# Electronic Supplementary Information (ESI)

## Erythrocyte Membrane-Coated Biomimetic Nanovectors with Programmed Delivery and Near-Infrared Light Triggering Properties for Photodynamic Therapy of Cancer

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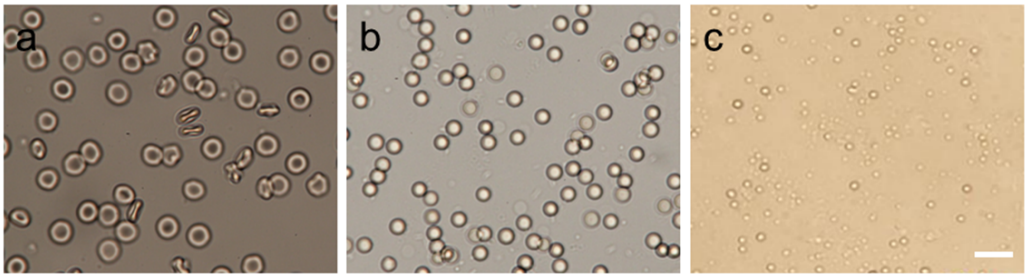


**Figure S1.** Images of red blood cells (a), red blood cell membrane (RM) before (b) and after ultrasound treatment (c). Scale bars: 10 μm.

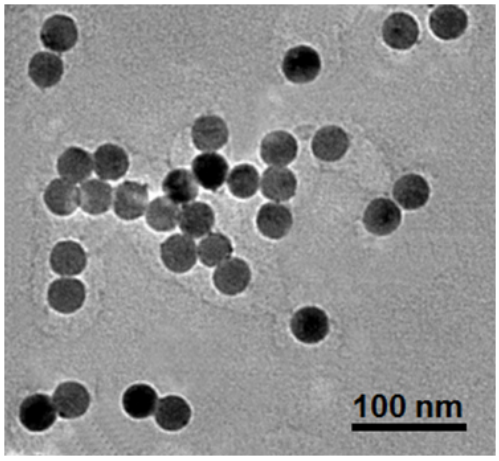


**Figure S2**. Typical TEM image of the UCNPs.

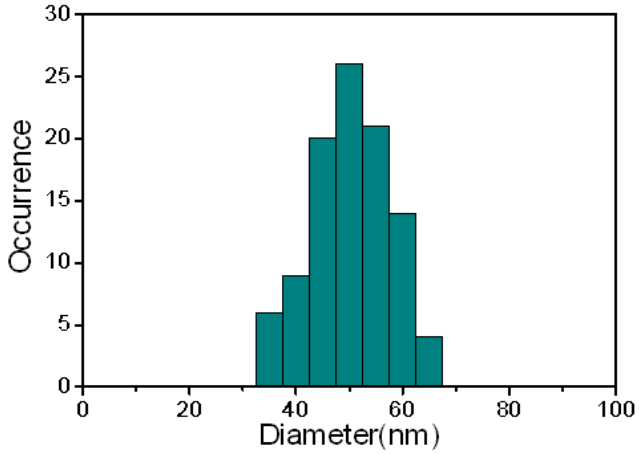


**Figure S3.** Dynamic light scattering (DLS) measurement of the as-prepared PDT agents, F/P-RM:Us/PS.

It is noted that the TEM characterization of the same batch of PDT agents displayed their spherical shape with an average diameter of ~35 nm. Such discrepancy in the obtained diameter results is probably attributable to the hydrodynamic swelling

effect as the DLS measurement is carried out with the nanoparticles suspended in an aqueous environment while the TEM measurement is made with dry nanoparticles under high vacuum conditions.

| Agent formulation | Diameter (nm) | Zeta potential (mV) |
|---|---|---|
| Us/PS | 30±2.4 | -5.89±1.82 |
| RM:Us/PS | 36±1.6 | -16.45±2.04 |
| F-RM:Us/PS | 42±1.7 | -29.56±2.36 |
| F/P-RM:Us/PS | 45±1.2 | -8.36±1.93 |

