Electronic Supplementary Information

A dual-aptamer biosensor for specific detection of breast cancer biomarker HER2 *via* flower-like nanozymes and DNA nanostructures

Dan Ou,[a] Duanping Sun,*[ab] Xiangan Lin,[c] Zhixian Liang,[a] Yongsheng Zhong,[d] Zuanguang Chen*[a]

[a] School of Pharmaceutical Sciences, Sun Yat-Sen University, Guangzhou 510006, China

[b] Center for Drug Research and Development, Guangdong Pharmaceutical University, Guangzhou 510006, China

[c] Sun Yat-Sen Memorial Hospital, Sun Yat-Sen University, Guangzhou 510120, China

[d] East Campus Lab Center, Sun Yat-Sen University, Guangzhou 510006, China

* Corresponding authors.

E-mail: sundp@gdpu.edu.cn (D.P. Sun), chenzg@mail.sysu.edu.cn (Z.G. Chen).

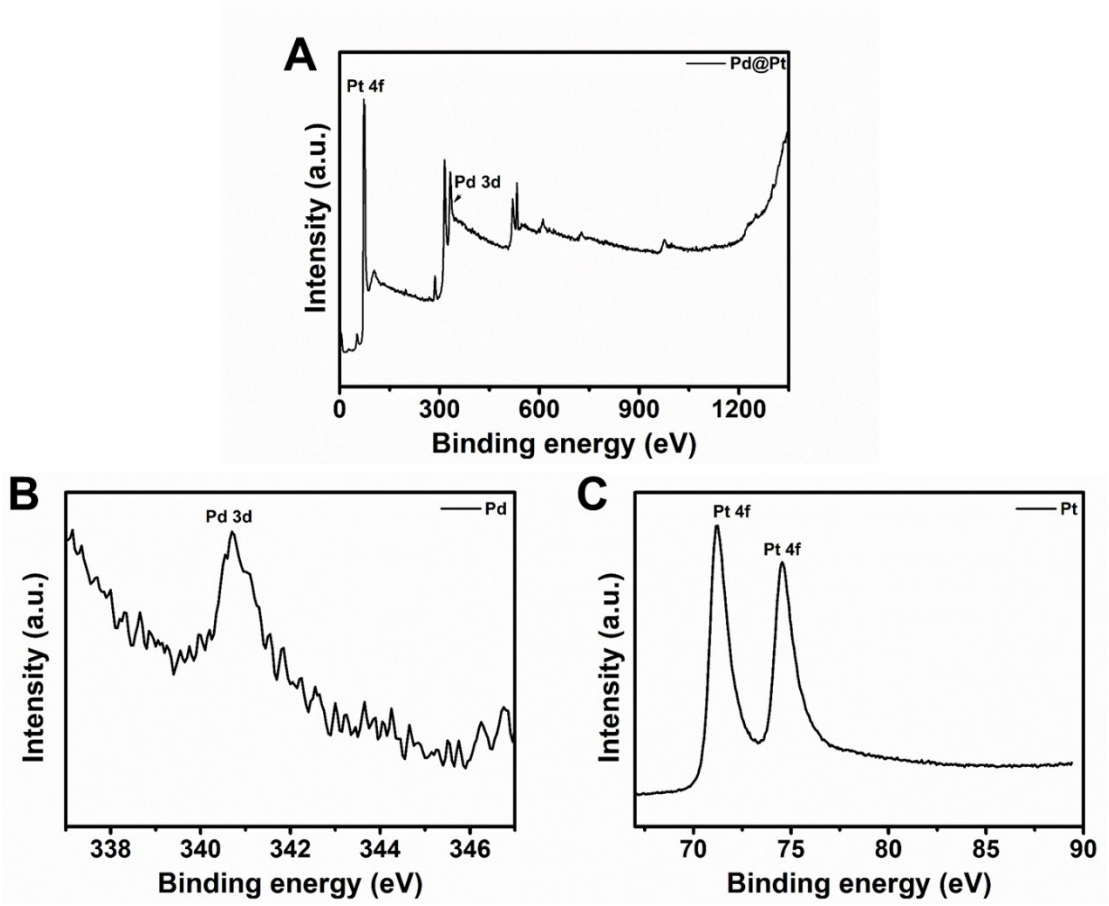

Figure S1. (A) X-ray photoelectron spectroscopy (XPS) spectrum of Pd@Pt NPs. (B) High-resolution XPS spectra of Pd 3d. (C) High-resolution XPS spectra of Pt 4f.

