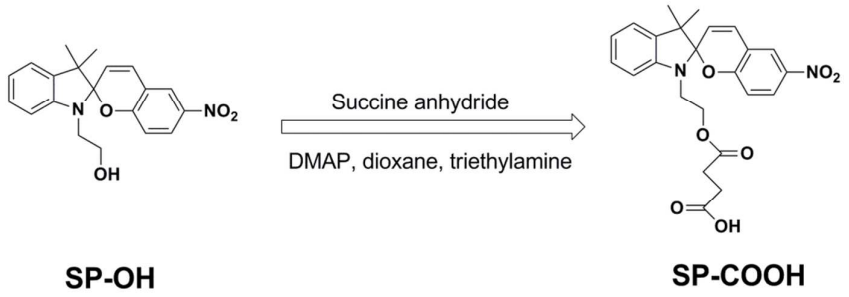


Figure S1. The synthesis of carboxyl-terminated spiropyran (SP-COOH). SP-OH was added into dioxane solution containing succine anhydride, 4-dimethylaminopyridine (DMAP), and triethylamine, which was stirred for 24 h at room temperature, followed by the solvent removal under vacuum. The crude product was purified by silica gel flash chromatography eluting to gain the final production SP-COOH.

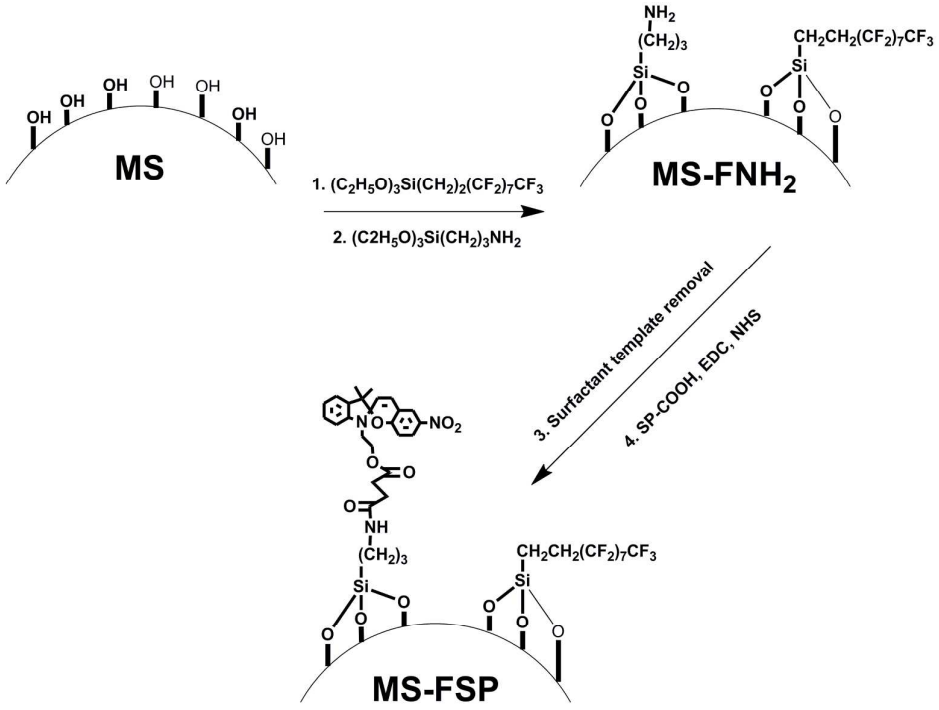


Figure S2. The process of preparation of spiropyran- and fluorosilane-modified MS (MS-FSP). MS particles reacted with the mixture of (1) perfluorodecyltriethoxysilane (PFDTES) and (2) 3-Aminopropyltriethoxy-silane (APTES) to achieve amine- and fluorinated silane-modifed MS (MS-FNH_2). After (3) surfactant template removal, MS-FNH_2 was added into the ethanol solution containing (4) SP-COOH, EDC, and NHS to afford spiropyran-functionalized MS (MS-FSP).

