

**An ultrasensitive electrochemical immunosensor for CEA using MWCNTs-NH₂
supported PdPt nanocages as labels for signal amplification**

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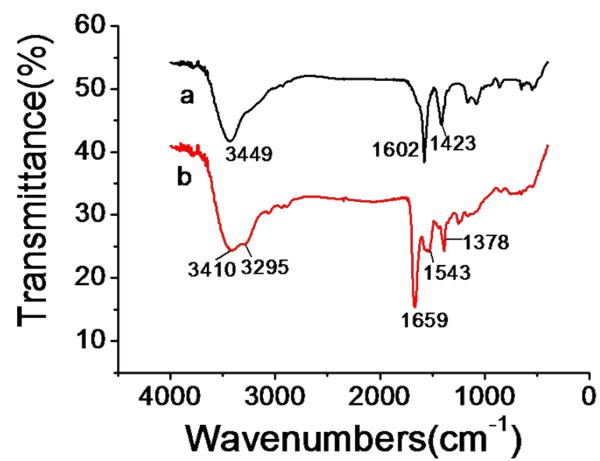


Fig. S1 The FTIR spectrum of MWCNTs-COOH (a) and MWCNTs-NH₂ (b).

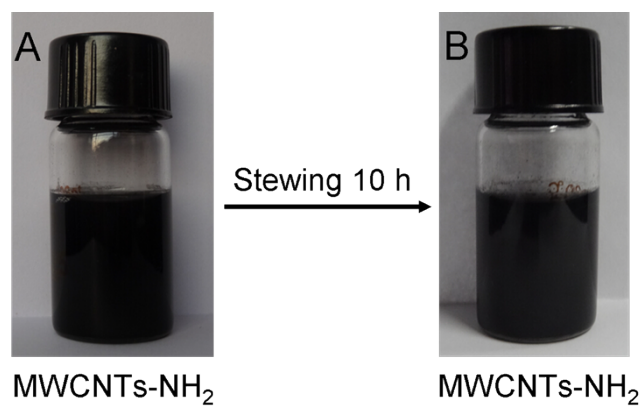


Fig. S2 The dispersibility of the MWCNTs-NH₂ in water for 0 h (A) and 10 h (B).

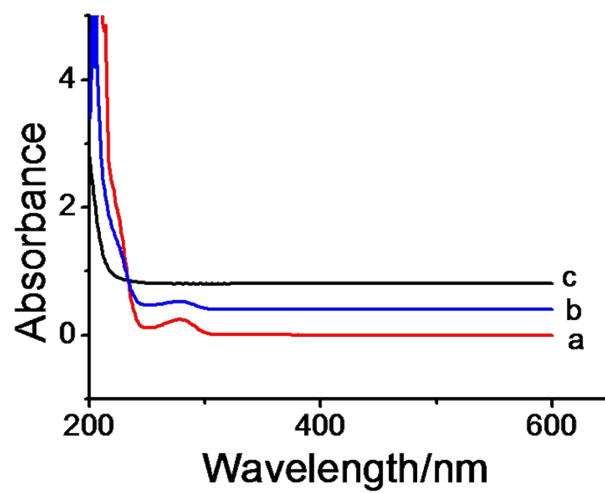


Fig. S3. UV-vis spectra of Ab₂ (a); PdPt nanocages/MWCNTs-NH₂-Ab₂ (b) and PdPt nanocages/MWCNTs-NH₂ (c)

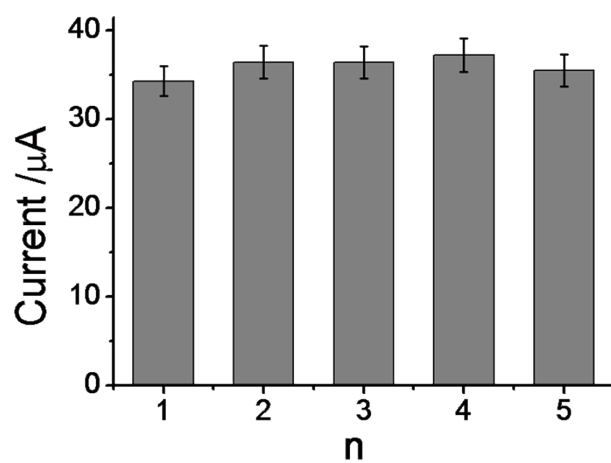


Fig. S4 Current responses of the immunosensor to 2 ng/mL CEA (1), 2 ng/mL CEA + 200 ng/mL SCC-Ag (2), 2 ng/mL CEA + 200 ng/mL AFP (3), 2 ng/mL CEA + 200 ng/mL glucose (4), 2 ng/mL CEA + 200 ng/mL BSA (5). Error bar=RSD ($n=5$).

Table S1 Comparison of different methods for the detection of CEA.

Method	Linear range	Detection limit	Reference
Electrochemiluminescence	-	1.67 pg/mL□	1
Fluorescence strategy	0.01-1 ng/mL	3 pg/mL	2
Chemiluminescence immunosensor	0.1-40 ng/mL	0.04 ng/mL	3
Voltammetric enzyme-linked immunoassay	0.50-80 ng/ml	0.5 ng/mL	4
Electrochemiluminescence	0.01-10.0 ng/mL	3.8 pg/mL	5
Fluoroimmunoassay	-	0.85 ng/mL	6
Electrochemical immunosensor	0.001-20 ng/mL	0.2 pg/mL	This work

Table S2: Here, 2.00 and 5.00 ng/mL CEA were added into the serum sample with the detection of standard addition method.

Human serum sample (ng/mL)	The addition content (ng/mL)	The detection content (ng/mL)	Average value (ng/mL)	RSD (%)	Recovery (%)
0.96	2.00	2.71, 3.08, 3.15, 2.79, 2.86	2.92	6.48	98.0
	5.00	5.85, 5.79, 6.11, 6.07, 6.16	6.00	2.75	100.8

References

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