Electronic Supplementary Information (ESI)

MnO_2 Nanosheets Mediated "DD-A" FRET Binary Probes for Sensitive Detection of Intracellular mRNA

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Supporting tables

Table S1. Oligonucleotide sequences

Oligo	Sequences(5'-3')
DNA target	CTGGTGATCAAGTATGCCAAAGACACTCGCTACAGCAGCA
one-base mismatched target:	CTGGTGATAAAGTATGCCAAAGACACTCGCTACAGCAGCA
single labelled-donor probe	FAM-TTGGCATACTTGATCACC
double labelled-donor probe	FAM-TT(-FAM)GGCATACTTGATCACC
single labelled-acceptor probe	TGCTGCTGTAGCGAGTGT-TAMRA
double labelled-acceptor probe	TGCTGCTGTAG GAGT(-TAMRA)GT-TAMRA
TK1 forward	CTCCTACCCACTGGTCTGCTTA
TK1 reverse	CAGGGAGAACAGAAACTCAGCA
GAPDH forward	TGGGTGTGAACCATGAGAAGT
GAPDH reverse	TGAGTCCTTCCACGATACCAA

The part of TK1 mRNA (red part denotes the selected target sequence):

AUGAGCUGCAUUAACCUGCCCACUGUGCUGCCUGGCUCCCCCAGCAAGACCCGGGG
GCAGAUCCAGGUGAUUCUCGGGCCGAUGUUCUCAGGAAAAAGCACAGAGUUGAUG
AGACGCGUCCGUCGCUUCCAGAUUGCUCAGUACAAGUGC**CUGGUGAUCAAGUAUG**
CCAAAGACACUCGCUACAGCAGCAGCUUCUGCACACAUGACCGGAACACCAUGGA
GGCACUGCCCGCCUGCCUGCUCCGAGACGUGGCCCAGGAGGCCCUGGGCGUGGCUG
UCAUAGGCAUCGACGAGGGGCAGUUUUUCCCUGACAUCGUGGAGUUCUGCGAGGC
CAUGGCCAACGCCGGGAAGACCGUAAUUGUGGCUGCACUGGAUGGGACCUUCCAG
AGGAAGCCAUUUGGGGCCAUCCUGAACCUGGUGCCGCUGGCCGAGAGCGUGGUGA
AGCUGACGGCGGUGUGCAUGGAGUGCUUCCGGGAAGCCGCCUAUACCAAGAGGCU
CGGCACAGAGAAGGAGGUCGAGGUGAUUGGGGGAGCAGACAAGUACCACUCCGUG
UGUCGGCU

Supporting Figures

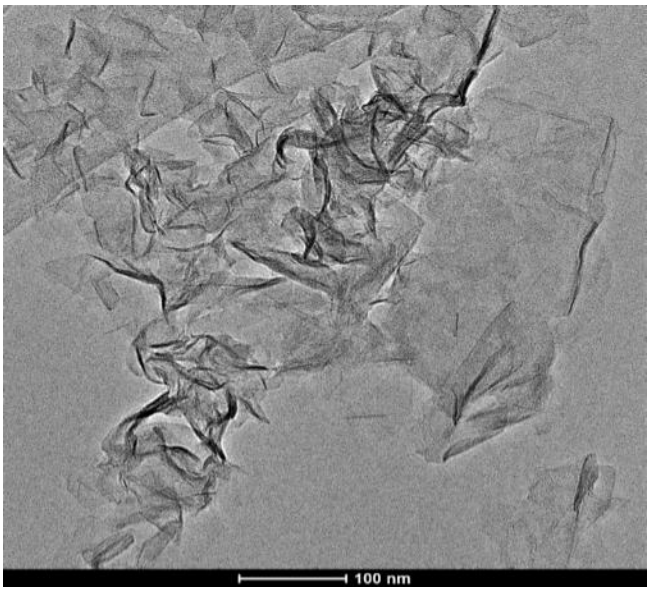


Figure S1. Transmission electron microscope (TEM) images of MnO_2 nanosheets.

