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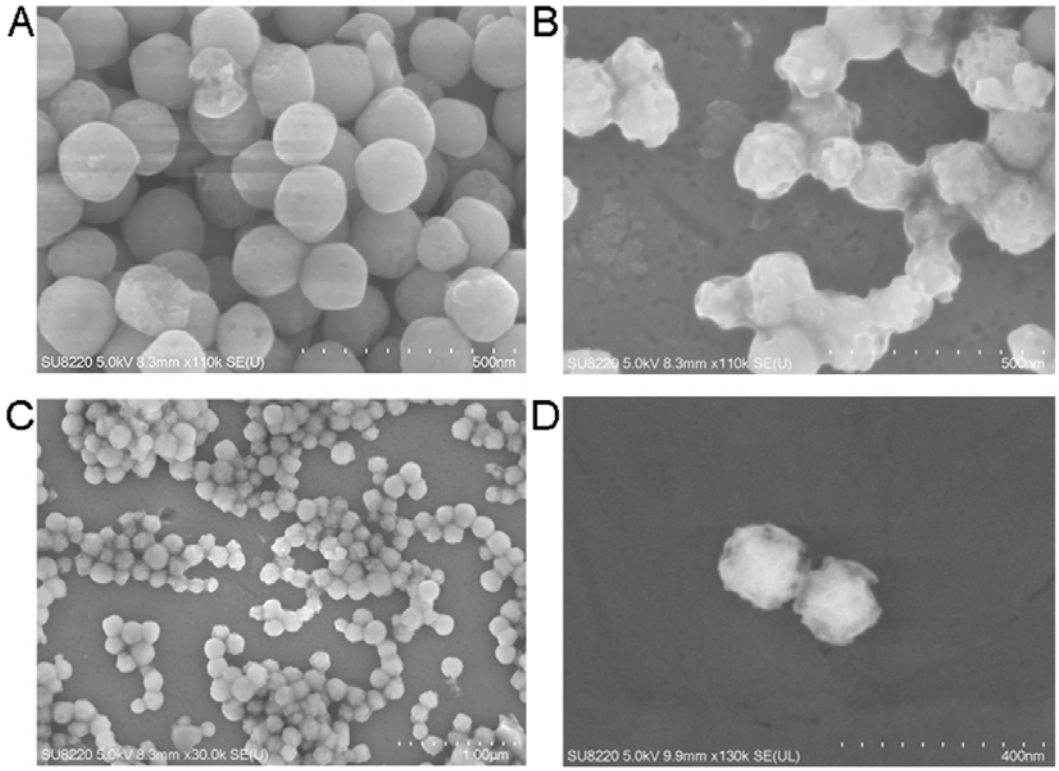

Additional Figure 1. Scanning electron microscope images of (A) upconversion nanoparticles, (B) upconversion nanoparticle@silica (US) and (C, D) polymer-modified upconversion nanoparticle@silica@manganese dioxide (USM) at different magnifications.

