Supporting Information

Degradable magnetic-response photoacoustic/up-conversion luminescence imaging-guided photodynamic/photothermal antitumor therapy

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Synthesis of Fe_3O_4@mSiO_2@UCNPs nanoparticles. Ultra-small UCNPs were dissolved in PAA solution and stirred at room temperature for 12 h. After the reaction was finished, the supernatant was centrifuged and discarded. The precipitate was dissolved in water (10 mL). Fe_3O_4@mSiO_2 (2 mg) was ultrasonically dispersed into the UCNPs solution, and then the mixed solution was shaken on a shaker for 12 h. After the reaction was completed, the magnetic nanoparticles were separated from the solution by a magnet, and washed three times with water. After drying in an oven at 60 ℃ for 12 h, the Fe_3O_4@mSiO_2@UCNPs composite materials were obtained.

Synthesis of Fe_3O_4@mSiO_2@UCNPs-FA. 1 mg of FA, 2 mg of NHS, and 6 mg of EDC were dissolved together in 20 mL of deionized water, and the prepared Fe_3O_4@mSiO_2@UCNPs was added to the mixture, and the solution was shaken overnight in the dark. Finally, Fe_3O_4@mSiO_2@UCNPs-FA was obtained by centrifugation and drying.

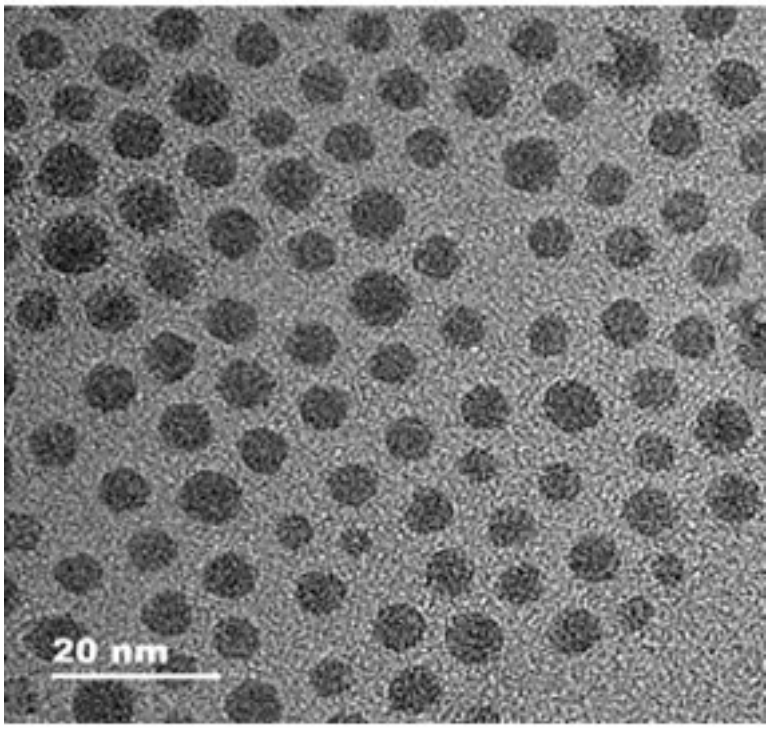

Fig. S1. TEM images ultra-small UCNPs.