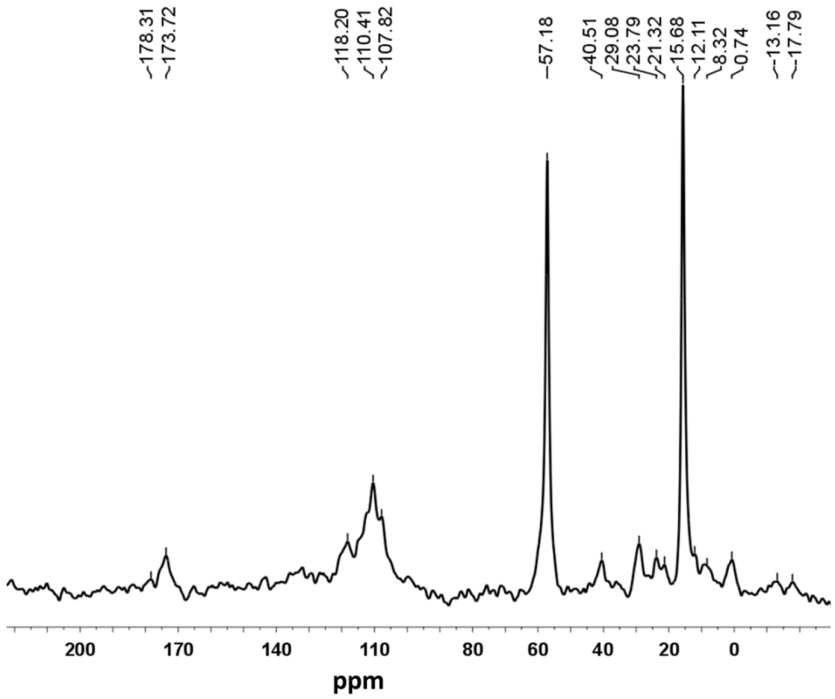


Figure S3 Solid-state ^{13}C NMR spectrum of MS-FSP. The peak at 178.31 ppm and 173.72 ppm were produced by the moiety of spiropyran, which indicated the successful modification of spiropyran to the surface of MS.

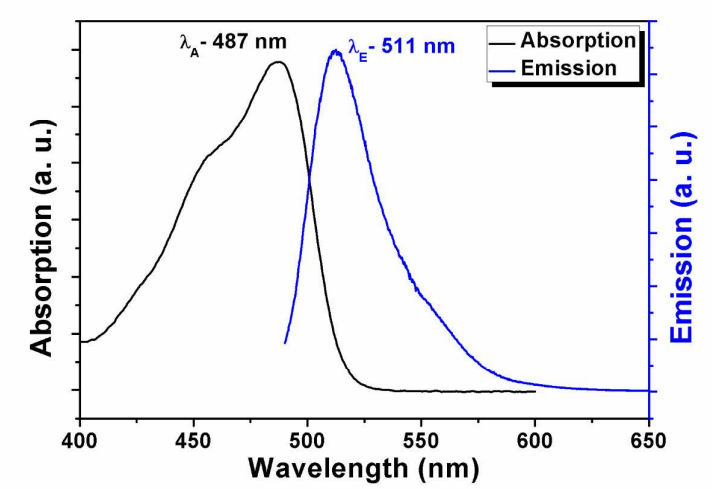


Figure S4. The absorption spectrum (black curve) and emission spectrum (blue curve) of fluorescein disodium in water. The peak of absorption is 487 nm, and the peak of emission is 511 nm.