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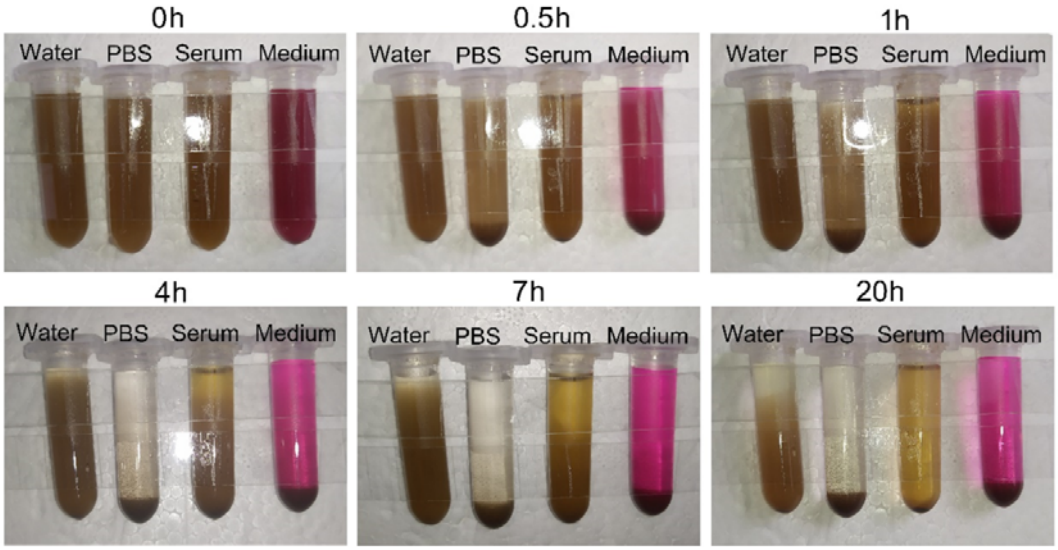
