

Supporting Information

MnO₂ Nanotubes-based NanoSearchlight for Imaging of Multiple MicroRNAs in Live Cells

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Table S1 Sequences of DNA probes.

	Sequences
miRNA-155	5'-UUAAUGC UAAUCGUGAUAGGGGU-3'
miRNA-21	5'-UAGCUUAUCAGACUGAUGUUGA-3'
Cy5-ssDNA-155	5'-/Cy5/ACCCCTATCACGATTAGCATTAA-3'
Cy3-ssDNA-21	5'-/Cy3/TCAACATCAGTCTGATAAGCTA-3'
Cy5-ODN	5'-Cy5-CAAGCTGATTACACCCGGTGA-3'

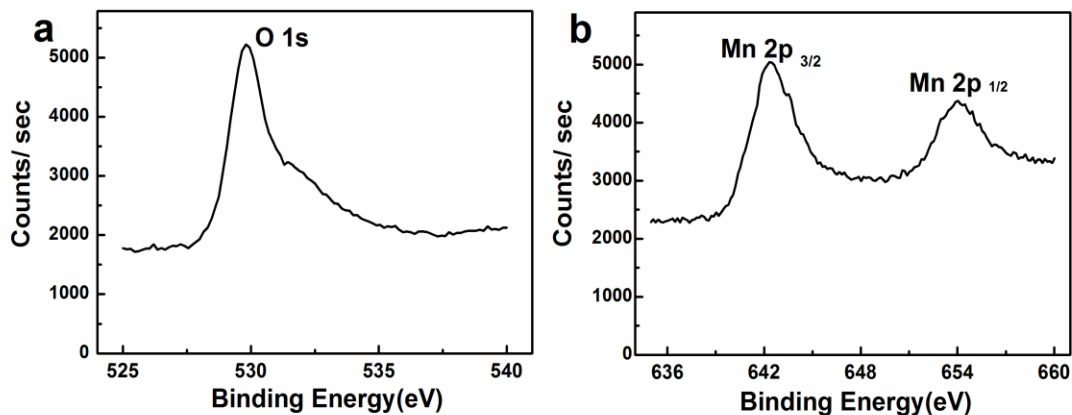


Figure S1 X-ray photoelectron spectroscopy of MnO₂ nanotubes (a, b).

The peaks of O (1s), Mn (2p_{3/2}) and Mn (2p_{1/2}) were recorded at the binding energy of around 529.8 (a), 642.3 and 654.0 eV (b), indicating that KMnO₄ was converted to MnO₂ nanotubes reduced by PDDA.^[1, 2]

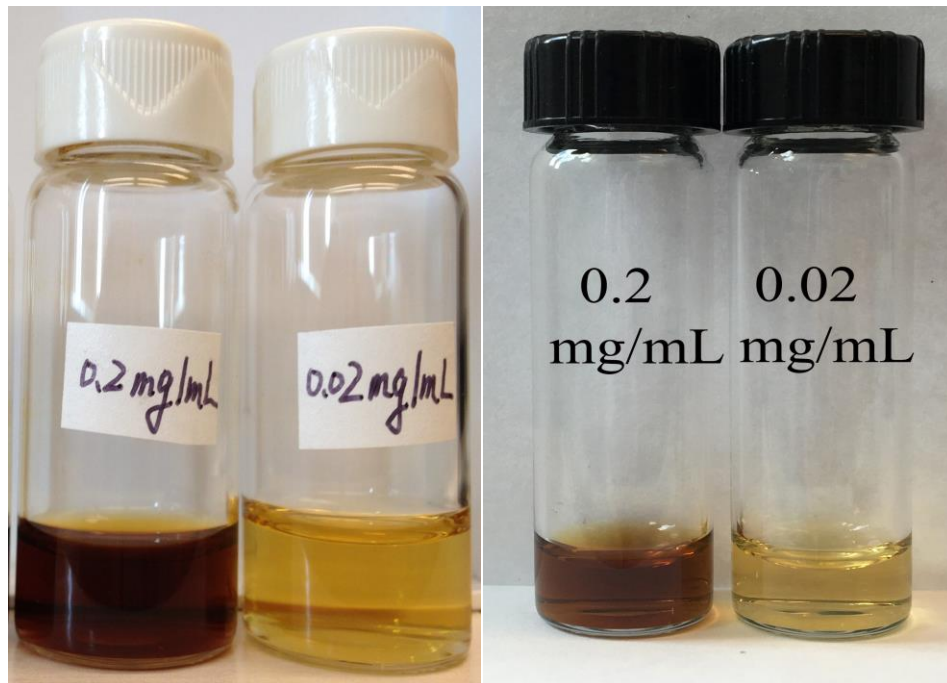


Figure S2 Photos of MnO₂ nanotubes dispersed in water (left) and after 3 months (right).