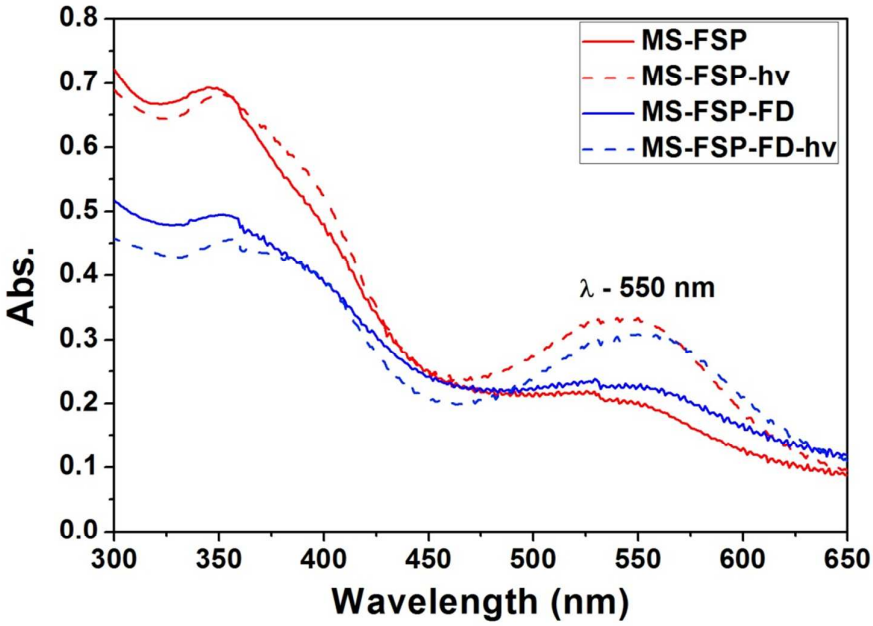
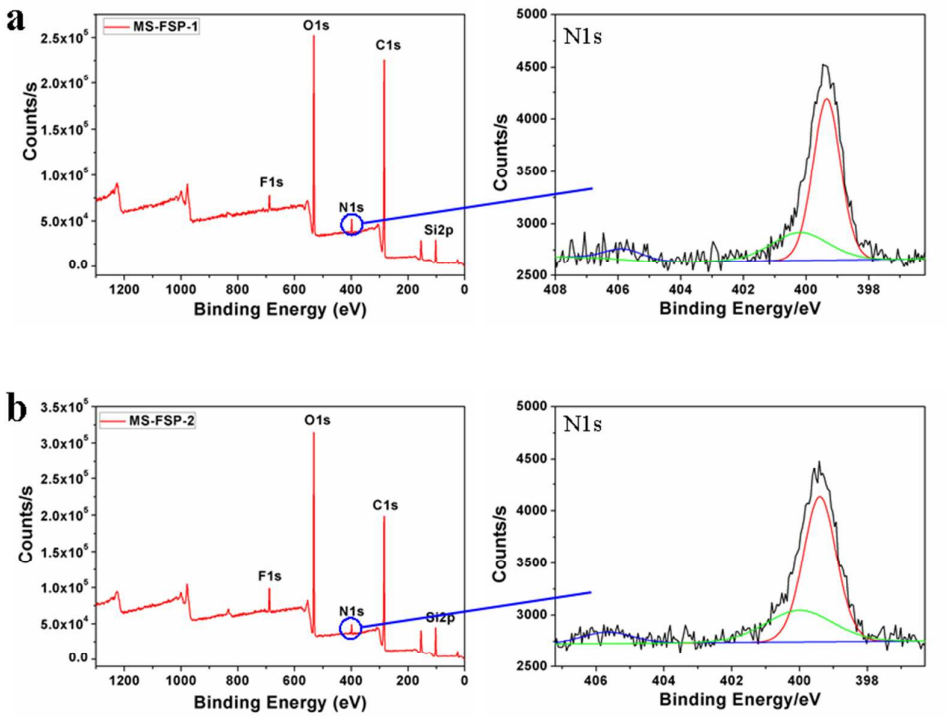


Figure S5. The UV-Vis spectra of MS-FSP and FD-loaded MS-FSP (MS-FSP-FD) dispersed in water before (solid curve) and after UV irradiation (dotted curve), which confirmed the isomerization of spiropyran attached to mesoporous silica surface.