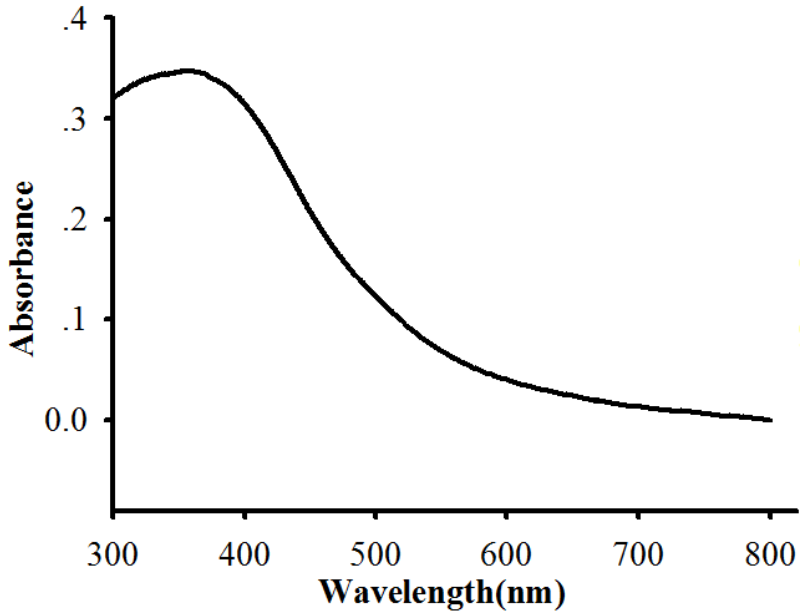


Figure S2.UV-vis adsorption spectrum characterization of MnO_2 nanosheets.

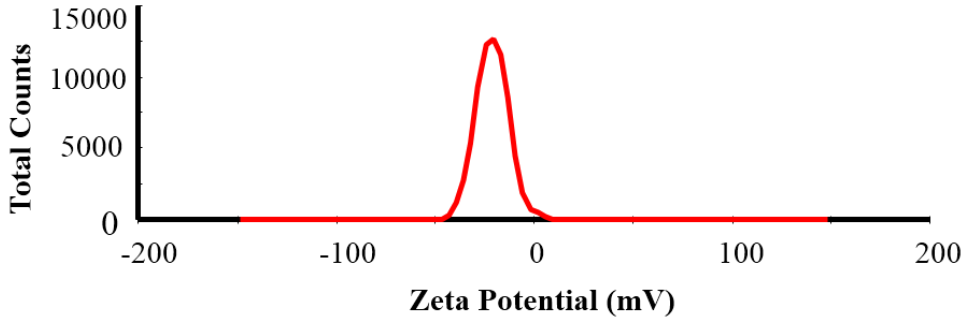


Figure S3. Zata potential analysis characterization of MnO_2 nanosheets.

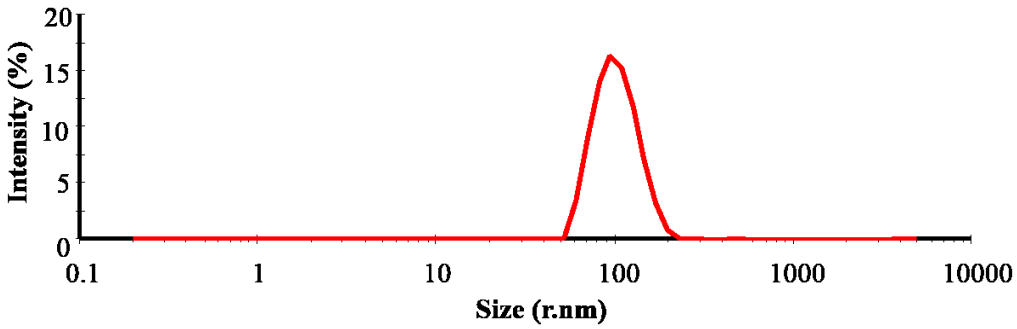
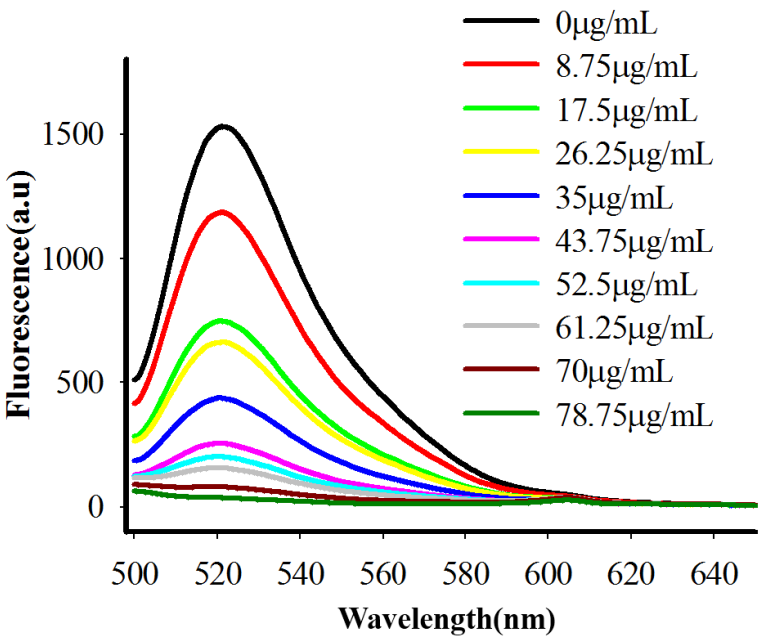