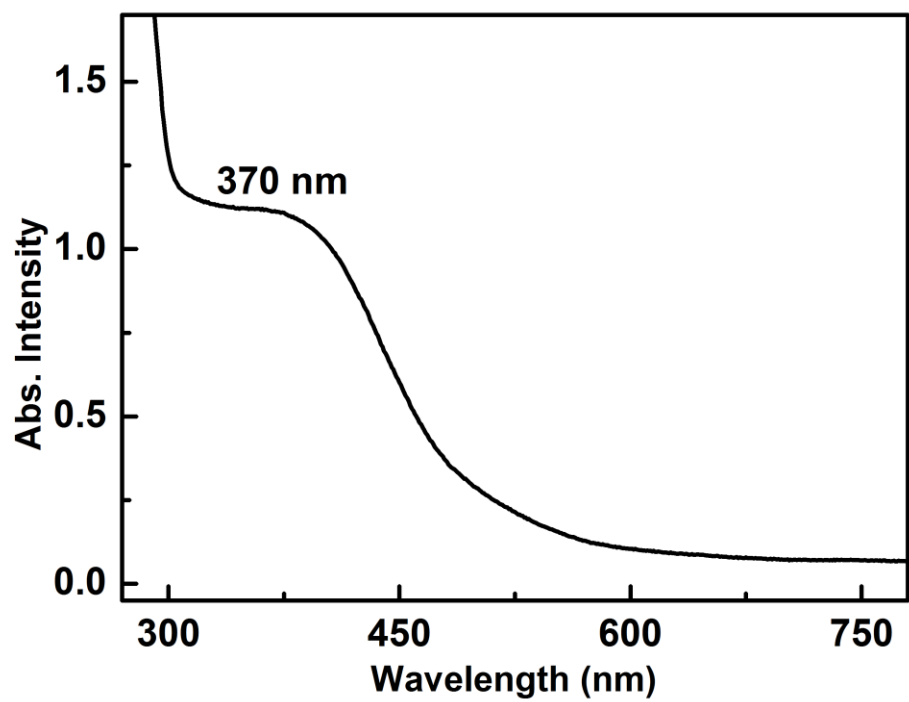


Figure S3 UV-vis absorption spectrum of MnO₂ nanotubes.