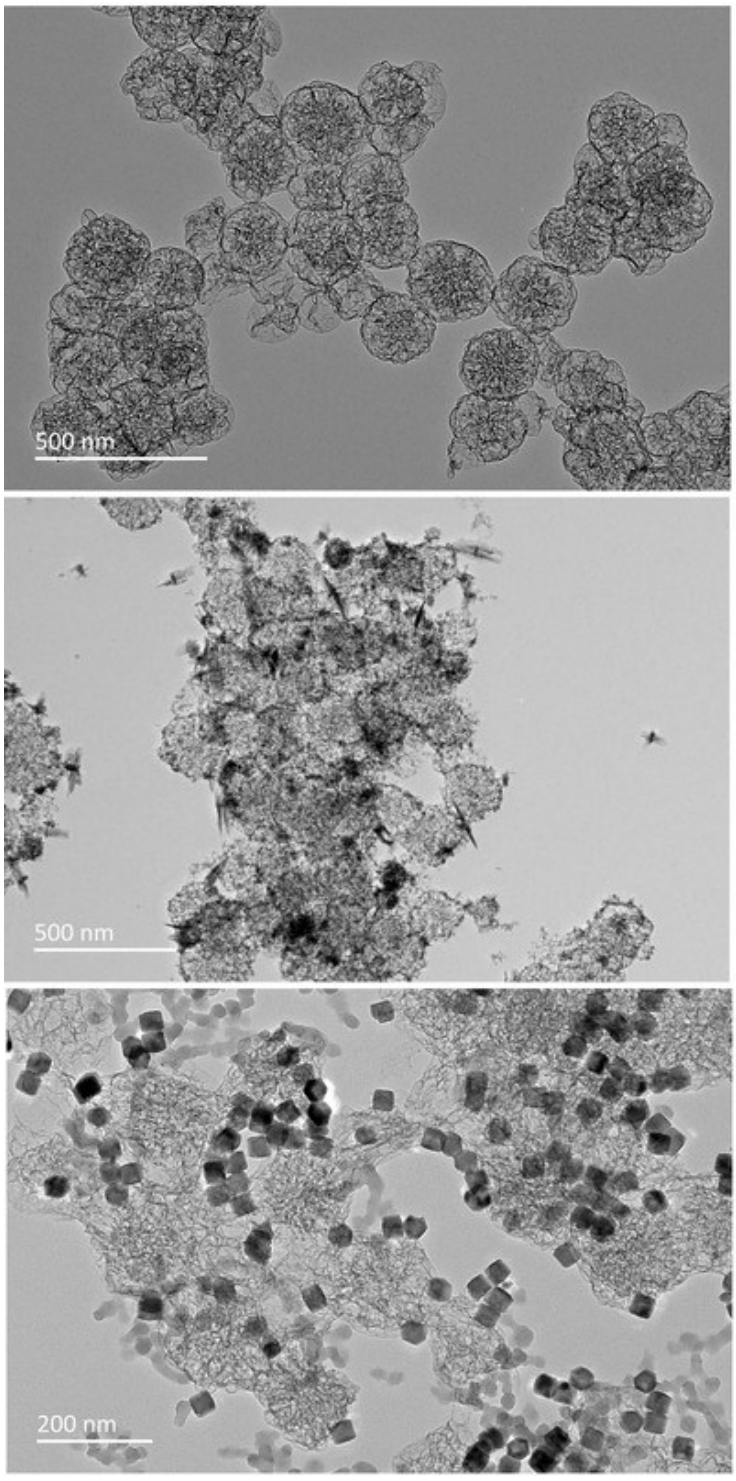

Fig. S2. TEM images of $mSiO_2$, $mSiO_2$@Au, and $mSiO_2$@Au@UCNPs.