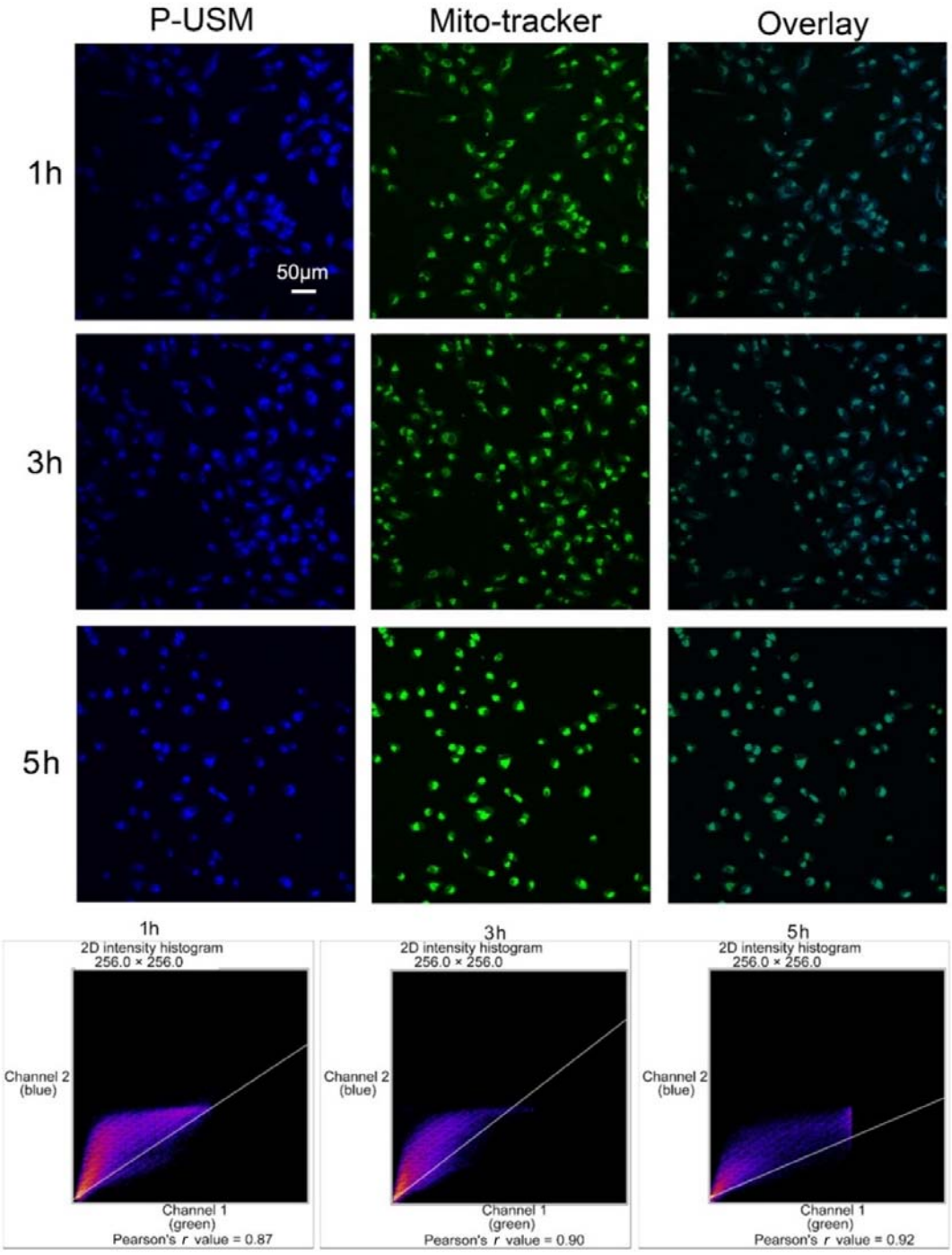
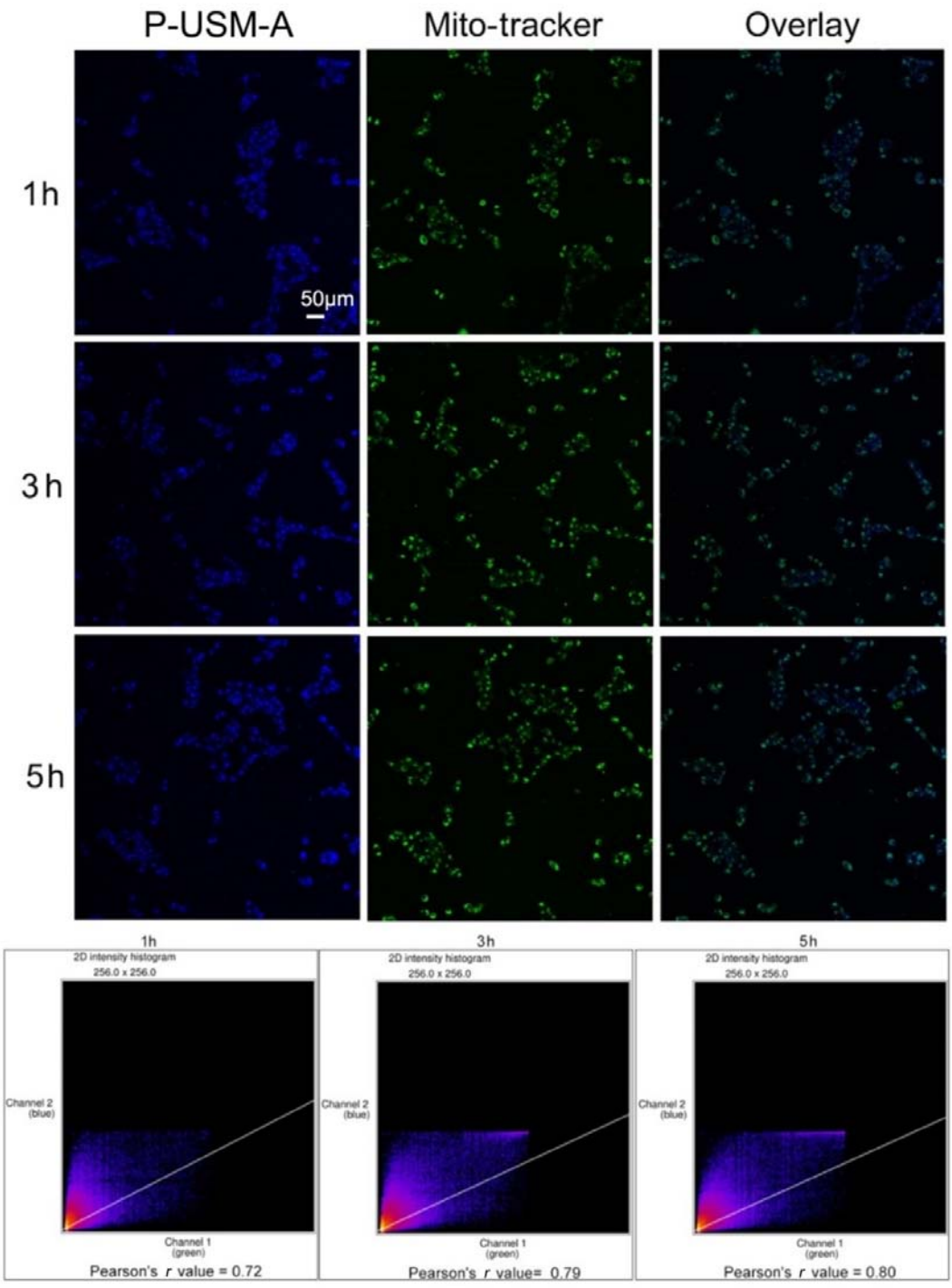