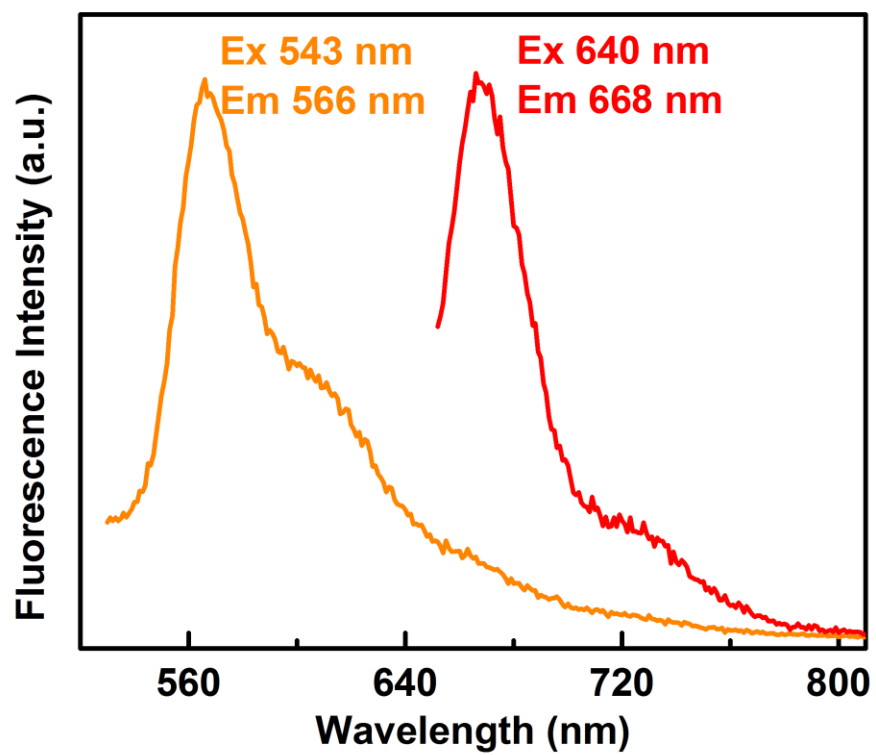


Figure S4 Fluorescence spectra of Cy3-ssDNA-21 (orange) and Cy5-ssDNA-155 (red).

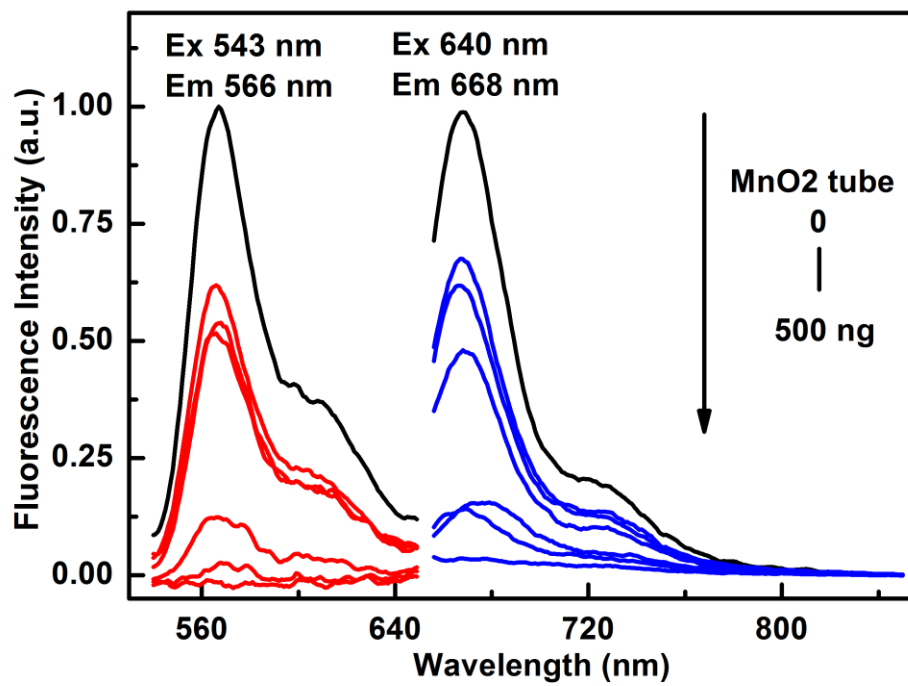


Figure S5 Fluorescence quenching of Cy3-ssDNA-21 and Cy5-ssDNA-155 (5 nM) by different concentration of MnO₂ nanotubes (0, 50, 100, 150, 200, 350, 500 ng/mL) for 5 min.

