Supporting Information for

Molybdenum carbide nanotubes: a novel multifunctional material for label-free electrochemical immunosensing

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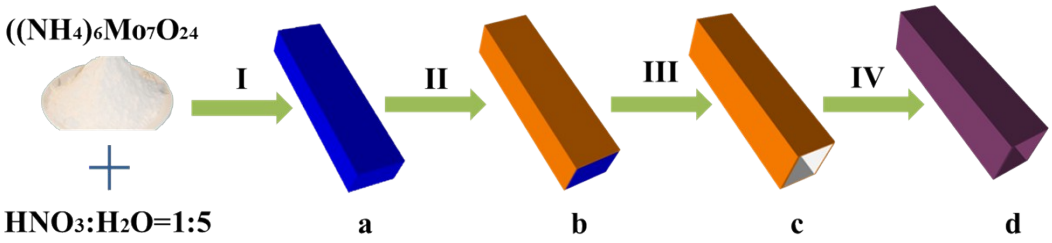

Scheme S1. Schematic illustration of the preparation process of Mo_2C nanotubes. (I) Hydrothermal method for preparation of MoO_3 nanorods. (II) Dopamine was added to form MoO_3-polydopamine hybrid nanosheets. (III) $NH_3 \cdot H_2O$ was introduced to etch MoO_3 and form Mo-polydopamine tube. (IV) high-temperature calcination to produce well-crystalline Mo_2C nanotubes.

Preparation of Mo_2C nanotubes. According the reported literature, Mo_2C nanotubes were synthesized through two steps (Scheme S1). MoO_3 nanorodes template were firstly prepared through hydrothermal method. Briefly, 1.4 g of ammonium heptamolybdate tetrahydrate ($(NH_4)_6Mo_7O_{24} \cdot 4H_2O$) was dissolved in 40 mL of mixed solution of 65% HNO_3 and deionized H_2O with a volume ratio of 1:5. Then, the above solution was transferred into a Teflon-lined stainless steel autoclave and heated at 200 ^oC for 20 h. After cooling, the white product was collected by centrifugation and washed with water and ethanol for several times, dried at 70 ^oC for next step. In the second step, the obtained MoO_3 nanorods were used as template to synthesize Mo_2C nanotube. In brief, 100 mg of the MoO_3 nanorods was added into 20 mL of deionized H_2O in a glass bottle and ultrasonic 15 min, then 200 mg of $(NH_4)_6Mo_7O_{24} \cdot 4H_2O$ and 50 mg of dopamine hydrochloride were dissolved into the above solution completely. Then ethanol (40 mL) was poured into the above solution.

After stirring for another 5 min, 28~30 % $NH_3 \cdot H_2O$ (0.3 mL) was quickly injected into the above reaction solution and the mixed solution reacted for 120 min with gent stirring. Finally, the orange–red precipitate was obtained by centrifugation, washed several times with ethanol and dried. In order to obtain the well- crystalline Mo_2C nanotubes, the above obtained orange–red precipitate was then annealed at 750 ^oC under Ar flow.

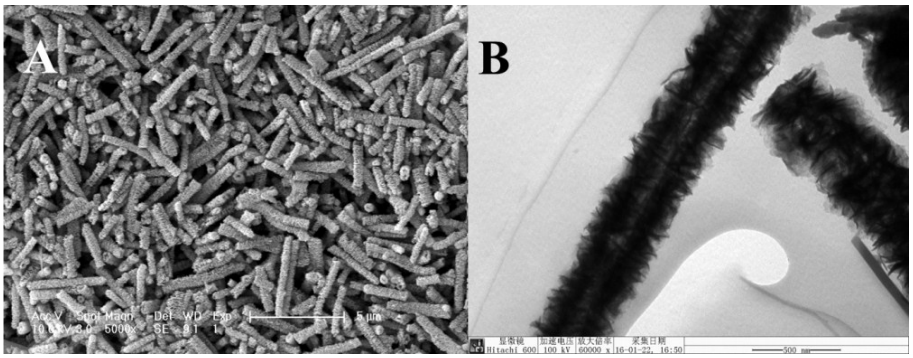

Figure S1. (A) SEM and (B) TEM characterizations of the prepared Mo_2C nanotubes.

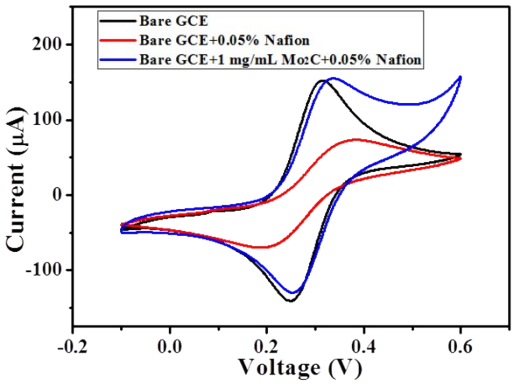

Figure S2. CV curve of the bare GCE, 0.05% Nafion modified GCE and 1 mg/mL Mo_2C nanotube + 0.05% Nafion modified GCE in 5 mM $[Fe(CN)_6]^{3-/4-}$.