Additional Figure 2. The stability of polymer-modified upconversion nanoparticle@silica@manganese dioxide (P-USM) in different common biophysical solutions: deionized water, phosphate buffer saline (PBS), fetal bovine serum, and culture medium.



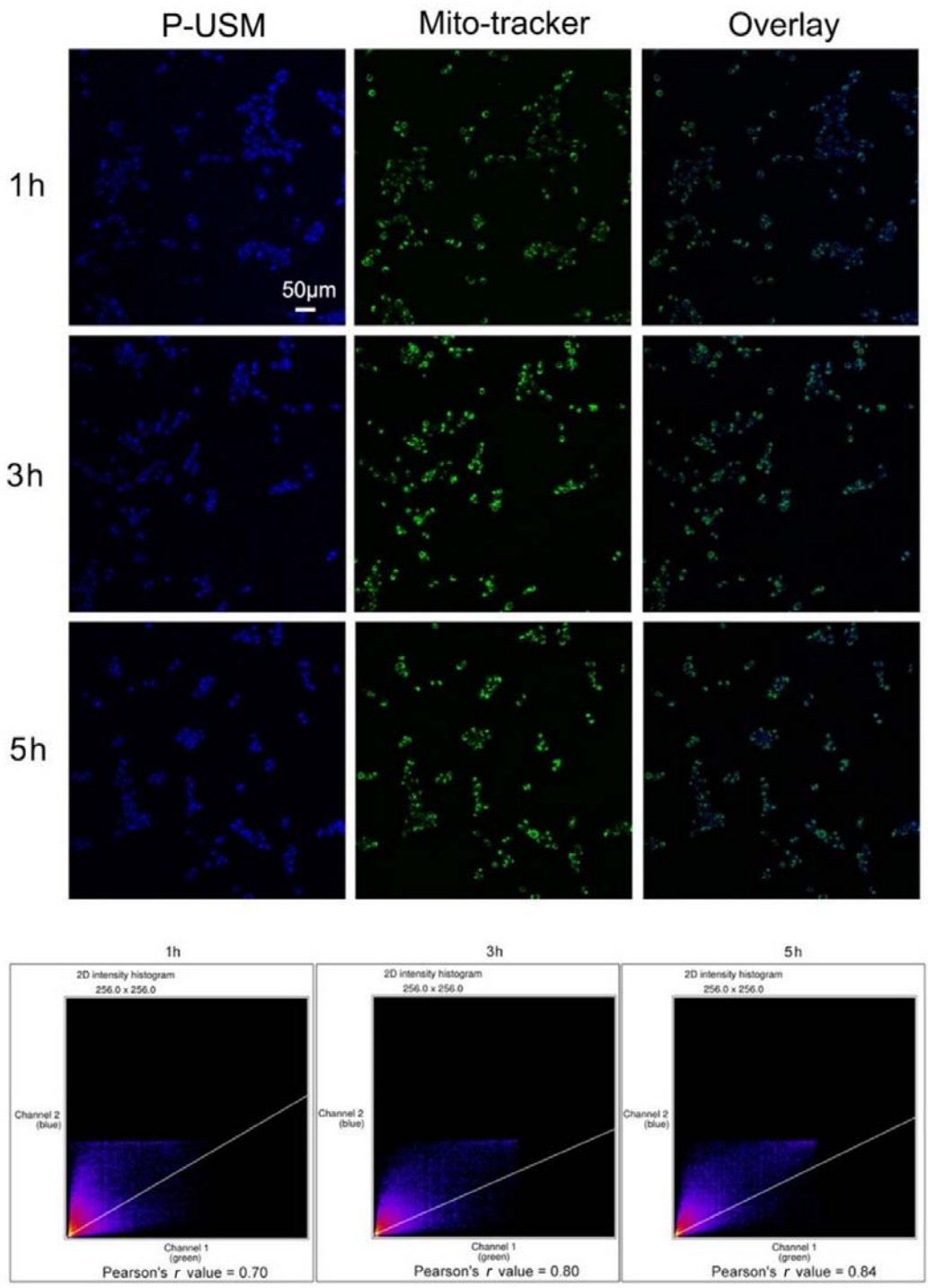
Additional Figure 3. The intracellular effect of P-USM without antibody modification. Confocal microscopy images of the A549 (human lung cancer) cells co-incubated with P-USM (500μg/mL) for different durations (1, 3, and 5hours), and the corresponding

Pearson’s *R* value. Note that the Pearson’s *R* value relates to the intracellular effect. All images have the same magnification. P-USM=polymer-modified upconversion nanoparticle@silica@manganese dioxide.