**Table S1**. Particle size and zeta potential of the PDT agents with different formulation.

Upon RM coating and surface decoration with targeting moieties FA and TPP, the diameter of the obtained agents displayed gradual and slight increase in sequence of RM:Us/PS, F-RM:Us/PS, F/P-RM:Us/PS. It can be seen that RM coating and the surface decoration with FA moiety resulted in significant increase in the zeta potential of the in aqueous milieu, owing to the hydrophilic nature of RM as lipid membrane and FA components. In sharp contrast, the surface decoration with TPP moiety led to remarkable decrease in the zeta potential of the agents. This is actually a foreseeable consequence of the cation nature of TPP, which is expected to neutralize the negative charge on the surfaces of the RM. Unequivocally, the gradual slight increase in the particle diameter and the above-mentioned change in the zeta potential upon surface functionalization verified the success of RM-coating and FA and TPP decoration on the surfaces of the agents.

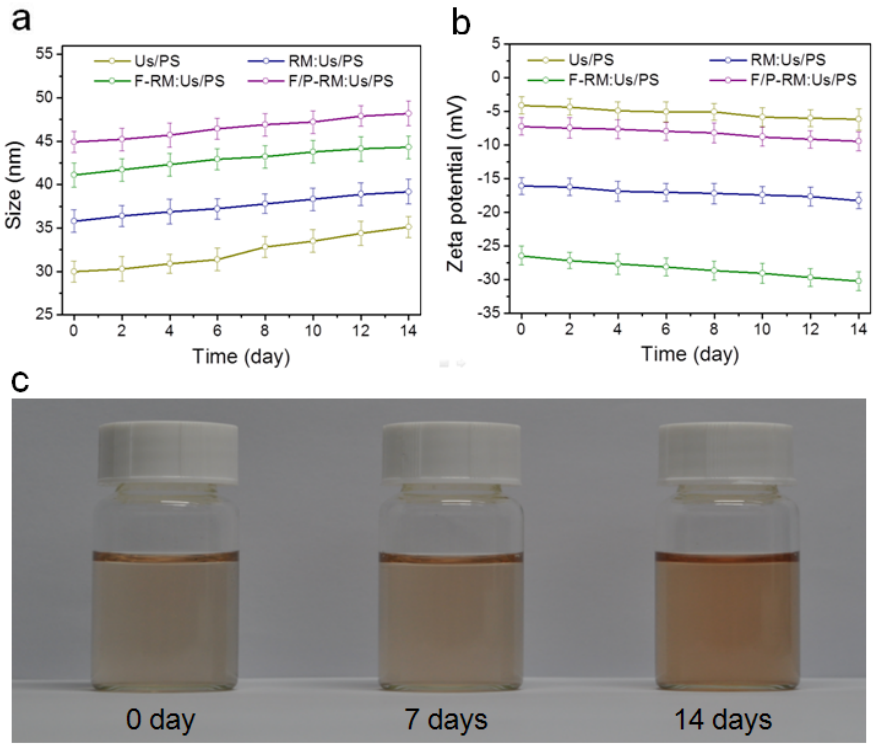


Figure S4. Evolution of diameter (a) and zeta potential (b) of the PDT agents as a function of the storage time. (c) Photographs of the aqueous F/P-RM:Us/PS dispersion sample acquired after 0, 7 and 14 days of storage, respectively.