Figure S4. Dynamic light scattering (DLS) results of MnO_2 nanosheets.

(a)



(b)

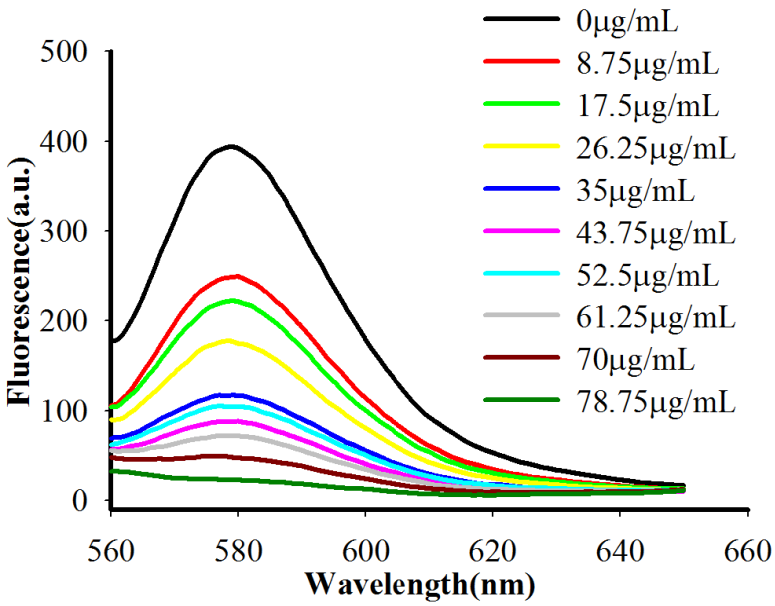


Figure S5. Adsorption of (a) FAM-labelled probes (100 nM) and (b) TAMRA-labelled (100 nM) probes on MnO_2 nanosheets at different concentrations.

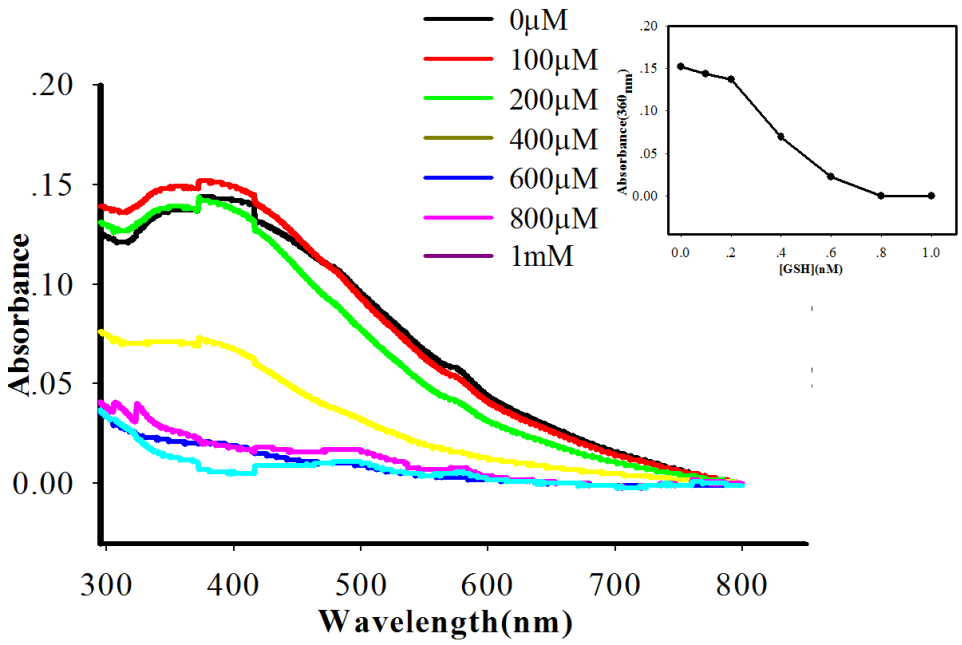


Figure S6. UV-vis absorption spectrum response of FAM-labelled probes/ MnO_2 nanosheets to different concentrations of GSH.