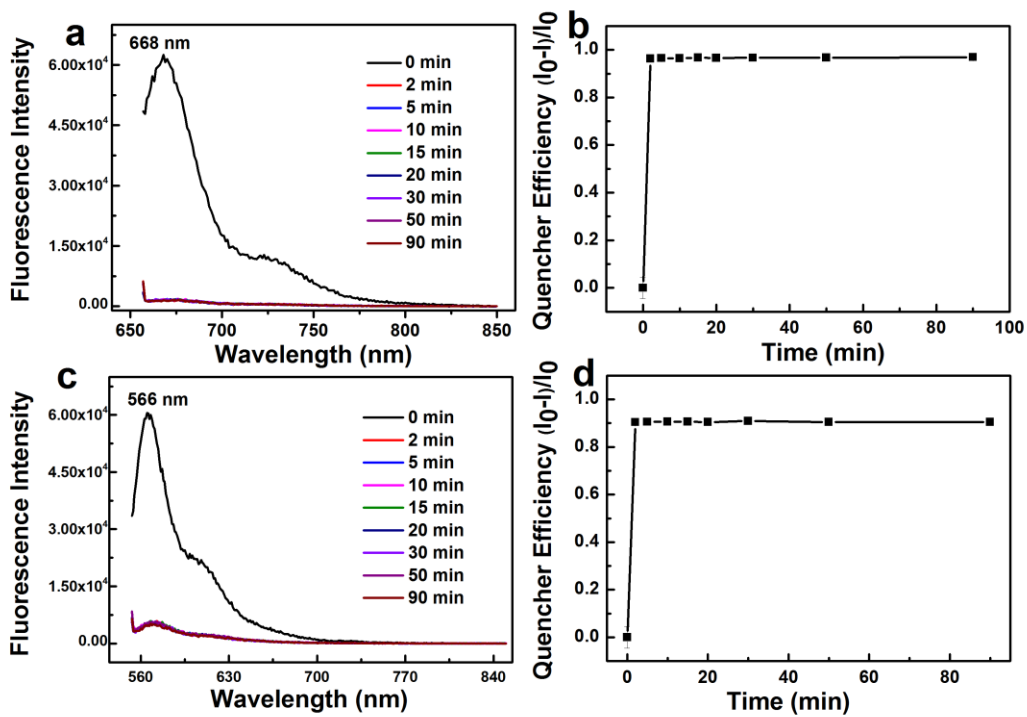


Figure S6 Fluorescence quenching of Cy5-ssDNA-155 (5 nM) (a, b) and Cy3-ssDNA-21 (5 nM) (c, d) by MnO₂ nanotubes (500 ng/mL).

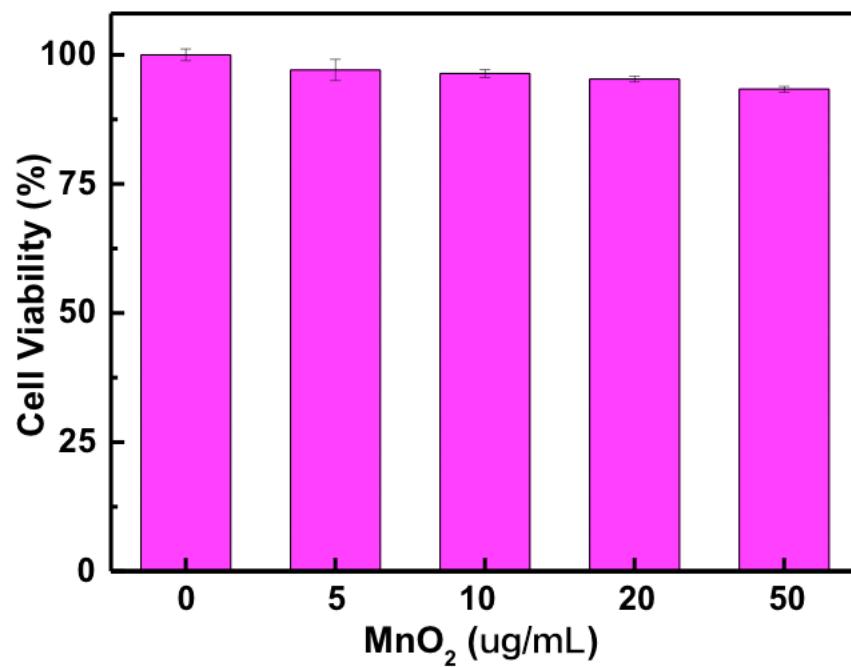


Figure S7 Cytotoxicity of MnO₂ nanotubes in MCF-7 cells.