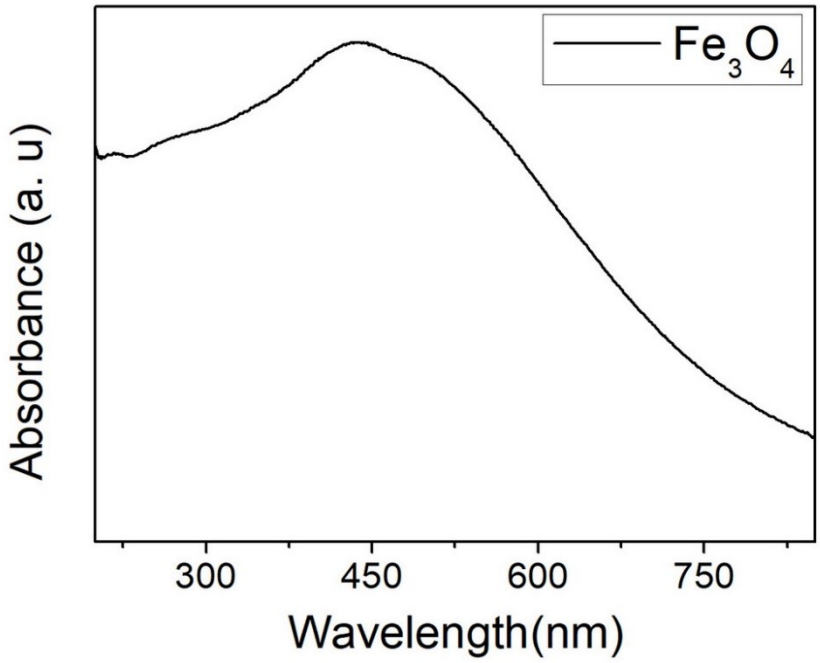

Fig. S3. The absorbance of Fe_3O_4@mSiO_2@UCNPs solution.

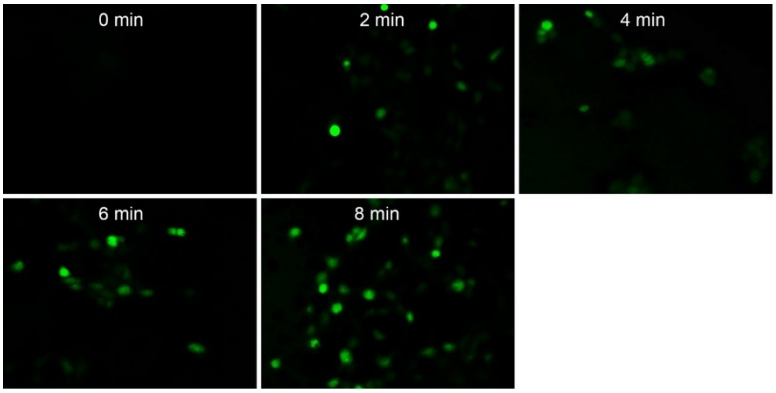

Fig. S4. The microscopy imaged of cells incubated with Fe_3O_4@mSiO_2@UCNPs and exposed to 808 nm laser. (The cells were marked by DCFH-DA).

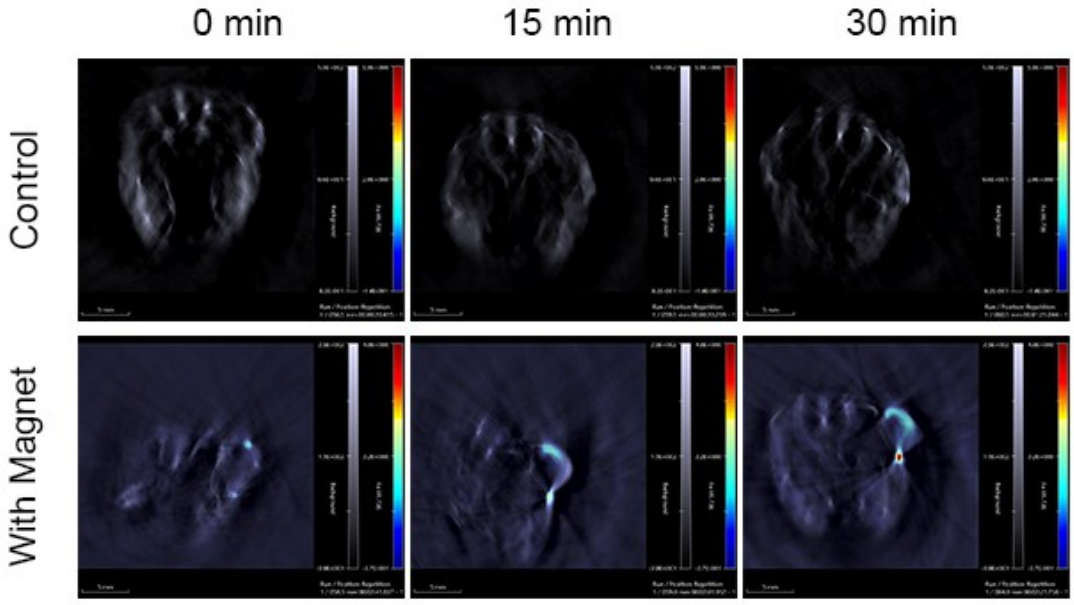

Fig. S5. Photoacoustic images of the tumor in the mice without treatment as the control group (up) and the mice after injected with Fe_3O_4@mSiO_2@UCNPs with magnet guided (down) for different time points.