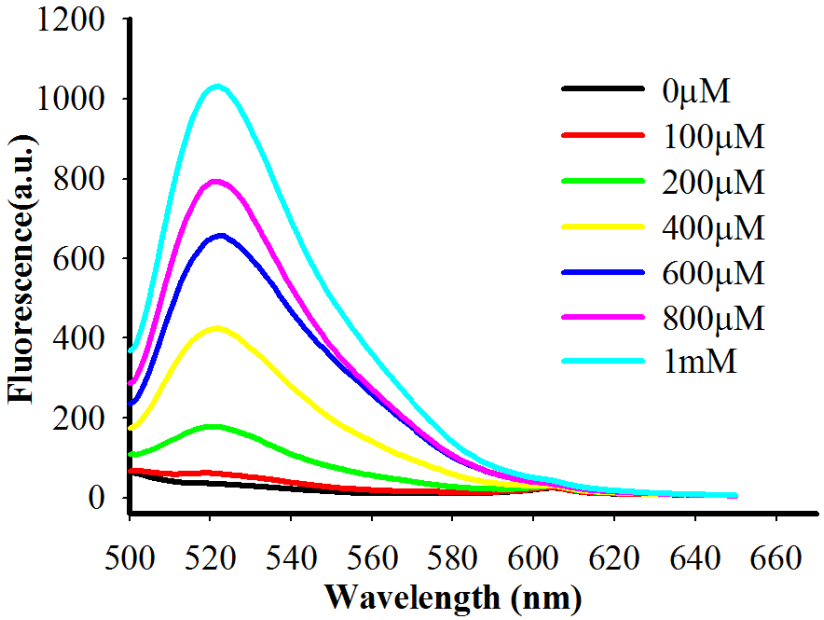


Figure S7. Fluorescence spectrum response of FAM-labelled probes/ MnO_2 nanosheets to different concentrations of GSH.

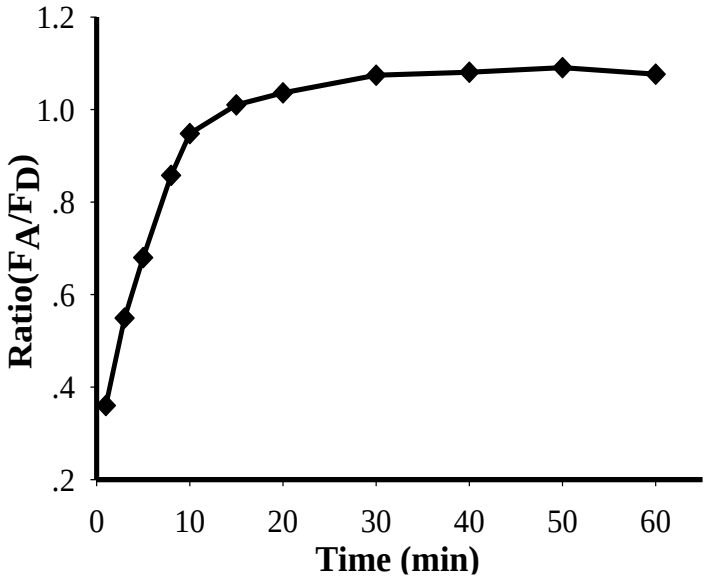


Figure S8. Kinetics of the MnO_2 nanosheets mediated "DD-A" FRET binary probes response to 50 nM target DNA.