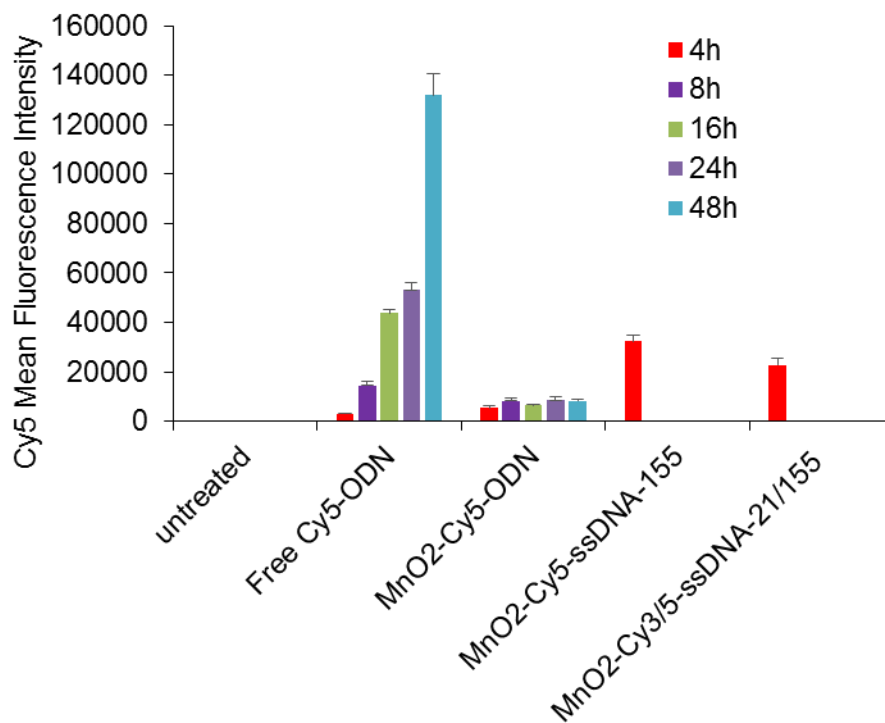


Figure S8 Fluorescence intensity of Cy5 after MCF7 cells were treated with free Cy5-ODN and MnO₂-Cy5-ODN, MnO₂-Cy5-ssDNA-155 and MnO₂-Cy3/5-ssDNA-21/155 at Cy5-ODN concentration of 100nM.

