Supporting Information

in

A ratiometric electrochemical sensor for detection multiplex cancer biomarkers using bismuth as internal reference and metal sulfide nanoparticles as signal tags

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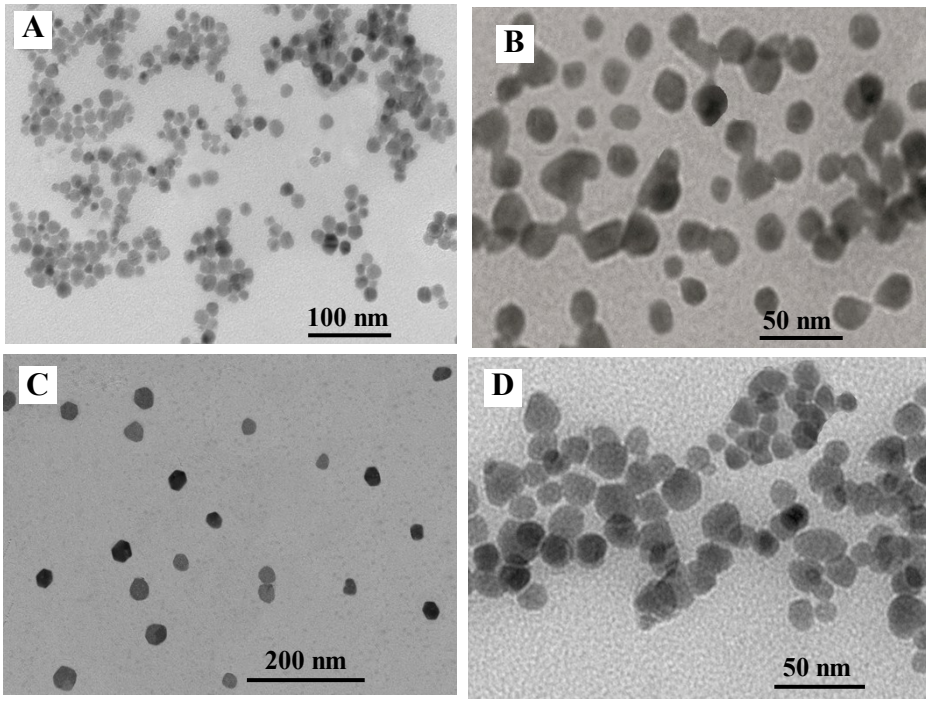

Fig. S1 TEM images of CdS (A), HgS (B), PbS (C), ZnS (D) nanoparticles.