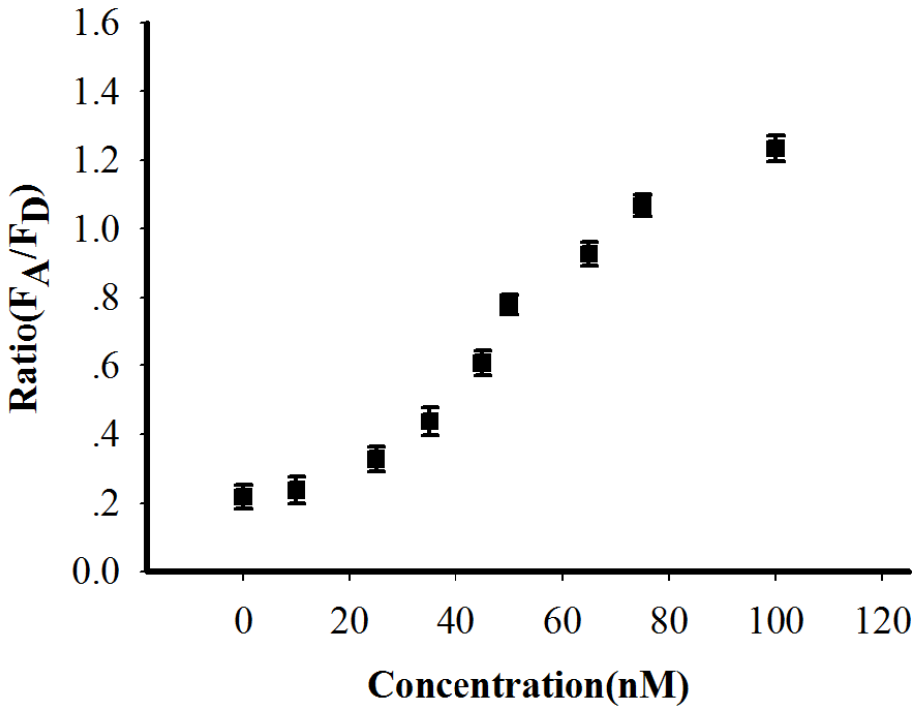


Figure S9. A plot of Acceptor-to-Donor ratio of the MnO_2 nanosheets mediated "D-A" FRET binary probes as a function of target concentrations. An estimated detection limit (three times the standard deviation in the blank solution) of the "D-A" model is 9.8 nM.

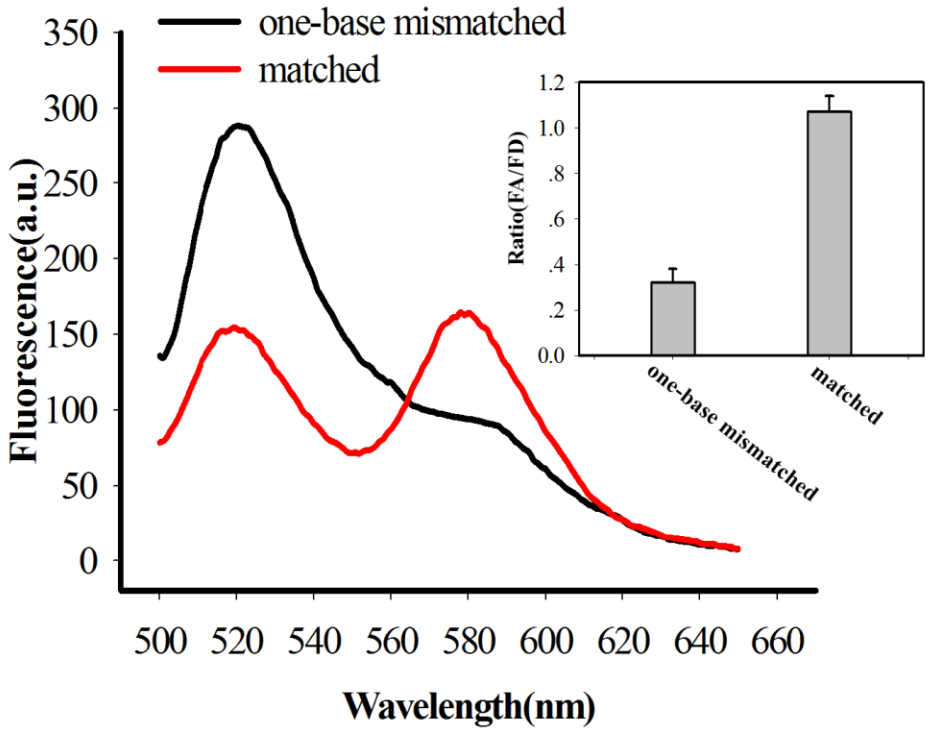


Figure S10. Selectivity studies of "DD-A" model between matched target and one-base mismatched target (50 nM each). Inset is a comparison histogram of matched target and one-base mismatched target.

