Supporting Information

Dendritic Pt@Au nanowires as nanocarriers and signal enhancers for sensitive electrochemical detection of carcinoembryonic antigen

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Optimization of experimental conditions

In order to obtain the optimal analysis performance for the proposed aptasensor, such as sensitivity, specificity and stability, we investigated the effect of different experiment conditions on the electrochemical response behavior. These crucial influencing factors involved in the concentration of CEAapt1 and the incubation time of CEA in the electrode surface, as well as the volume of H_2O_2 and pH in tested solution.

Firstly, when the proposed aptasensor was incubated with different concentrations of CEAapt1 from 1.0 μM to 3.0 μM, the CV response was studied in 5 mM $K_3[Fe(CN)_6]/K_4[Fe(CN)_6]$ solution (pH 7.4) at 100 mV/s scan rate. As shown in Fig. S1A, the current response decreased with the increment of CEAapt1 concentration, and leveled off at 2.5 μM, which was the optimum concentration for the incubation of CEAapt1 in the electrode surface.

The combination time of CEA with CEAapt1 in the electrode surface is very important for high capture efficiency of the target CEA, which in turn would play beneficial role in the great combination of CEAapt2 with electroactive probe Tb and the enhancement of the electrochemical signal. After 10 ng mL^{-1} CEA was incubated onto the resulting electrode surface for 10 min to 50 min, respectively, the CV response was investigated in 5 mM $K_3[Fe(CN)_6]/K_4[Fe(CN)_6]$ solution (pH 7.4) at 100 mV/s scan rate. As shown in Fig. S1B, the peak current declined with the increase of the CEA incubation time, and then reached a plateau at 40 min. So, 40 min was the optimum for incubation of CEA.

In addition, the amount of H_2O_2 in testing buffer has a direct effect on the catalytic capacity of the proposed aptasensor, which in turn would promote the electrochemical signal and improve the sensitivity. Fig S1C exhibits DPV response of aptasensor toward 10 ng mL^{-1} CEA in 1.03 mL PBS (0.1 M, pH 7.0) containing different concentrations of H_2O_2 (from 0.30 mM to 1.15 mM). As could be seen, the response signal increased along with the increasing H_2O_2 concentration from 0.30 to 0.87 mM, and then reached a saturated state. Hence, 0.1 M PBS (pH 7.0) with 0.87 mM of H_2O_2 was used as the tested solution of DPV response throughout the experiment.

The pH of the testing buffer is an indispensable parameter for any analytical method. Finally, the optimization of pH was carried out by investigating DPV response in 0.1 M PBS with different pH in the range of 5.0-9.0 and 0.87 mM H_2O_2, after the proposed aptasensor was immobilized with 10 ng mL^{-1} CEA for 40 min. As

shown in Fig S1D, the electrochemical response increased gradually with increment of pH value from 5.0 to 7.0 and then decreased at larger pH than 7.0, indicating that pH 7.0 was the optimal for the proposed aptasensor in this work.

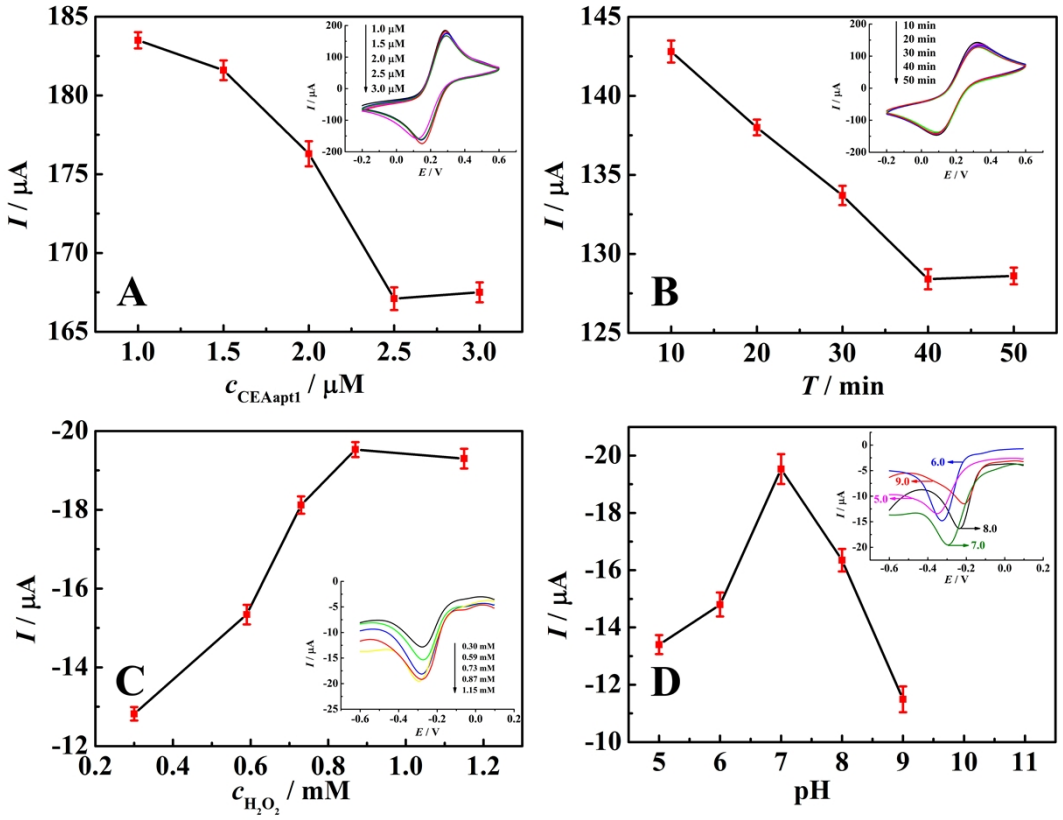

Fig. S1 Effect of different experimental conditions on the electrochemical response of the designed aptasensor: (A) the concentration of CEAapt1 and (B) the incubation time of CEA in 1 mL $K_3[Fe(CN)_6]/K_4[Fe(CN)_6]$ (5.0 mM, pH 7.4) at the scan rate of 100 mV/s, (C) the concentration of H_2O_2 in 1 mL PBS (0.1 M, pH 7.0) and (D) pH of the testing buffer solution in 1.03 mL PBS (pH 7.0) containing 0.87 mM H_2O_2. Error bars: SD, n=3.

Table S1 Comparisons of the proposed aptasensor with different methodologies

Analytical methods	Linear range (ng mL^{-1})	Detection limit (pg mL^{-1})	Ref.
CL	0.0654~6.54	8	1
CV	0.002~80	1.0	2
ECL	0.01~10.0	3.8	3
ECL	0.001~50	0.7	4
Colorimetry	0.05~50	48	5
Colorimetry	0.005~0.5	2	6
SERS	0.001~10	1	7
DPV	0.01~12	5	8
DPV	0.5~25	220	9
DPV	5~80	1100	10
DPV	0.001~80	0.31	This work

Abbreviation: chemiluminescence (CL); cyclic voltammetry (CV); electrochemiluminescent (ECL); surface-enhanced Raman scattering (SERS); differential pulse voltammetry (DPV);

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