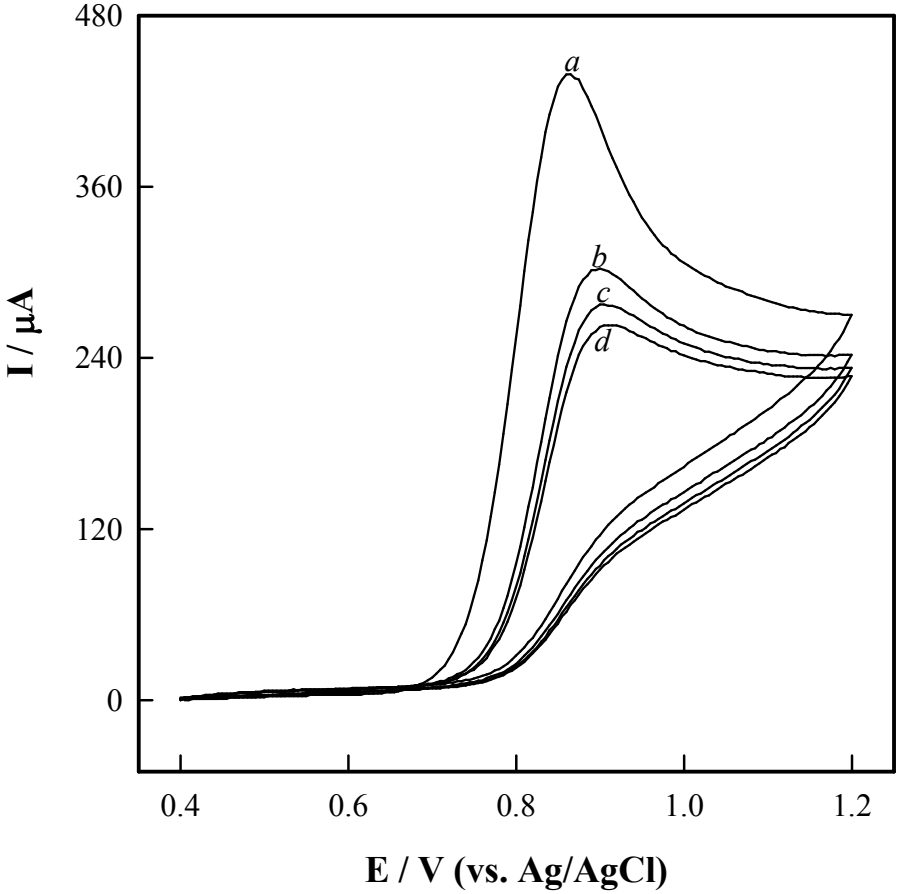

Fig. S2 Repetitive cyclic voltammograms of GCE during the polymerization in 2.0 mM ATA +0.20 mg mL^{-1} CNTs+ 5.0 mM H_2SO_4 solution. Potential scan rate：10 mV s^{-1}. Curves *a* to *d* corresponding to scanning cycle number of 1 to 4.

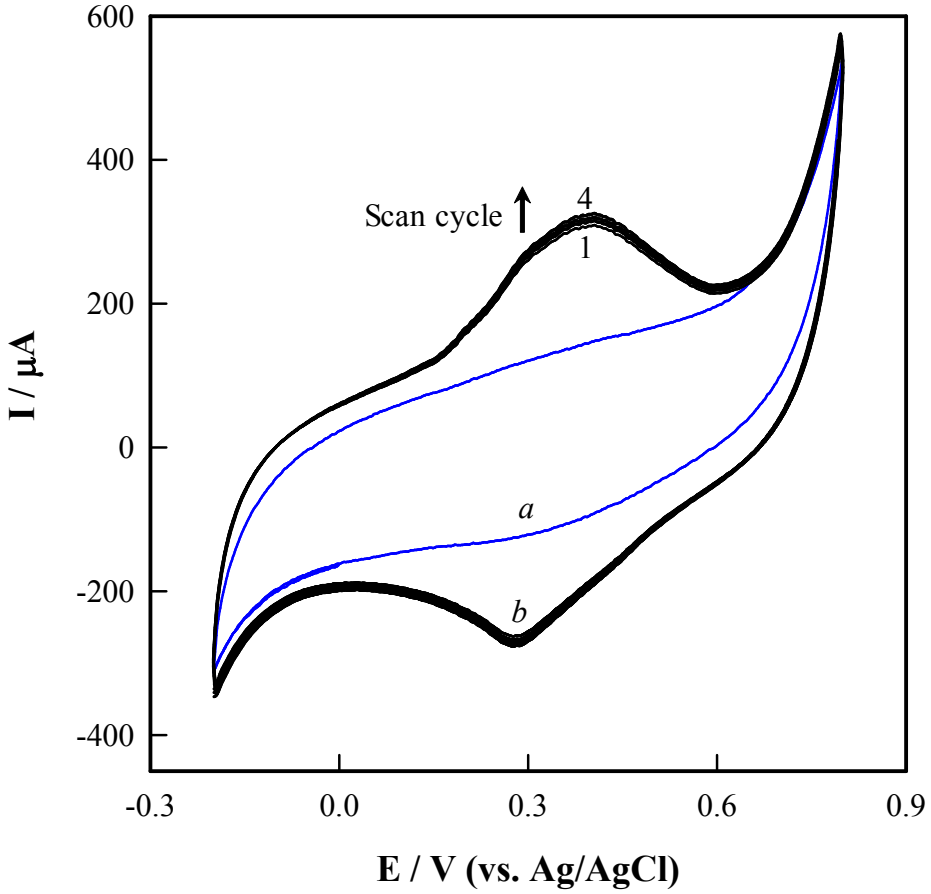

Fig. S3 Repetitive cyclic voltammograms of CNTs-ATA/GCE in 0.1 M H_2SO_4 (*a*) and 5.0 mM MSA+0.1 M H_2SO_4 (b). Potential scan rate: 50 mV s^{-1}.