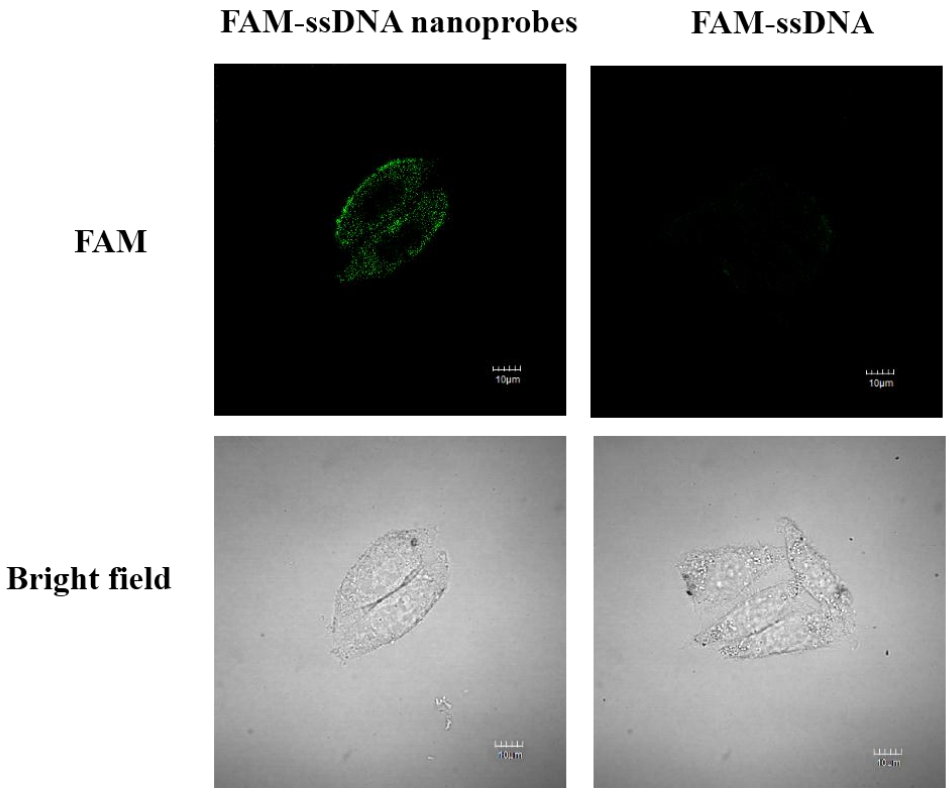


Figure S11. Fluorescence images of TK1 mRNA in HepG2 cells incubated with FAM-labelled probes/ MnO_2 nanosheets and free FAM-labelled probes, respectively. Scale bar: 10 μm.

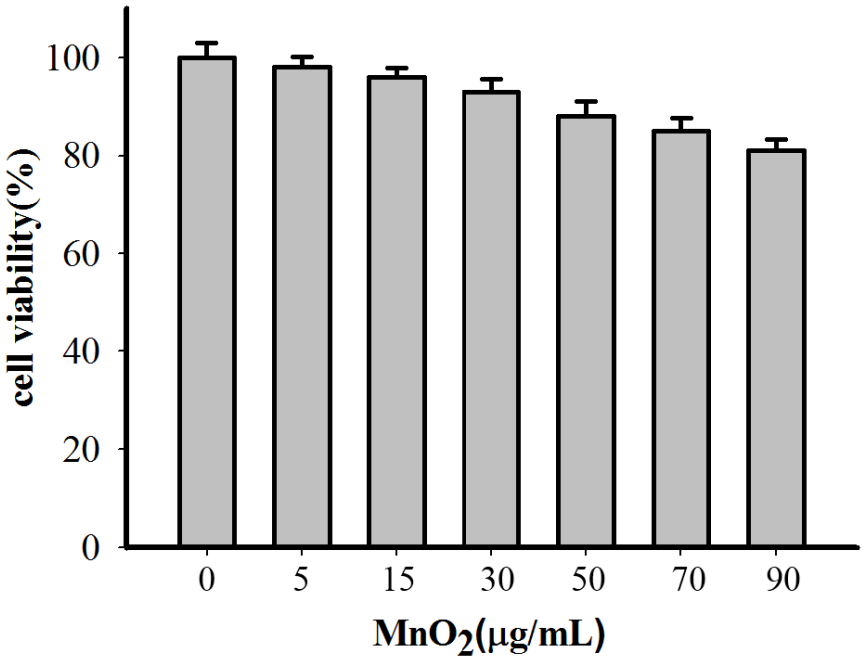


Figure S12. Cytotoxicity of MnO_2 nanosheets incubated with HepG2 cells at different concentrations.