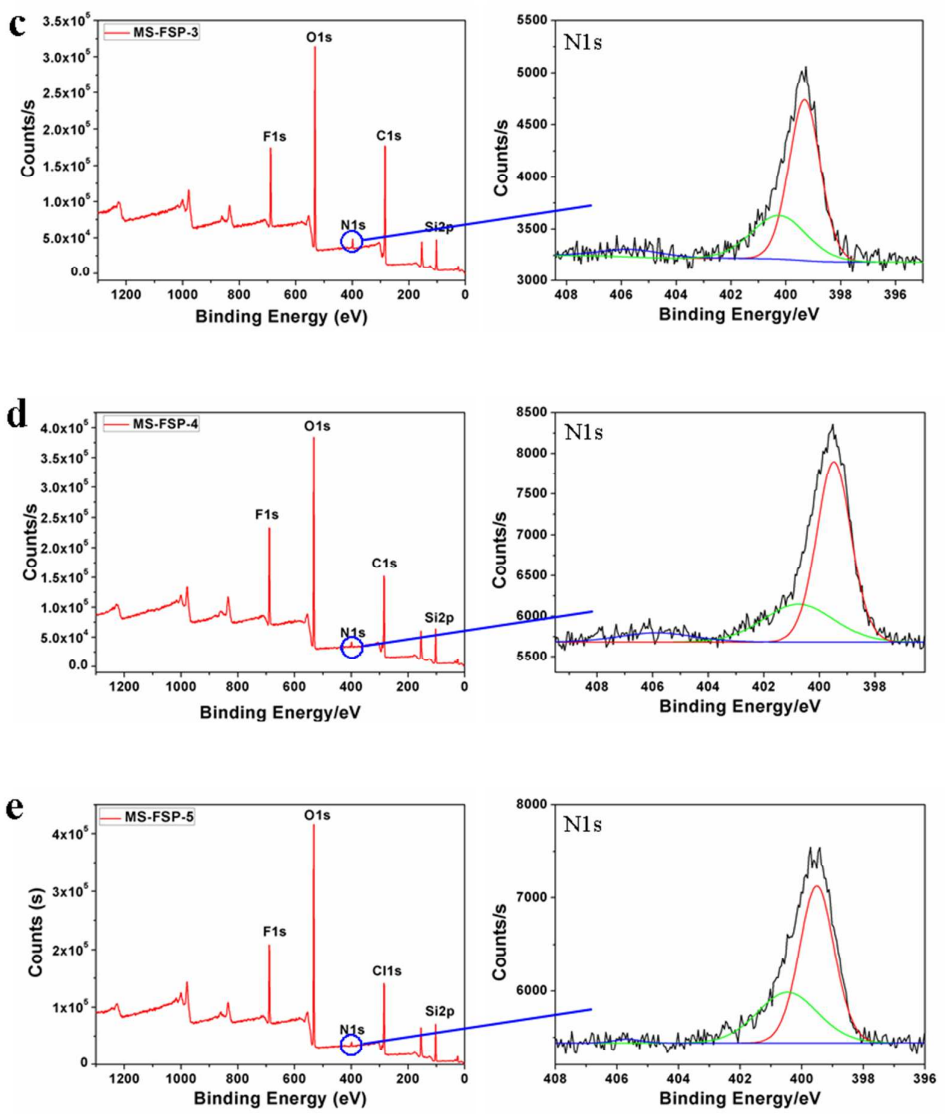


Figure S6. XPS of MS-FSP-1 (a), MS-FSP-2 (b), MS-FSP-3 (c), MS-FSP-4 (d), and MS-FSP-5 (e) with different molar ratio of spiropyran and fluorinated silane moiety. The right panel was the nitrogen (N1s) XPS photopeak which was fitted with three peaks locating at *ca*. 399.4 eV (red curve), 400.0 eV (green curve), and 405.7 eV (blue curve) which belonged to $–NH_2$, $-NH_3^+$, and $–NO_2$, respectively.