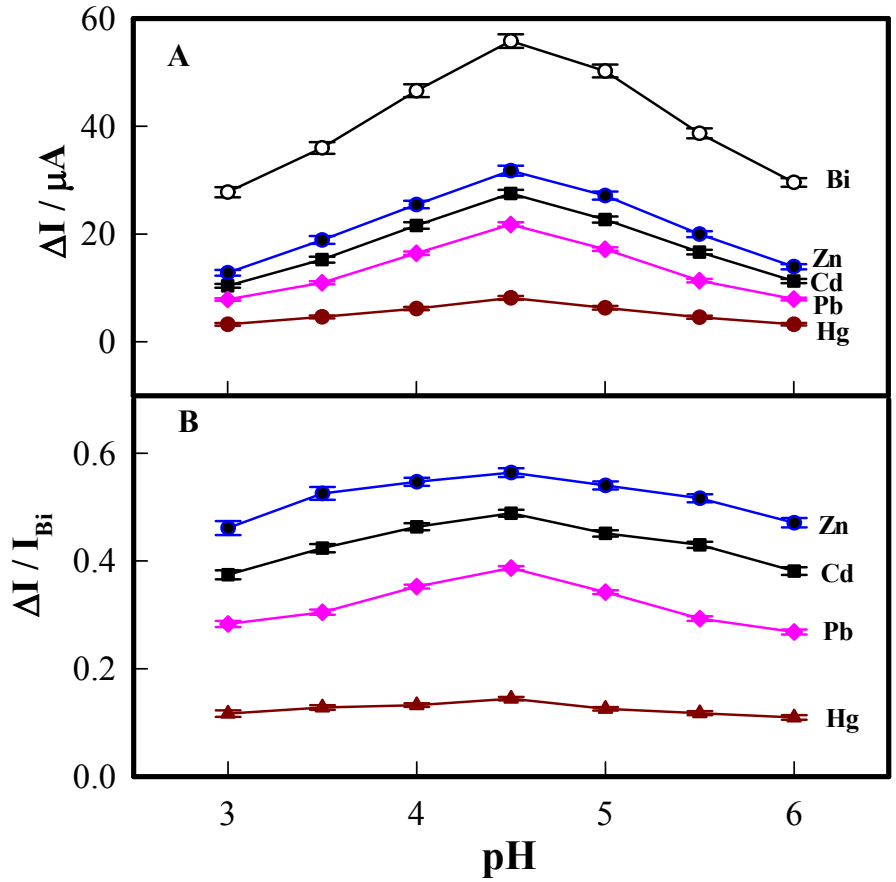

Fig. S4 Influence of pH on the DPASV peak currents (A) and current ratio of target analytes to Bi (B) using the MSA-CNTs-ATA/GCE. The concentrations of Hg(II), Pb(II), Cd(II) and Zn(II) were 30 μg L^{-1}. All the solutions were contained 400 μg L^{-1} Bi(III)..