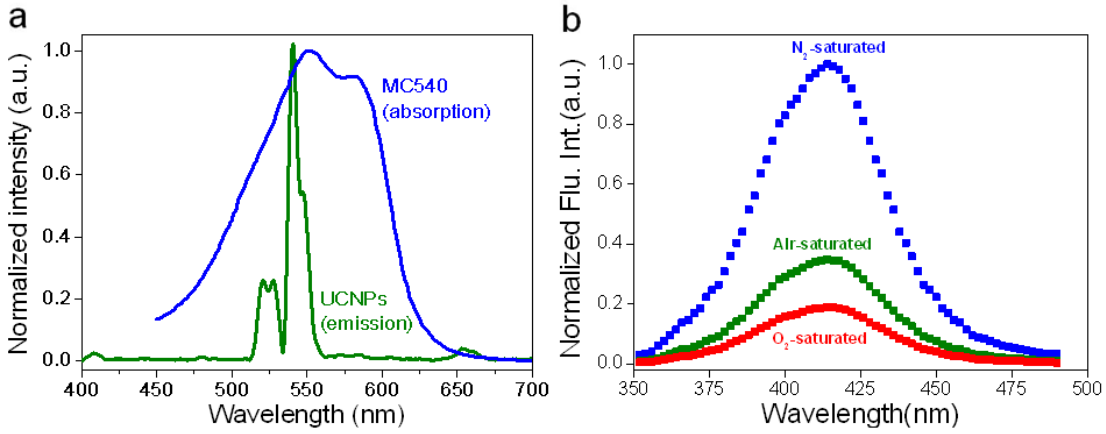


Figure S5. (a) The fluorescence emission spectrum of UCNPs under 980-nm NIR laser excitation and the absorption spectra of MC540 photosensitizers. (b) Oxygen-dependent fluorescence emission spectra, of ABDA in presence of F/P-RM:Us/PS nanoparticles after 3-min 980-nm light irradiation ($\lambda_{ex}$ = 400nm).

Upon 980-nm irradiation, UCNPs luminesce in the visible region with maximum at□540nm, which perfectly overlaps with the absorbance band of MC540, thus,

enabling Förster resonance energy transfer (FRET) from UCNPs to MC540 and therefore the activation of the latter (Fig. 5Sa). The involvement of ground-state oxygen in the generation of $^1O_2$ using the as-prepared PDT agents and the $^1O_2$-mediated destruction of ABDA was confirmed (Fig. 5Sb).

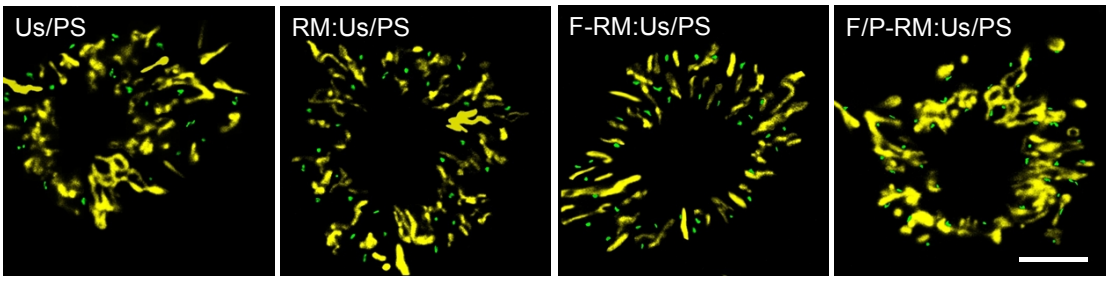


Figure S6. Typical low magnification CLSM images of mitochondria (yellow area) in cells with internalized PDT agents (green dots) with different formulation. Scale bars: 10 μm.

It can be seen that the coupling rate of mitochondria with the PDT agents in the case of F/P-RM:Us/PS is apparently higher as compared to that in other group, confirming the crucial role of TPP moiety decorated on the RM in mitochondrion guiding.

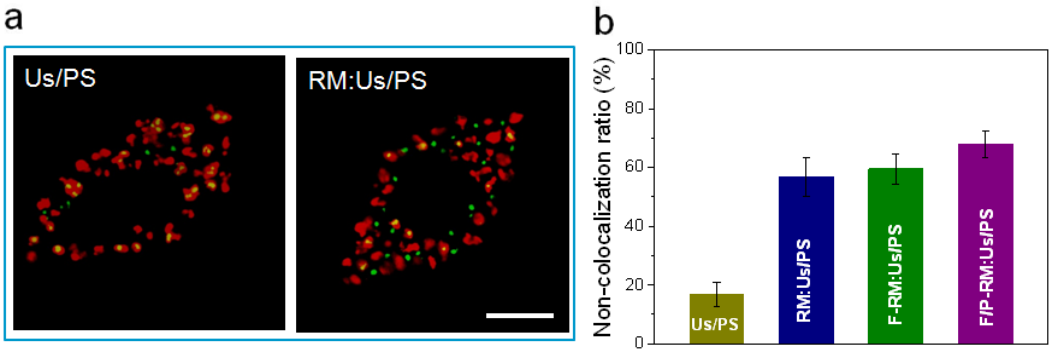


Figure S7. (a) CLSM images of lysosomes (red area) in B16 cells with internalized PDT nanoparticles (green dots) and the corresponding lysosome-nanoparticle colocalization analysis. Scale bars: 20 μm.

