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Supplementary Material

A Novel Sandwich-type Immunosensor Based on Three Dimensional Graphene-Au Aerogels and Quaternary Chalcogenide Nanocrystals for the Detection of Carcino Embryonie Antigen

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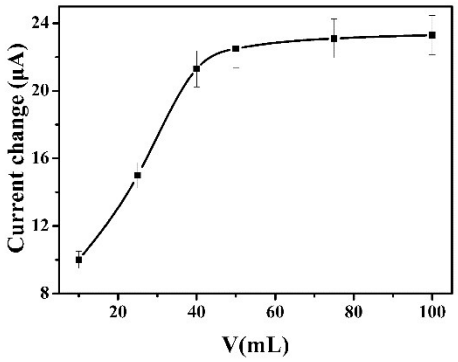
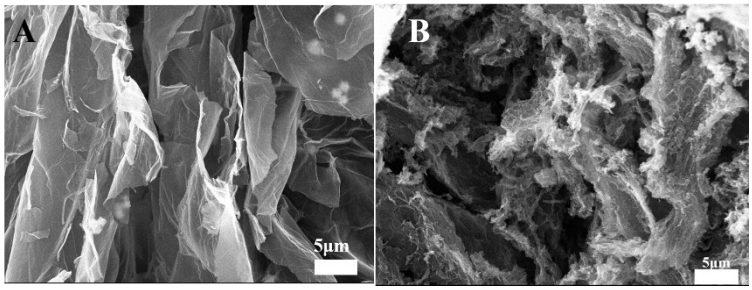
TableS1. Different catalysts for reduction of H_2O_2

Materials	Concernation of H_2O_2(mmol/L)	test solution	Reduction potential(V)	Current (μA)	references
Pd catalyst	0.5	pH 7.0 PBS (0.1M)	-0.4	15	1
Fe_3O_4-PDDA	1.6	pH 7.0 PBS(0.1M)	-0.3	45	2
Ag catalyst	1	pH 7.4 PBS(0.05M)	-0.68	-45	3
Fe_3O_4-Ag catalyst	20	pH 7.0 PBS(0.1M)	-0.62	-180	4
Au catalyst	4	pH 7.4 PBS(0.1M)	-0.43	-63	5
Pt catalyst	1.4	pH 7.0 PBS(0.1M)	-0.3	60	6
CZTS NCs	5	pH 7.4 PBS(1/15M)	-0.45	-320	Our work



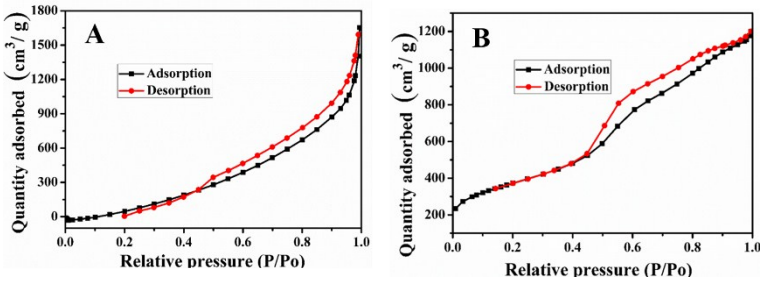
FigureS1. The optimization of Au NPs amount.

To optimize the amount of Au NPs, the experiment of different volume of Au NPs solution (10, 30, 50, 70, 100 mL，which response to 0.8, 2.4, 4.0, 5.6 and 8.0 mg of $HAuCl_4$) to 3D GN aerogels were carried out. The result is shown in Figure S1. The current signal increases obvious when the addition volume of Au NPs increases from 10 mL to 50 mL (0.8mg to 4.0 mg of $HAuCl_4$). But when the addition volume of Au NPs increases further from 50 mL to 100 mL, the current signal increases slowly, which maybe because that 50 mL of Au NPs (4.0 mg of $HAuCl_4$) can be distributed on GN evenly. When more Au NPs were loaded on GN, because of aggregation of Au NPs, the current signal increases slowly. In consideration of performance and cost of the immunosensor, 50 mL of Au NPs (4.0 mg of $HAuCl_4$) was chose.



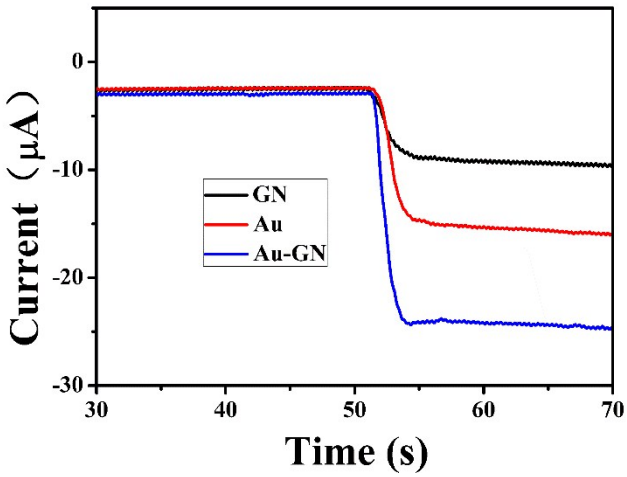
FigureS2. SEM image of (A) 2D Au-GN and (B) 3D Au-GN aerogel

2D GN was produced by the improved Hummers method[7]: 100 mg of GO was dispersed in 10 mL of ethanol with ultrasonic stirring for 1 h. After that 0.1 mL of 80 wt% hydrazine hydrate was added, then the mixture was heated to 95 ℃ and lasted for 1 h. After all of that, the mixture was centrifuged for 20min at 9000 rpm and dried in vacuum oven for 12 h to get solid for late usage. Au NPs were loaded onto the 2D GN in the same way onto 3D GN.

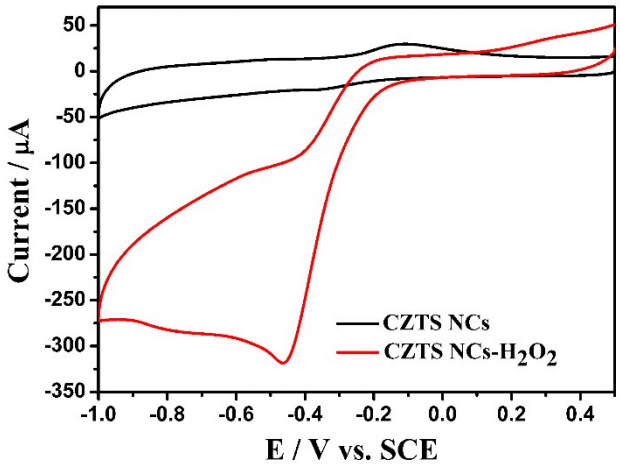


FigureS3. Nitrogen adsorption and desorption isotherm of

(A) 2D Au-GN and (B)3D Au-GN aerogel.



FigureS4. The current responses to different substrate materials in the immunosensor



FugureS5. The catalytic activity of pure CZTS NCs to H_2O_2

Table S2 Assay results of serum samples using the immunosensor and ELISA method

Serum samples	The immunosensor (ng mL^{-1})	ELISA (ng mL^{-1})	Relative error (%)
1	6.4	6.2	3.1
2	6.0	5.5	8.3
3	7.0	7.4	5.7

References:

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