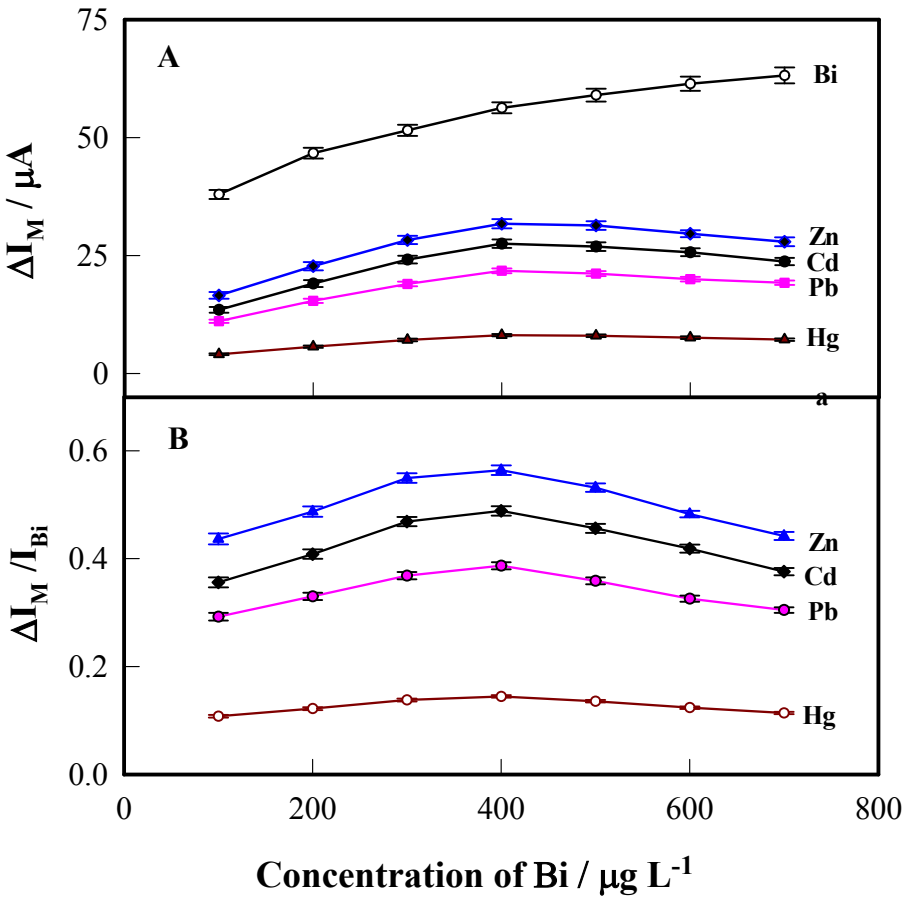

Fig. S5 Influence of concentration of Bi(III) on the DPASV peak currents (A) and current ratio of target analytes to Bi (B) using the using the MSA-CNTs-ATA/GCE (pH4.5). The concentrations of Hg(II), Pb(II), Cd(II) and Zn(II) were 30 μg L^{-1}.

Table S1 Comparison of analytical performance of some electrochemical immunosensors for the four biomarkers.

Signal tags	Biomarker	Linear range *	LOD *	Refs.
Fc-AuNPs-Ab_2	CEA	0.05–20	0.01	S1
Cu-CP-Ab_2	CEA	0.1-100	0.02	S2
Envision/PbS- Ab_2	CEA	0.001-50	0.0002	S3
Thi-SA/DNA-Ab_2	CEA	0.0002-0.6	4.8×10^{-5}	S4
ZnS NPs -Ab_2	CEA	0.003-10	0.00023	This work
Aq-SA/DNA-Ab_2	AFP	0.0002-0.8	6.2×10^{-5}	S4
Envision/CdS-Ab_2	AFP	0.001-50	0.0005	S3
Pd/APTES-M-CeO_2-GS-Ab_2	AFP	0.0001-50	3.3×10^{-5}	S5
AuNPs-polymer brush-Ab_2	AFP	0.01-100	0.0018	S6
PbS NPs -Ab_2	AFP	0.003-10	0.00011	This work
Cd-CP-Ab_2	CA125	1-150	0.3	S2
AuNPs-aptamer-HCR	CA125	0.0001-10	5×10^{-5}	S7
AuNP-Lox-Ab_2	CA125	0.01–100	0.002	S8
Cd NPs -Ab_2	CA125	0.03-100	0.00068	This work
Pb-CP-Ab_2	CA19-9	1-150	0.4	S2
V^{2+}-Ab_2	CA19-9	0.01-200	0.0039	S9
HgS NPs-Ab_2	CA19-9	0.03-100	0.0014	This work

* AFP and CEA：ng mL^{-1}， CA125 and CA19-9 : U mL^{-1}

Aq-SA: anthraquinone 2-carboxylic acid-streptavidin, Fc: ferrocene, AuNPs-aptamer-HCR: gold nanoparticles-aptamer-hybridization chain reaction, AuNP-Lox: gold nanoparticle-lactate oxidase, CP: chitosan–poly(acrylic acid) nanospheres, Pd/APTES-M-CeO_2-GS: graphene Oxide and CeO_2 mesoporous nanocomposite functionalized by the 3-aminopropyl-triethoxysilane supported Pd octahedral nanoparticles, Thi-SA : thionine- streptavidin, V^{2+}: bipyridinium.

References

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