Table S1. Surface elemental compositions of MS-FSP samples as determined by XPS analysis

Sample	C (at.%)	O (at.%)	Si (at.%)	F (at.%)	N (at.%)	N ($-NO_2$) (at.%)[a]	n(-SP):n(-PFDTES)
MS-FSP-1	67.92	22.72	5.56	1.18	2.61	6.85	2.57 : 1
MS-FSP-2	61.88	24.9	8.36	2.81	2.04	7.69	0.949 : 1
[b]MS-FSP-3	50.36	28.84	10.11	8.68	2.01	6.33	0.249 : 1
MS-FSP-4	41.23	31.7	13.35	12.02	1.7	7.14	0.172 : 1
MS-FSP-5	38.63	35.2	14.75	10.14	1.28	1.27	0.03 : 1

[a] The nitrogen atomic percentage of $–NO_2$ in total nitrogen

[b] The sample grafted with optimal ratio of spiropyran and PFDTES

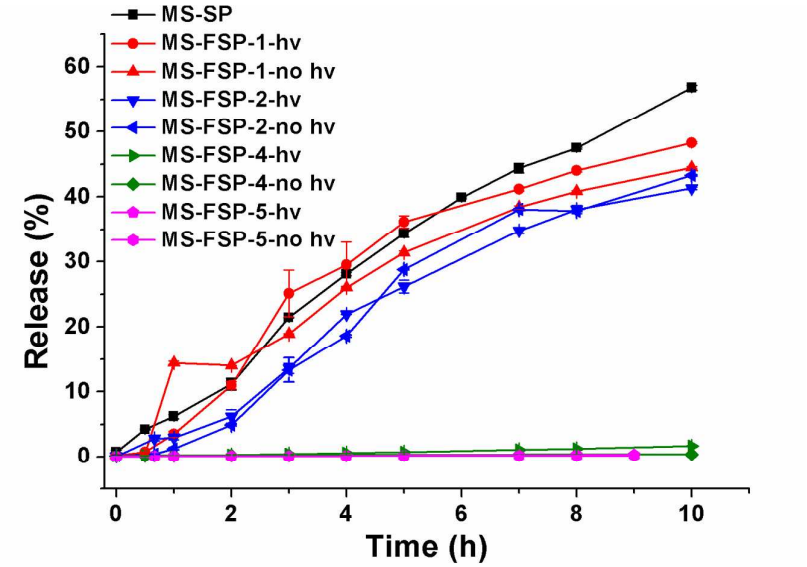


Figure S7. The fluorescein disodium release profile of samples with different ratio of spiropyran and PFDTES. To achieve the light-triggered release, the surface of MS should be functionalized with an appropriate ratio of spiropyran to PFDTES. It was found that MS-SP grafted with only spiropyran showed rapid release, which indicated FD molecules would escape from the pores without hydrophobic effect (black curve). Moreover, when the ratio was too large, the hydrophobicity of samples could not be able to repel the water and FD quickly released with little difference before and after UV irradiation, which confirmed the FD was mainly inside the pores but not on the surface by adsorption (MS-FSP-1, red curve and MS-FSP-2, blue curve). However, when the ratio was too small, the surface was so highly hydrophobic that FD could hardly run out of the pores (MS-FSP-4, green curve and MS-FSP-5, pink curve).