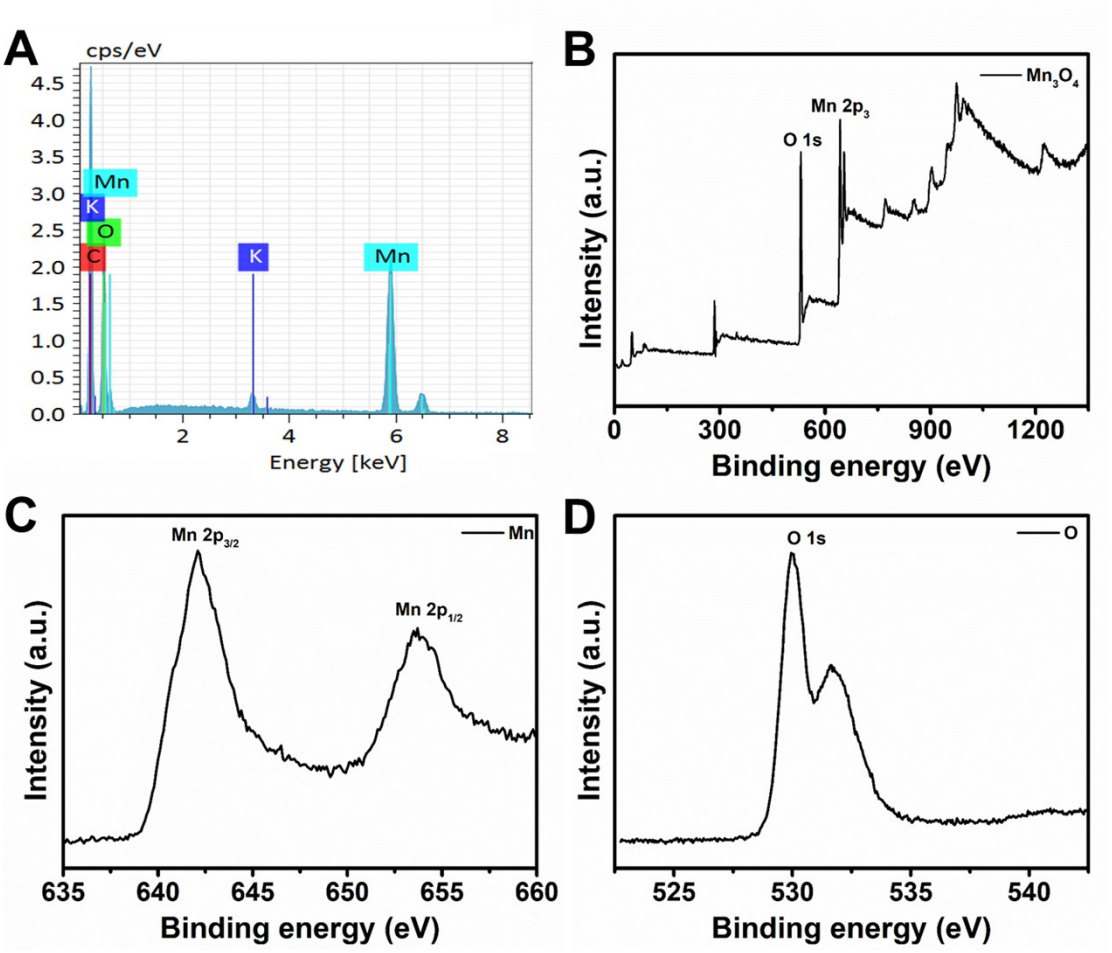

Figure S2. (A) Energy dispersive X-ray spectrum (EDS) of Mn_3O_4 NPs collected on a field emission scanning electron microscope (FE-SEM). (B) XPS spectrum of Mn_3O_4 NPs. (C) High-resolution XPS spectra of Mn $2p_{3/2}$ and Mn $2p_{1/2}$ photoelectron peaks. (D) High-resolution XPS spectra of O 1s photoelectron peaks.