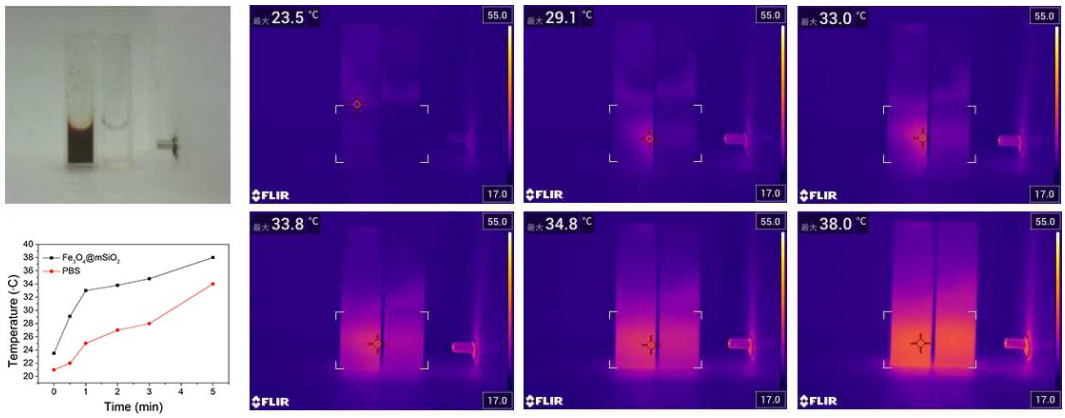

Fig. S6. Thermal imaging images of Fe_3O_4@mSiO_2 and PBS at different time points (0min, 0.5 min, 1 min, 2 min, 3 min, and 5 min) under 980 nm laser irradiation.

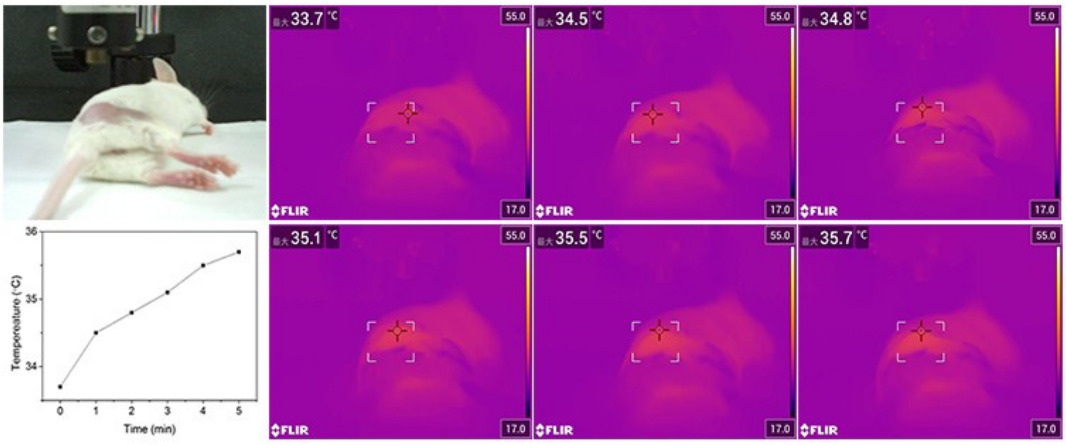

Fig. S7. Thermal imaging of Balb/c mouse injected subcutaneously with PBS under 808 nm laser irradiation.