It can be seen that the RM cloaking could help the NPs escape from the lysosome due to the membrane fusion process.

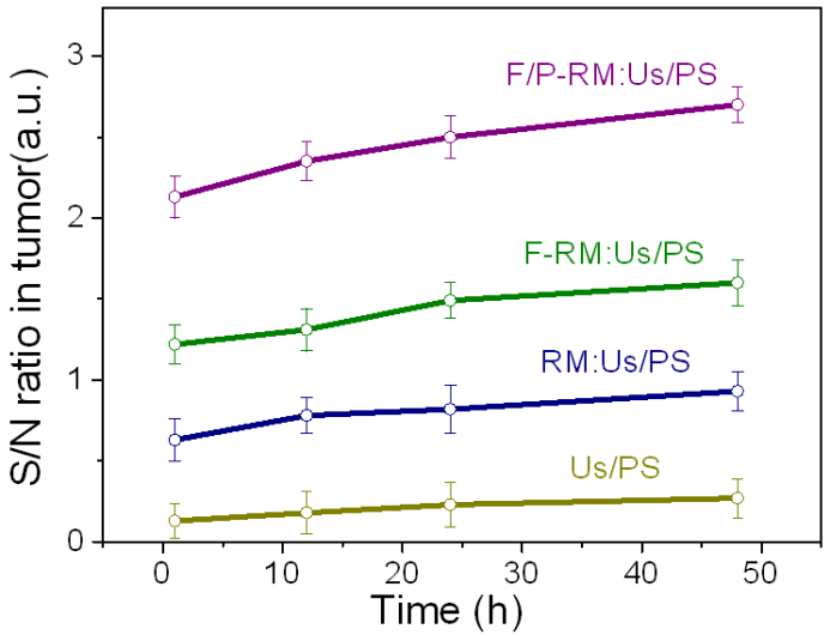


Figure S8. Signal-to-noise ratio of the *in vivo* fluorescence images of real-time tumor targeting characteristics in tumor-bearing mice after intravenous injection of model PDT agents with different formulation.

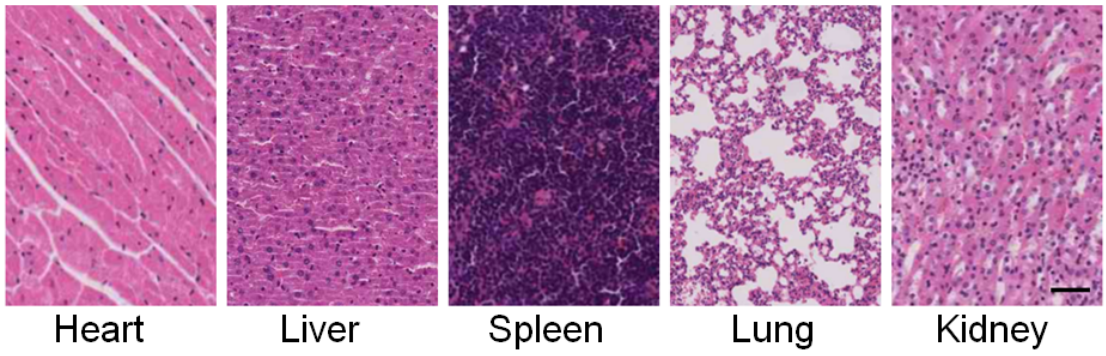


Figure S9. Hematoxylin and eosin (HE) staining of B16-bearing mice organs after treatment with F/P-RM:Us/PS nanoparticles (28 days after tumor cells injection). No organic damage was observed. Scale bar: 100 μm.