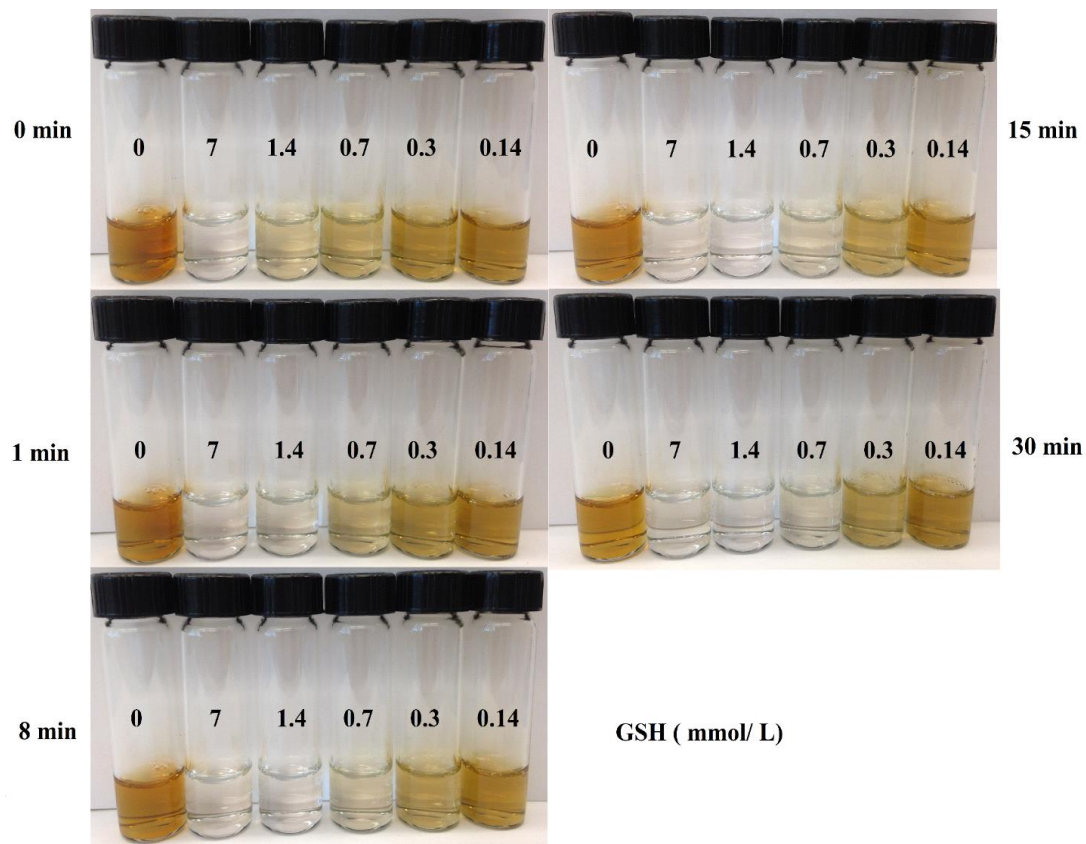


Figure S9 Color changes of $100 \mu\text{g mL}^{-1}$ MnO_2 nanotubes at 0, 1, 8, 15 and 30 min after treated with increasing concentration of GSH (0, 0.14, 0.3, 0.7, 1.4, 7.0 mM).