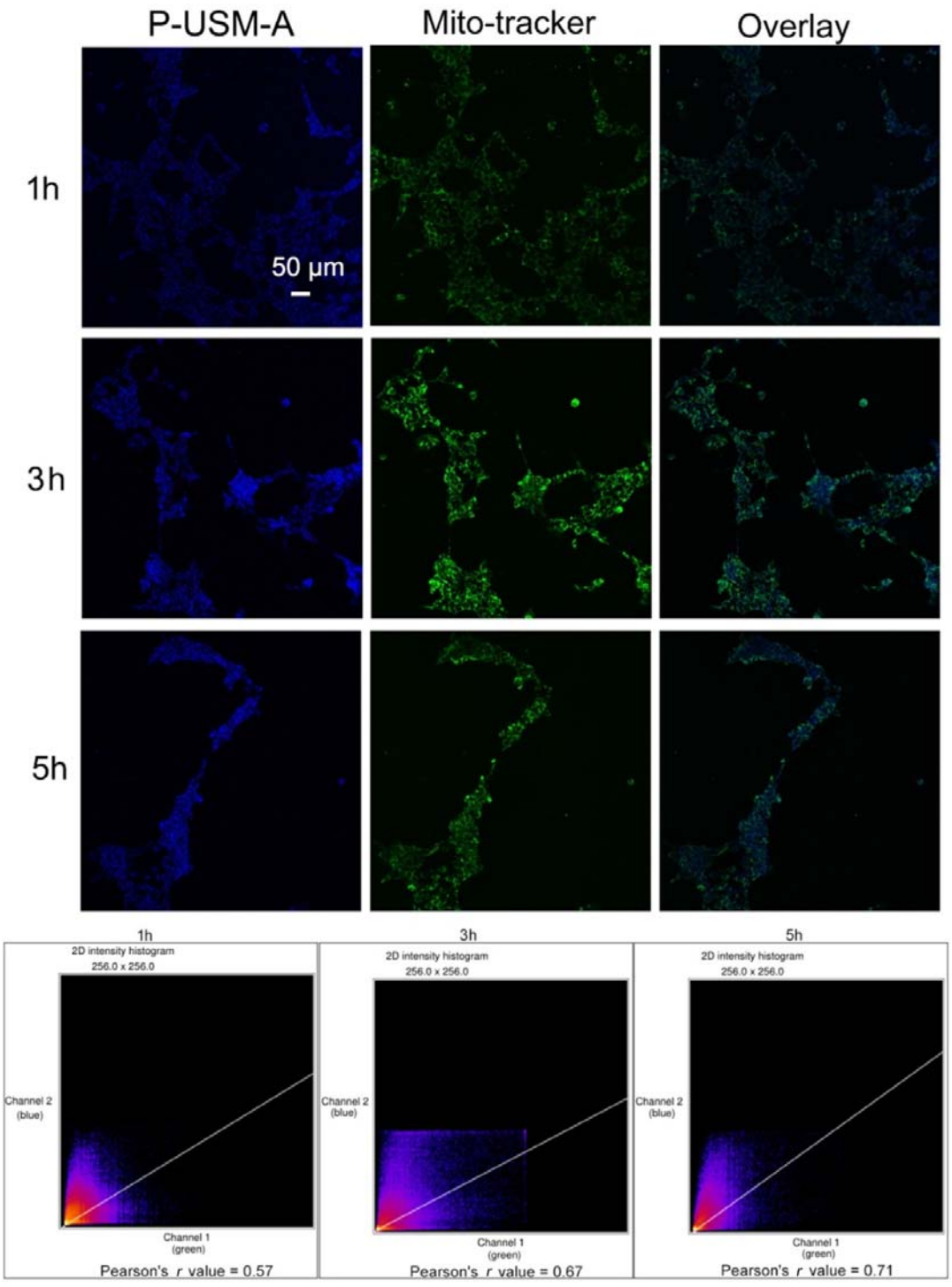
Additional Figure 4. The intracellular effect of antibody-modified material (P-USM-A). Confocal microscopy images of the C27 cells co-incubated with P-USM-A (500μg/mL)

for different durations (1, 3, and 5hours), and the corresponding Pearson's *R* value. Note that the Pearson's *R* value relates to the intracellular effect. All images have the same magnification. P-USM=polymer-modified upconversion nanoparticle@silica@manganese dioxide.