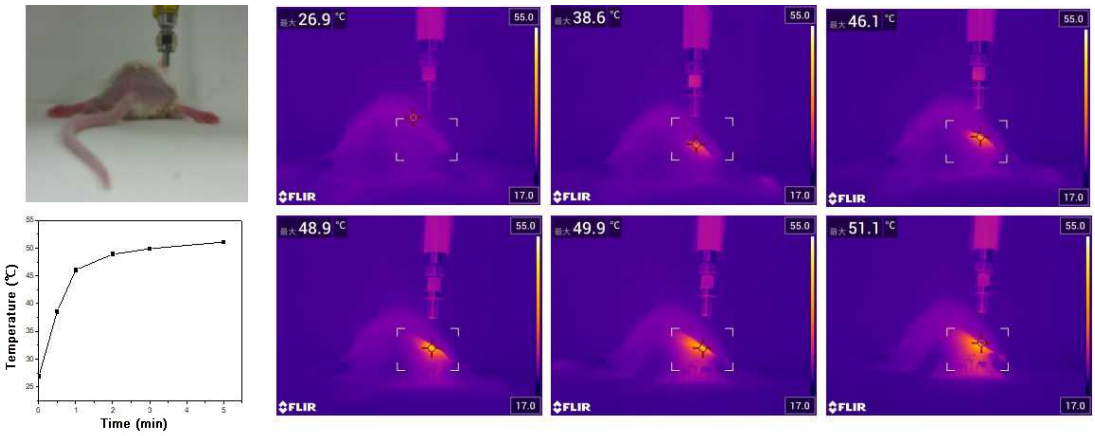

Fig. S8. Thermal imaging of Balb/c mouse injected subcutaneously with Fe_3O_4@mSiO_2 under 980 nm laser irradiation.

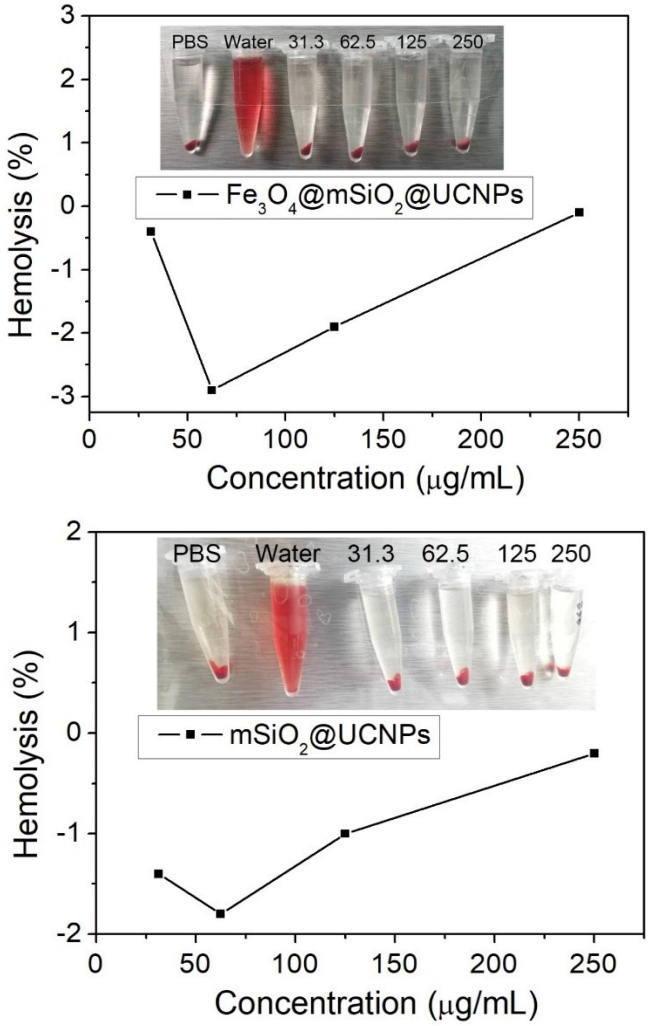

Fig. S9. Hemolysis results of Fe_3O_4@$mSiO_2$@UCNPs (up) and $mSiO_2$@UCNPs (down).