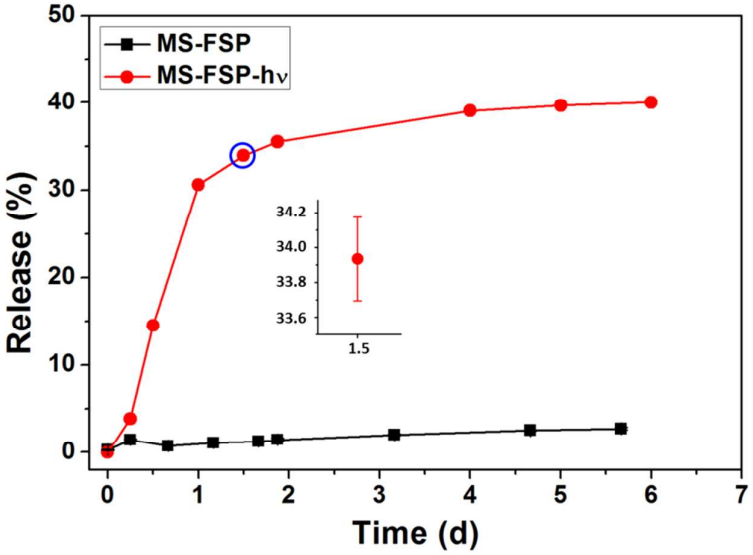


Figure S8 The release profile of fluorescein disodium molecules from MS-FSP-3 in PBS solution (0.1 M, pH 7.2) versus time. In about 6 days, the sample without UV light irradiation exhibited negligible release, which indicated the cargos were sufficiently inhibited in the pores. Upon UV light exposure, in the first 24 h, MS-FSP-3 displayed quick release, and then kept slow and sustainable release.

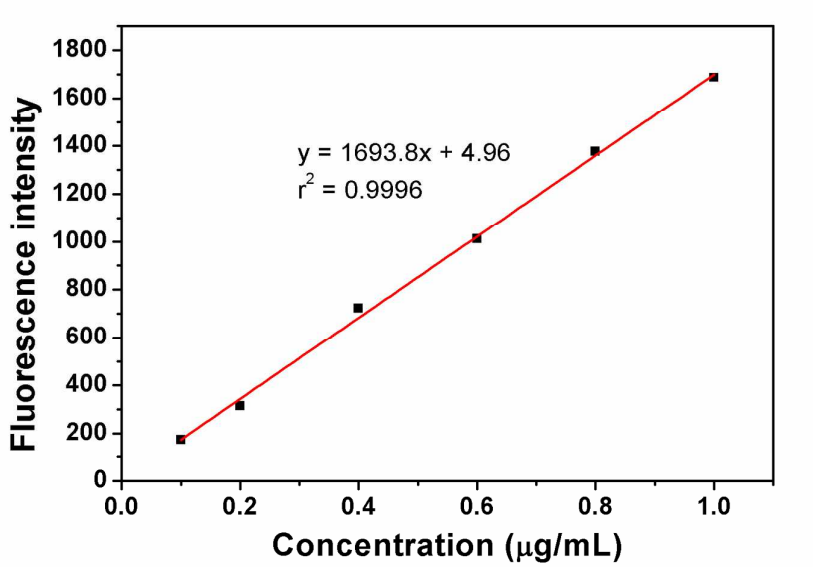


Figure S9. The standard line of CPT solution was established by fluorescence spectroscopy with excitation wavelength and emission wavelength at 380 nm, and 447 nm, respectively. The curve was used to determine the CPT loading content in MS-FSP.

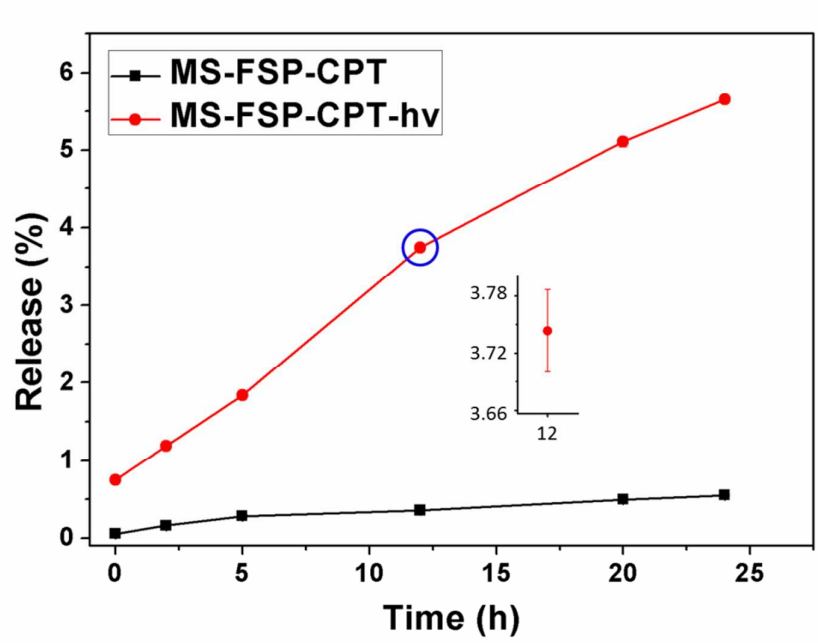


Figure S10. The CPT release profile of MS-FSP-CPT in PBS solution (0.1 M, pH 7.2). Upon UV light irradiation, MS-FSP-CPT exhibited sustainable release (red curve) while the sample displayed poor release without UV light exposure (black curve).