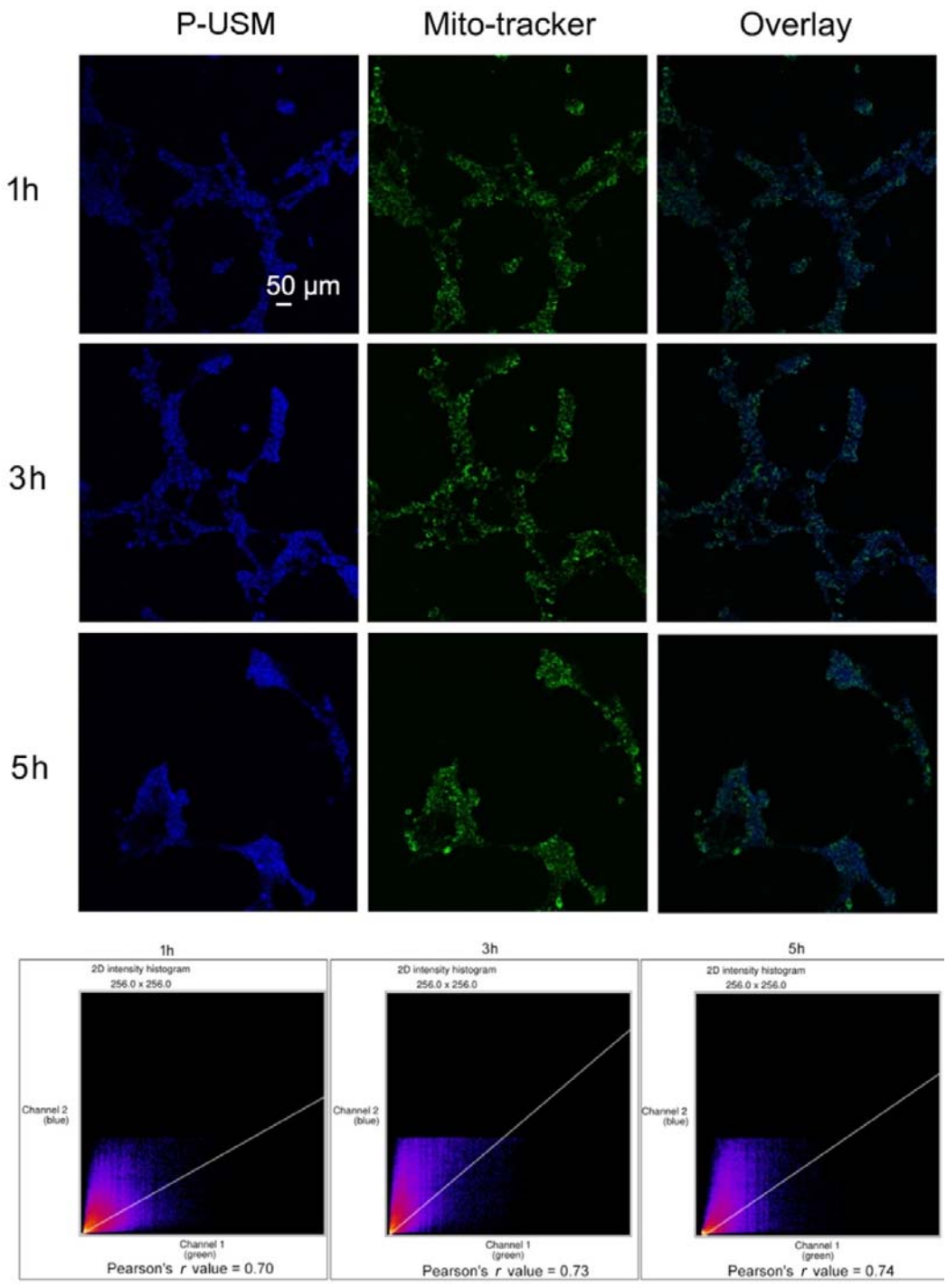
Additional Figure 5. The intracellular effect of P-USM without antibody modification. Confocal microscopy images of the C27 (human tongue) cells co-incubated with P-USM (500μg/mL) for different durations (1, 3, and 5hours) and the corresponding Pearson's *R*

value. Note that the Pearson's *R* value relates to the intracellular effect. All images have the same magnification. P-USM=polymer-modified upconversion nanoparticle@silica@manganese dioxide.



Additional Figure 6. The intracellular effect of the antibody-modified material (P-USM-

A). Confocal microscopy images of the 4T1 cells co-incubated with P-USM-A (500μg/mL) for different durations (1, 3, and 5hours) and the corresponding Pearson's *R* value of the 4T1 cells cultured with P-USM-A (500μg/mL). Note that the Pearson's *R* value relates to the intracellular effect. All images have the same magnification. P-USM=polymer modified upconversion nanoparticle@silica@manganese dioxide.



Additional Figure 7. The intracellular effect of P-USM without antibody modification. Confocal microscopy images of the 4T1 (mouse breast cancer) cells co-incubated with P-

USM (500μg/mL) for different durations (1, 3, and 5hours) and the corresponding Pearson's *R* value of the 4T1 cells cultured with UCNP (500μg/mL) for different time points. Note that the Pearson's *R* value relates to the intracellular effect. All images have the same magnification. P-USM=polymer-modified upconversion nanoparticle@silica@manganese dioxide.