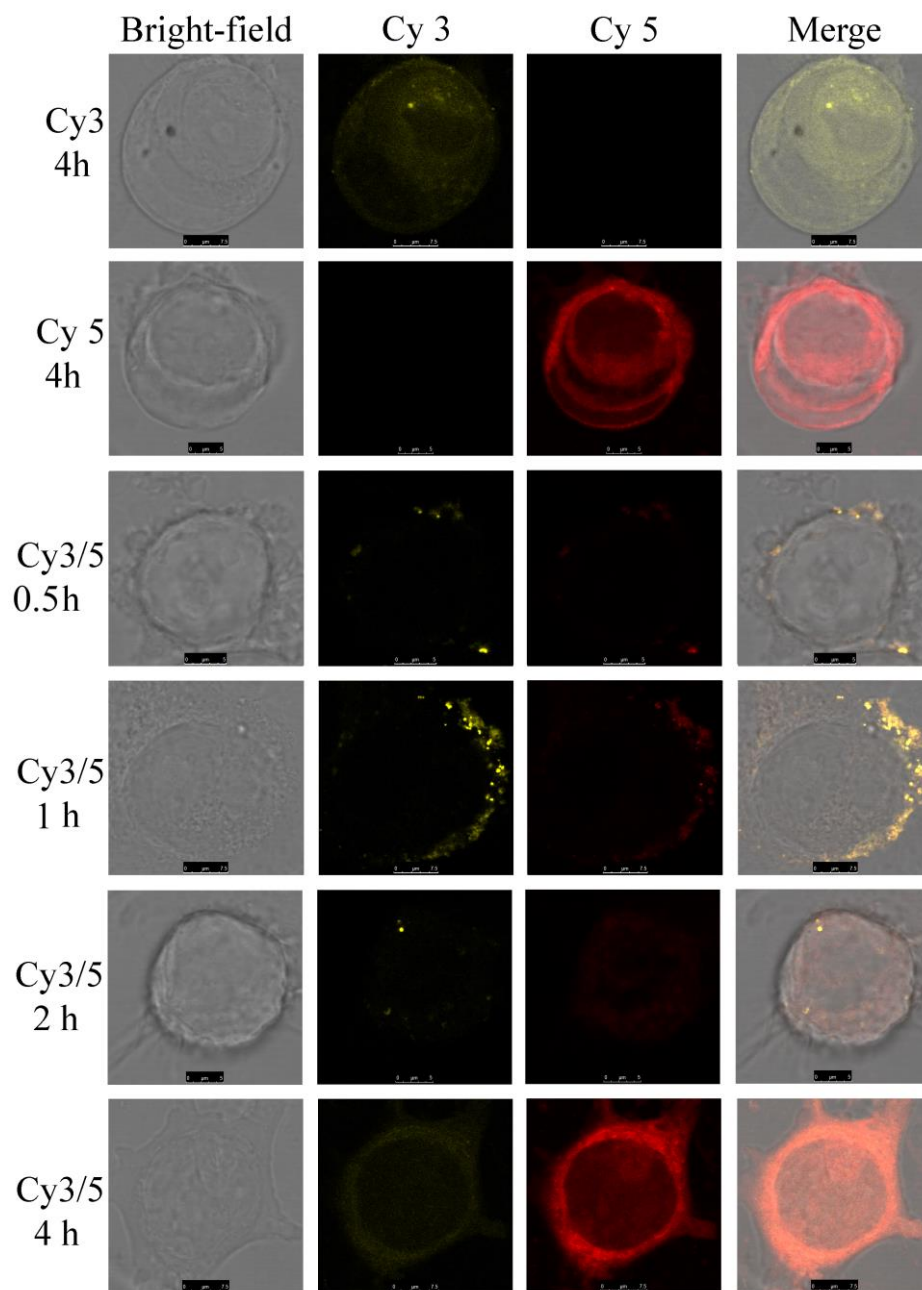


Figure S10 Confocal microscopy images of MCF-7 single cells at 0.5, 1, 2, and 4 h after the MCF-7 cells were treated with MnO₂-Cy3-ssDNA-21, MnO₂-Cy5-ssDNA-155 and MnO₂-Cy3-ssDNA-21/Cy5-ssDNA-155.

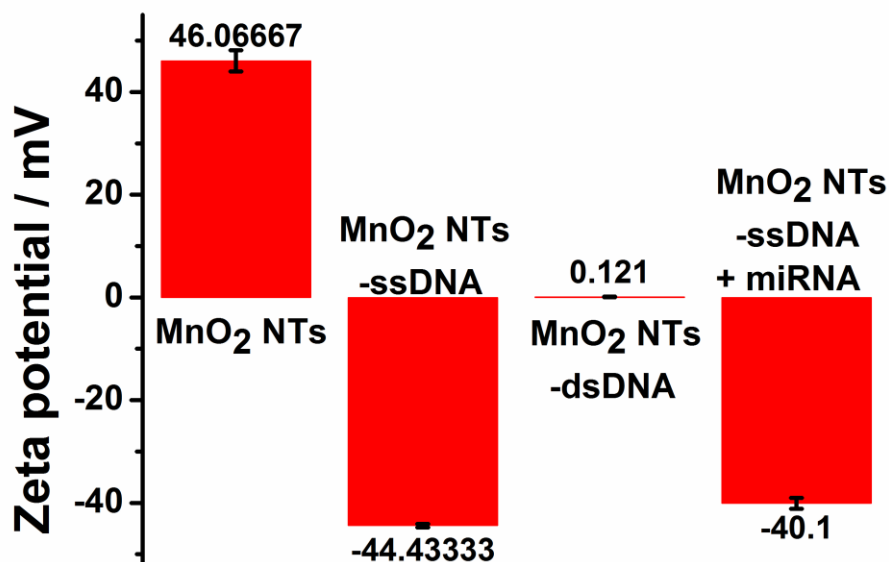


Figure S11 Zeta potential of MnO₂ nanotubes (40.0 μg mL⁻¹), MnO₂- ssDNA (40.0 μg mL⁻¹ MnO₂ nanotubes were mixed with 0.2 μM Cy5-ssDNA-155 and 0.2 μM Cy3-ssDNA-21), MnO₂- dsDNA (0.2 μM Cy5-ssDNA-155 and 0.2 μM miRNA 21, 0.2 μM Cy3-ssDNA-21 and 0.2 μM miRNA 155 was incubated at 37 °C in a water bath for 10 min. Then the two solutions were mixed and added to 40.0 μg mL⁻¹ MnO₂ nanotubes), MnO₂ NTs- ssDNA+ miRNA (40.0 μg mL⁻¹ MnO₂ nanotubes, 0.2 μM Cy5-ssDNA-155 and 0.2 μM Cy3-ssDNA-21 were mixed. After 5 min, 0.2 μM miRNA-155 and 0.2 μM miRNA-21 were added and the mixture was incubated at 37 °C in a water bath for 10 min).

References

- [1] Zhao, Z.; Fan, H.; Zhou, G.; Bai, H.; Liang, H.; Wang, R.; Zhang, X.; Tan, W. Activatable Fluorescence/MRI Bimodal Platform for Tumor Cell Imaging via MnO₂ Nanosheet–Aptamer Nanoprobe. *J. Am. Chem. Soc.* **2014**, *136*, 11220-11223.
- [2] Chen, Y.; Ye, D.; Wu, M.; Chen, H.; Zhang, L.; Shi, J.; Wang, L. Break-up of Two-Dimensional MnO₂ Nanosheets Promotes Ultrasensitive pH-Triggered Theranostics of Cancer. *Adv. Mater.* **2014**, *26*, 7019-7026.