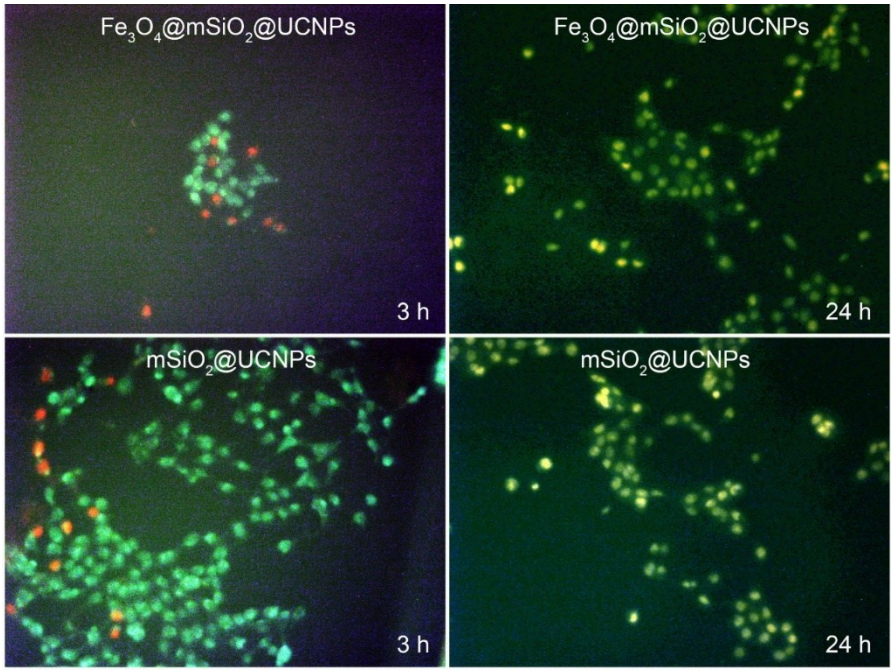

Fig. S10. The intracellular biocompatibility of SGC-7901 cells incubated with materials marked by Calcein AM/PI for different time points. Here, Calcein AM (green colour)/PI (red colour) are presented for live/dead state of cells, respectively.