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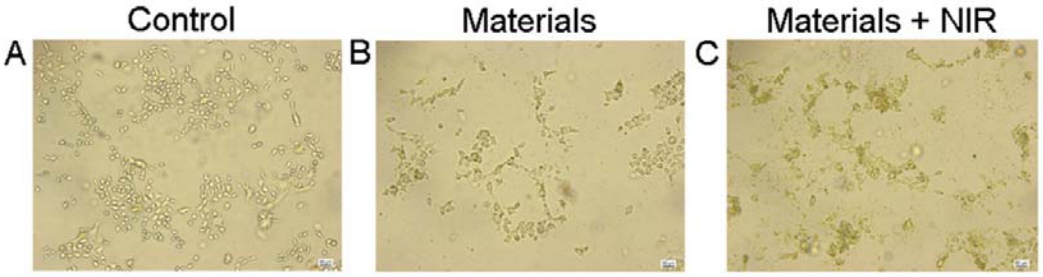

Additional Figure 8. Trypan blue staining experiment. The microscopy images of A549 cells incubated with (A) culture only, (B) P-USM material, and (C) P-USM material under near-infrared (NIR) laser irradiation. P-USM=polymer-modified upconversion nanoparticle@silica@manganese dioxide.

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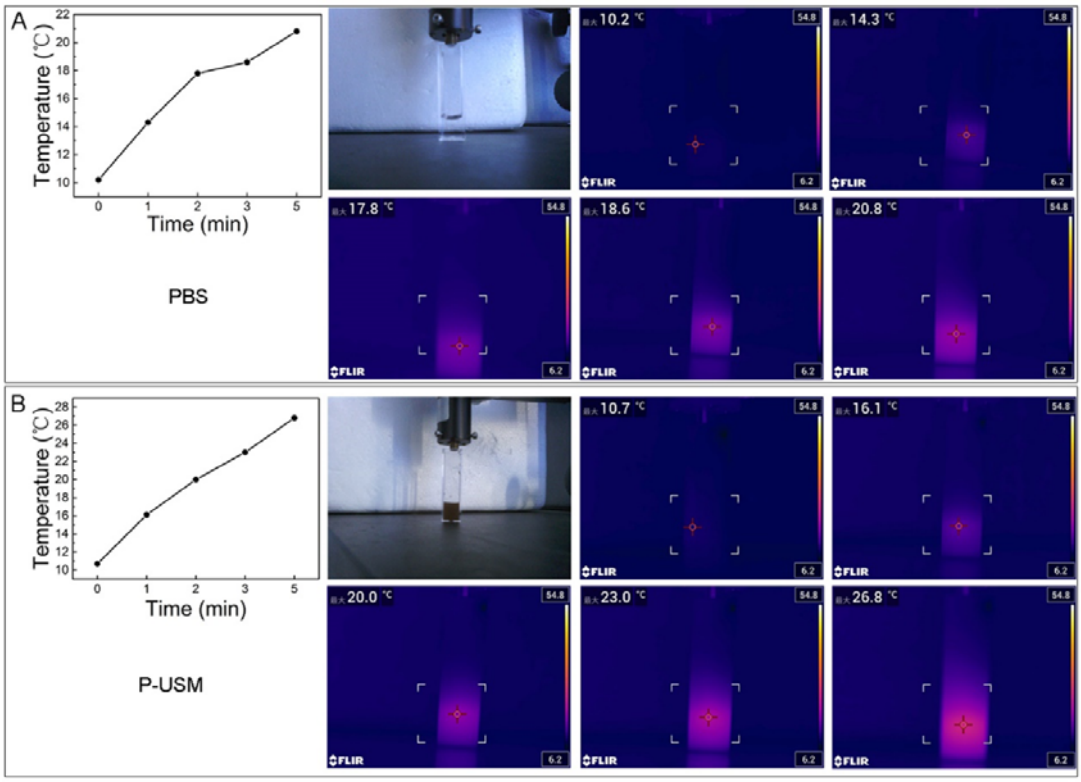
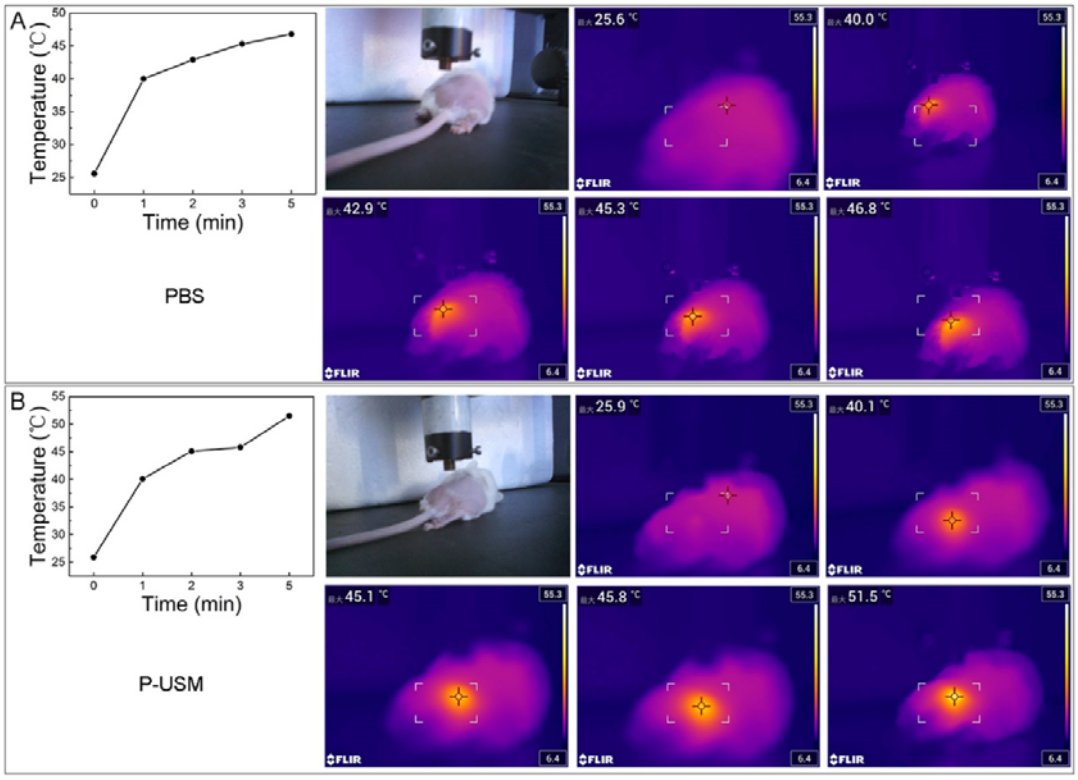