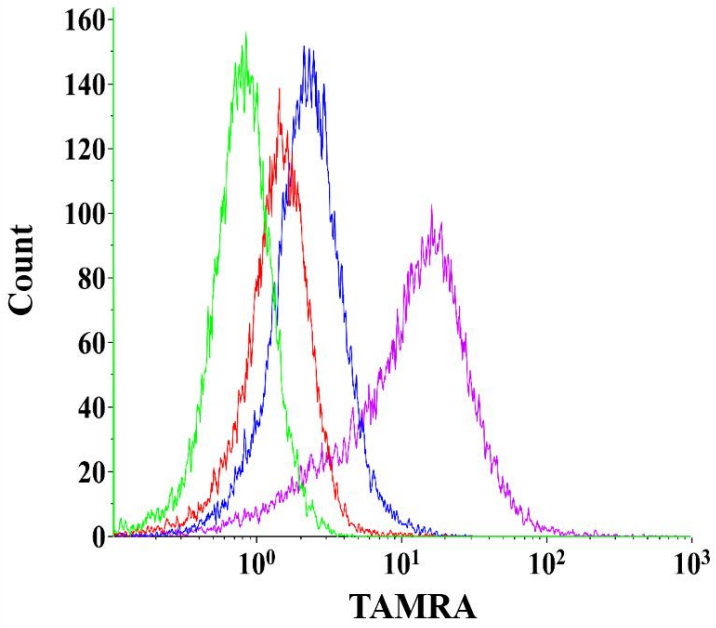


Figure S13. Flow cytometry analysis of with "D-AA", "D-A", "DD-AA" and "DD-A" models incubated with HepG2 cells, respectively.

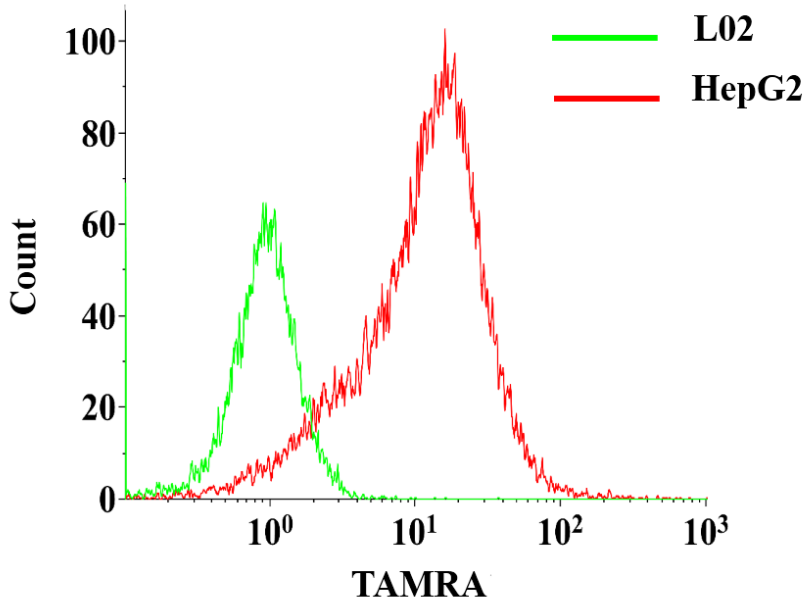
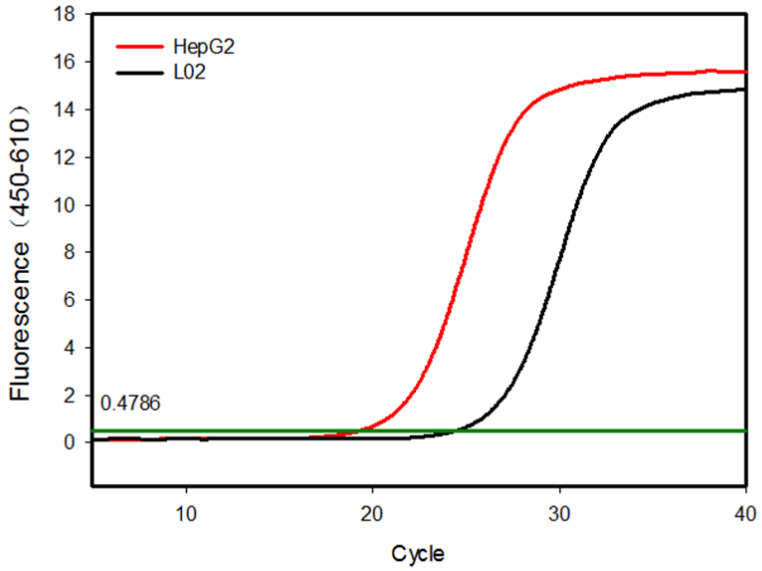