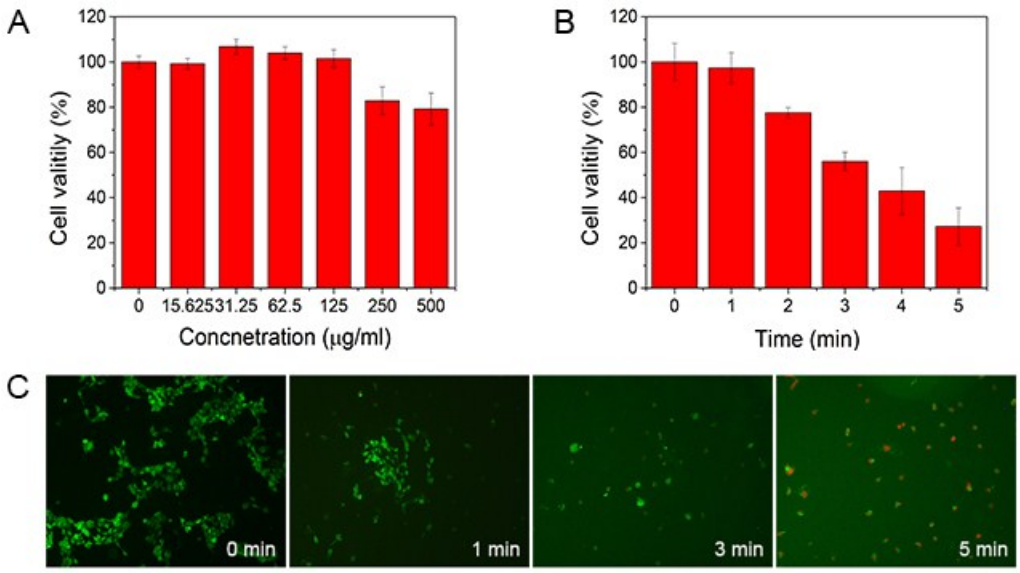

Fig. S11. (A) The viability of 4T1 cells incubated with Fe_3O_4@mSiO_2@UCNPs for different concentrations. (B) The viability of 4T1 cells incubated with Fe_3O_4@mSiO_2@UCNPs under 808 nm laser irradiation for different time points. (C) 4T1 cells incubated with Fe_3O_4@mSiO_2@UCNPs under 808 nm laser irradiation for different time points and marked with Calcein AM/PI. Here, Calcein AM (green colour)/PI (red colour) are presented for live/dead state of cells, respectively.

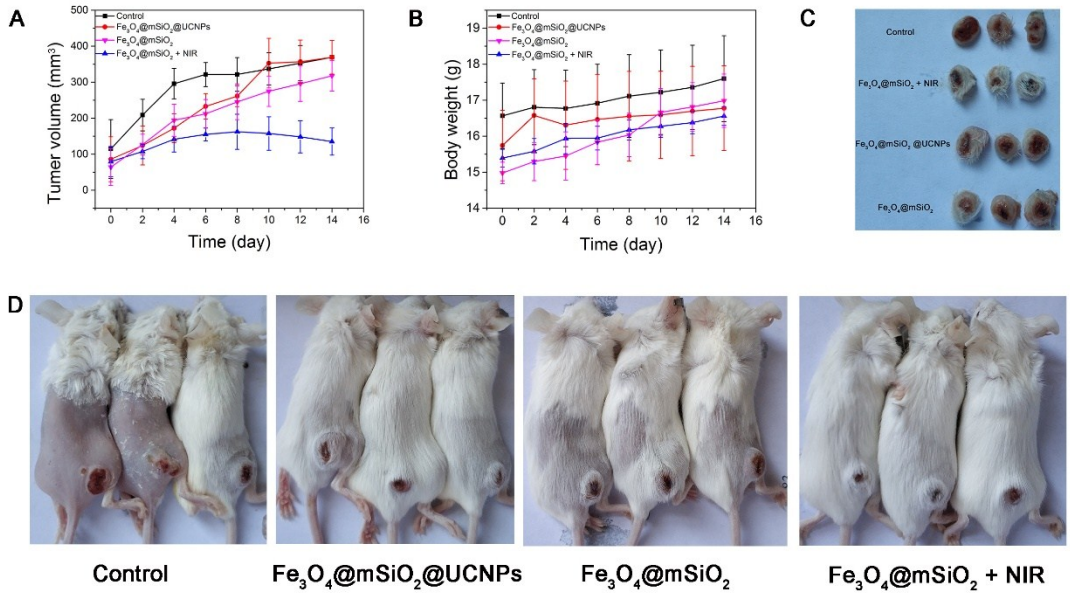

Fig. S12. *In vivo* therapy of more control groups. (A) Tumor size and (B) body weight of the mice treated with different control groups. The pictures of (C) tumors and (D) mice with tumor treated with different control groups.

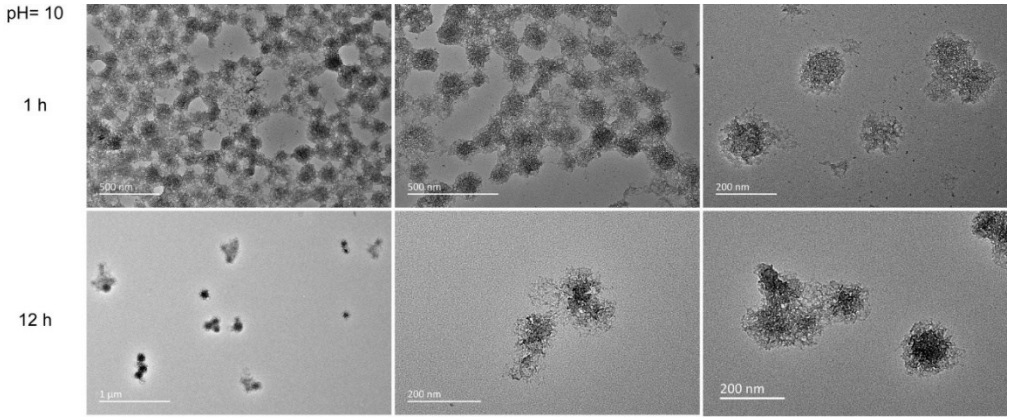

Fig. S13. TEM images of $mSiO_2$ in the diluted NaOH solution (pH = 10) for different degradable time points.