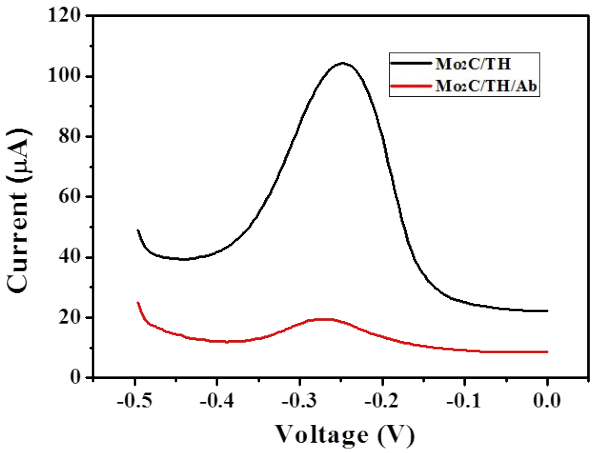

Figure S3. DPV curves of GCE modified with Mo_2C/TH and Mo_2C/TH/Ab composites.

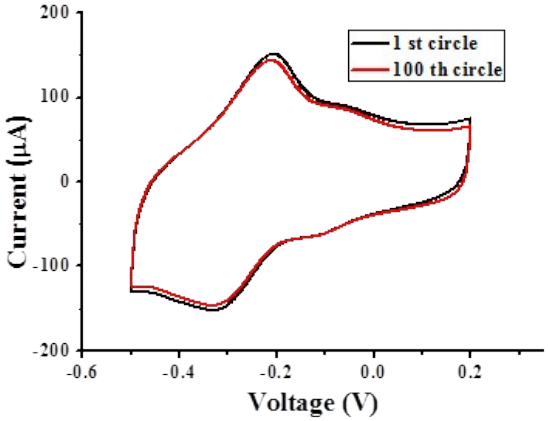

Figure S4. The CV curves of Mo_2C/thionin modified GCE that scan at the first cycle and scan after 100 cycles with the scan rate of 0.8 V/s in 0.1 M PBS buffer (pH=7.4).

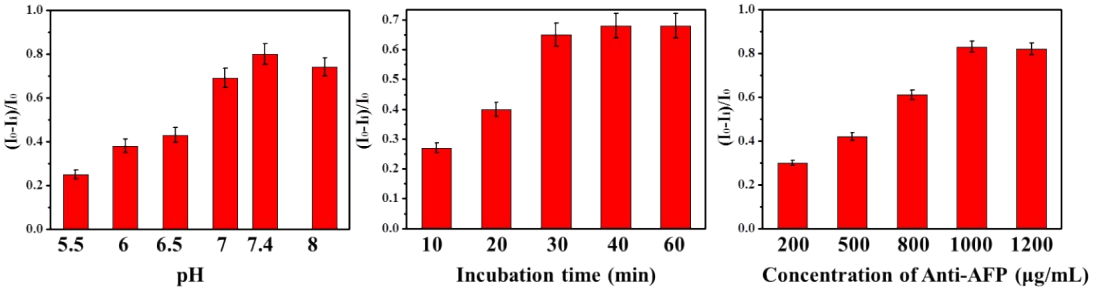

Figure S5. Effects of (A) pH of detection solution, (B) the amount of anti-AFP, (C) incubation time on the immunosensor.

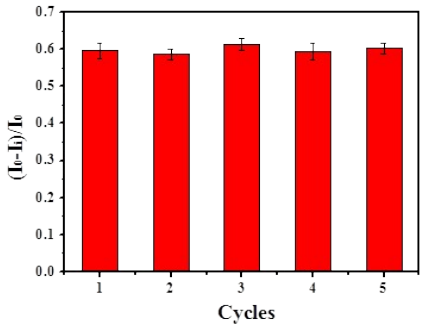

Figure S6. The reproducibility of the immunosensor for AFP (1 ng/mL) detection with five electrodes.

Table S1. Comparison of different electrochemical immunosensors for detection of AFP.

Modified materials	Linear range (ng/mL)	Detection limit (ng/mL)	Ref.
graphene/SnO_2/Au	0.02-50	0.01	1
Au/PAMAM/ethyleneamine–viologen	0.001-45	0.00013	2
Au–Pd/N-graphene	0.05-30	0.005	3
GoldMag nanocomposite/graphene	0.01–200	0.001	4
TiO_2/CdS	0.05-50	0.04	5
gold nanorods	0.1-200	0.04	6
carbon nanotubes/ mesoporous silica and graphene	0.1-100	0.06	7
palladium–graphene	0.01-12	0.005	8
Mo_2C nanotubes/thionin	0.01-10	0.003	This work

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