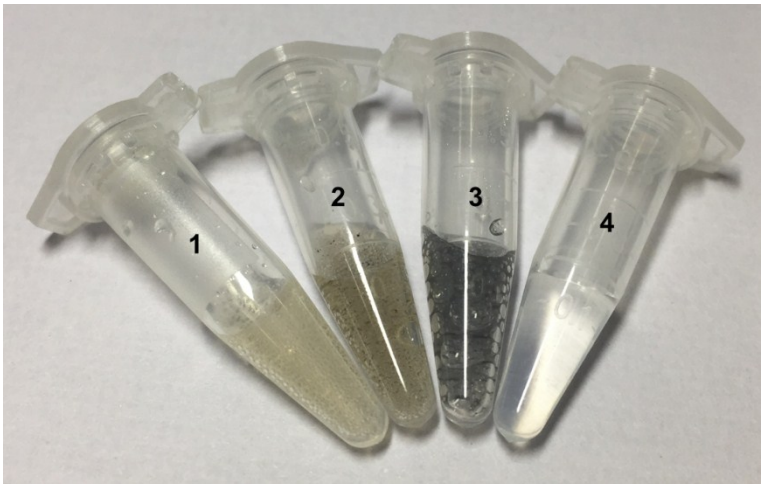

Figure S3. Photograph of characterization of catalytic activity of nanomaterials (The tubes were (1) catalase (10 μg/mL) + H_2O_2 (20 mM), (2) Mn_3O_4 NPs (50 μg/mL) + H_2O_2 (20 mM), (3) Pd@Pt NPs (50 μg/mL) + H_2O_2 (20 mM), and (4) H_2O_2 (20 mM) as the blank, respectively, were reacted at 25 °C.).

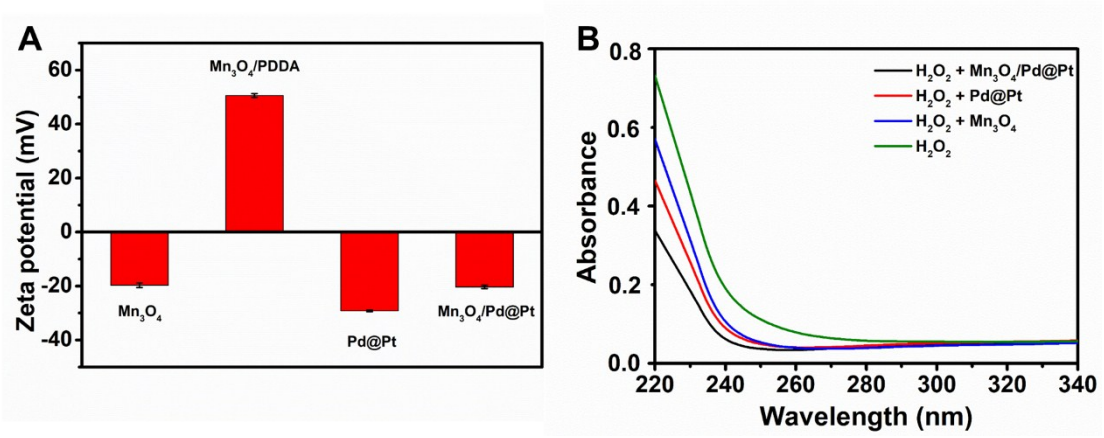

Figure S4. (A) Evolution of zeta potentials during the Mn_3O_4/Pd@Pt NPs nanocomposite assembly processes. (B) UV-vis spectra of remainder H_2O_2 after reaction with Mn_3O_4 NPs, Pd@Pt NPs and Mn_3O_4/Pd@Pt NPs.