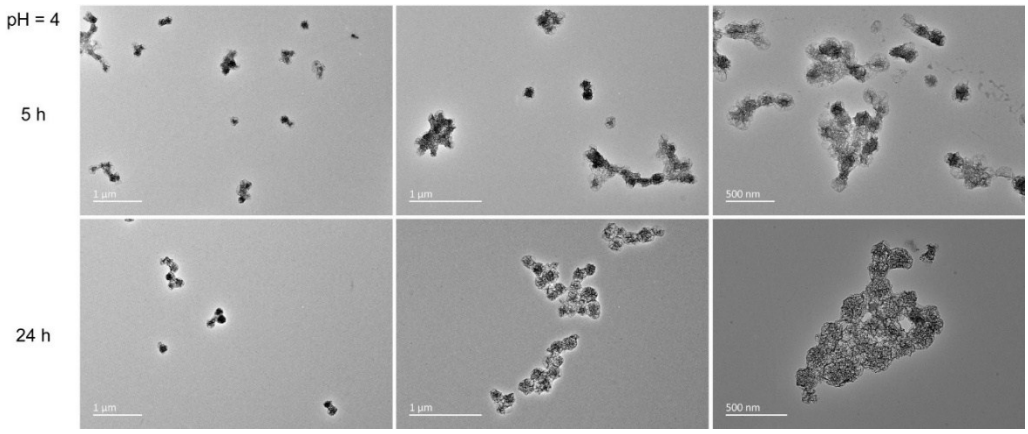

Fig. S14. TEM images of $mSiO_2$ in the diluted HCl solution (pH = 4) for different degradable time points.

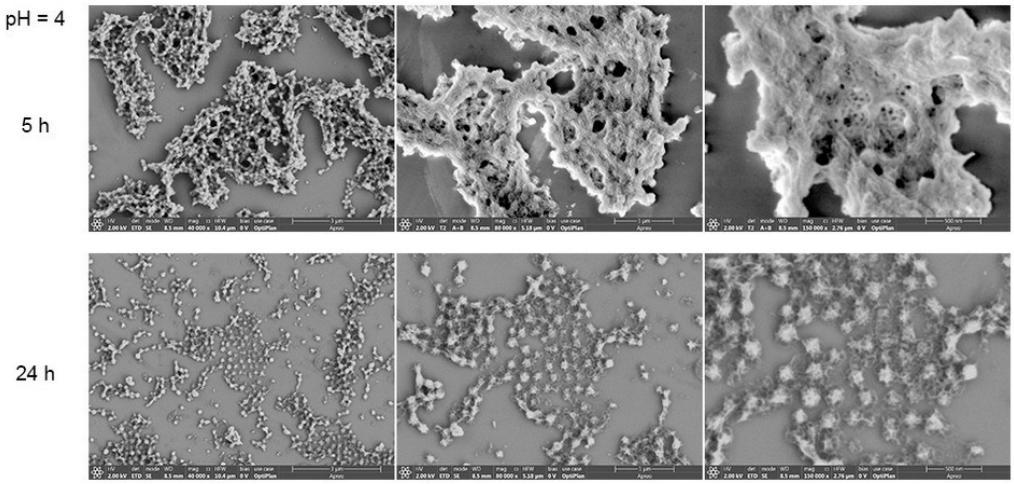

Fig. S15. SEM images of $mSiO_2$ in the diluted HCl solution (pH = 4) for different degradable time points.