Figure S14. Flow cytometry analysis of the "DD-A" models incubated with HepG2 cells and L02 cells, respectively.

(a)



(b)

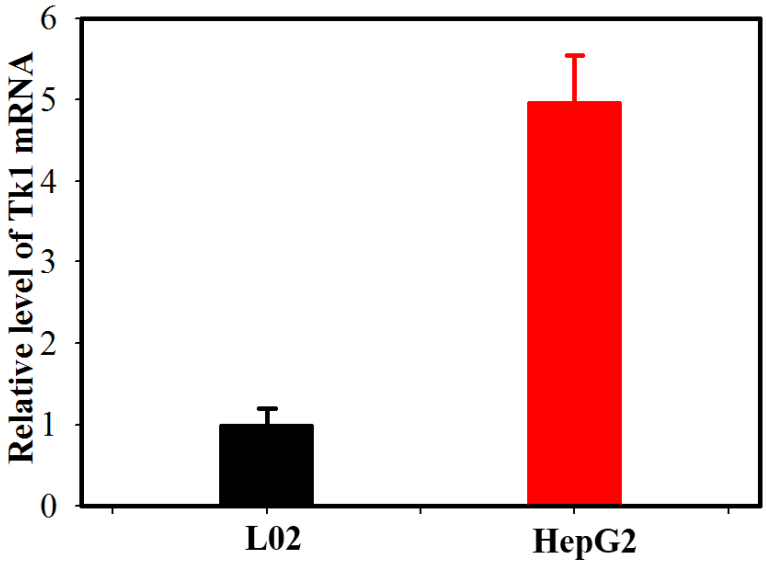


Figure S15. Analysis of Tk1 mRNA expressions in HepG2 and L02 cells by qRT-PCR. (a) Real-time fluorescence curves in qRT-PCR analysis. (b) Relative expression levels for Tk1 mRNA in two different cell lines.

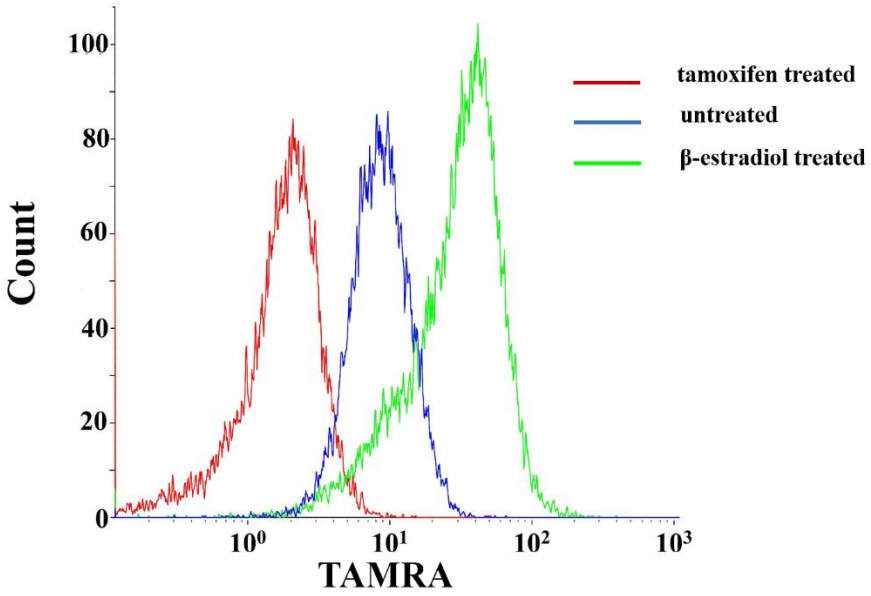


Figure S16. Flow cytometry analysis of the "DD-A" models incubated with different groups of HepG2 cells (untreated, tamoxifen-treated and β-estradiol-treated groups).