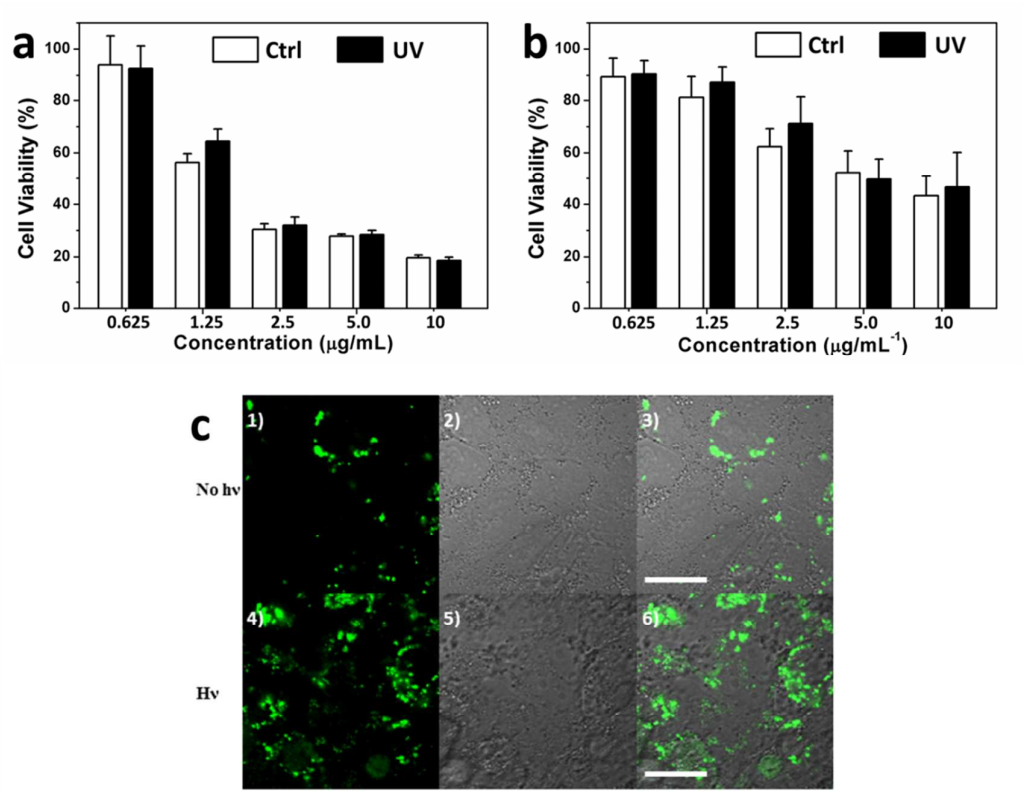


Figure S11. (a) EA.hy926 cells and (b) Hella cells after being separately incubated with CPT for 24 h. Blank bar represented samples without UV light irradiation while black bar represented samples with UV light irradiation (2.4 μW/cm^2) for 5 min. (c) Confocal fluorescence and bright images corresponding to Hela cell incubated with FD-loaded MS-FSP (50 μg/mL) without (1, 2, 3) and with (4, 5, 6) UV light irradiation for 5 min. (1) (4) fluorescence (λ_{ex} = 488 nm); (2) (5) bright field; (3) (6) the overlay image of (1) (2), and (4) (5). The scale-bar corresponds to 20 μm. The results demonstrated the efficient uptake of MS-FSP by Hela cells and successful release within cells upon UV light irradiation.