Additional Figure 9. In vitro photothermal effect. Infrared thermal photographs of (A) PBS and (B) P-USM solution (0.1mL). All solution concentrations were 4mg/mL. PBS=phosphate buffer saline, P-USM=polymer-modified upconversion nanoparticle@silica@manganese dioxide.



Additional Figure 10. In vivo photothermal effect. Infrared thermal photographs of a mouse after injection with (A) PBS and (B) P-USM solution (100μL). All solution concentrations were 4mg/mL. PBS=phosphate buffer saline, P-USM=polymer-modified upconversion nanoparticle@silica@manganese dioxide.

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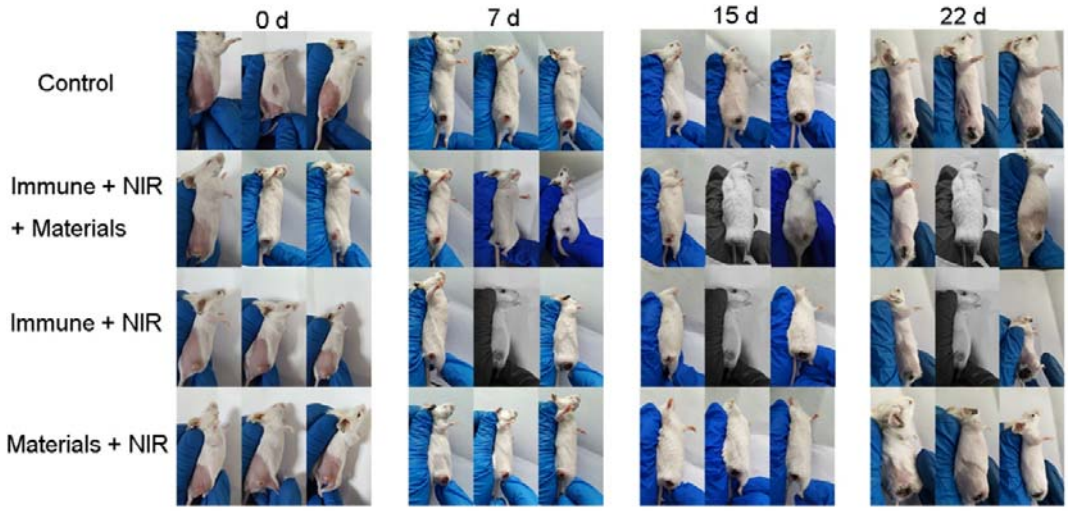

Additional Figure 11. Survival of mice in the four treatment groups. The photographs show the mice with different treatments at different times post-treatment. NIR=near infrared.