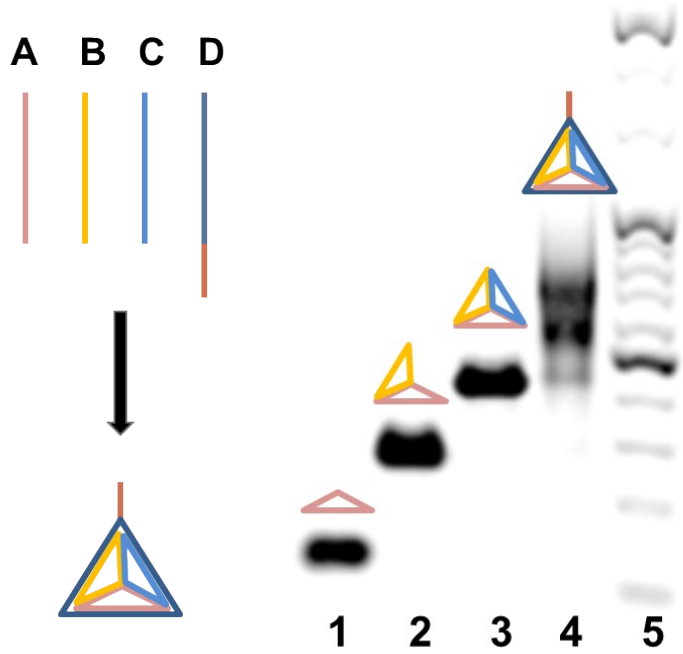

Figure S5. Agarose gel electrophoresis analysis of TDN-aptamer 1. Lane 1: A; Lane 2: A+B; Lane 3: A+B+C; Lane 4: A+B+C+D; Lane 5: DNA ladder marker.

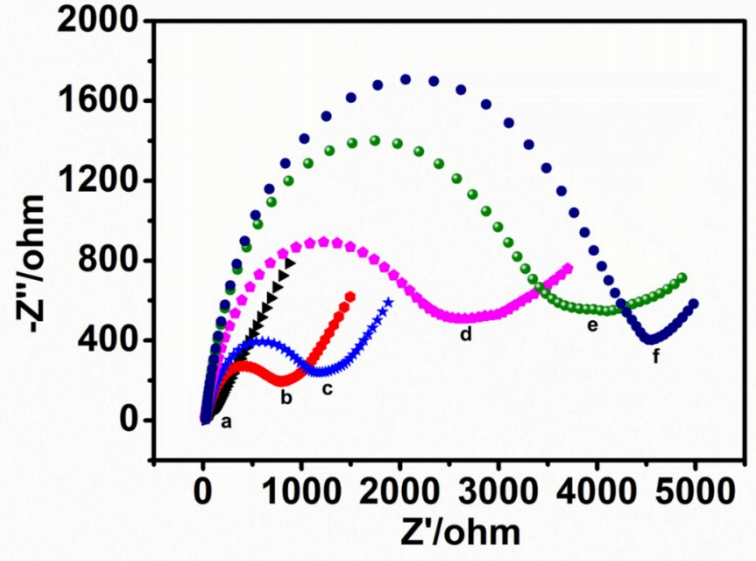

Figure S6. (A) Electrochemical impedance spectroscopy of (a) bare GE, (b) TDN-aptamer 1/GE, (c) MCH/TDN-aptamer 1/GE, (d) HER2/MCH/TDN-aptamer 1/GE, (e) nanoprobe 1/HER2/MCH/TDN-aptamer 1/GE, (f) nanoprobe 2/ nanoprobe 1/HER2/MCH/TDN-aptamer 1/GE in 0.5 M KCl solution containing 5 mM $[Fe(CN)_6]^{4-/3-}$ (impedance spectral frequency 0.1-10^5 Hz, amplitude 10 mV).

Table S1 Detailed information of the ssDNA sequence

Name	Sequence (ssDNA direction: 5'→3')
A	HS-TATCACCAGGCAGTTGACAGTGTAGCAAGCTGTAATAGATGCGAGGGTCCAATAC
B	HS-TCAACTGCCTGGTGATAAAACGACACTACGTGGGAATCTACTATGGCGGCTCTTC
C	HS-TTCAGACTTAGGAATGTGCTTCCCACGTAGTGTCGTTTGTATTGGACCCTCGCAT
D	ACATTCCTAAGTCTGAAACATTACAGCTTGCTACACGAGAAGAGCCGCCATAGTATTTTTTTTTTAATTAAGCCGCGAGGGGAGGGATAGGGTAGGGCGCGGCT
Aptamer 2	HS-GCAGCGGTGTGGGGGCAGCGGTGTGGGGGCAGCGGTGTGGGG
cDNA	HS-TTTTTCCCCACACCGCTGC

The underlined sequence of the D presents the aptamer 1 region.