

Supporting Information

**Dual-mode label-free electrochemical immunosensor for ultrasensitive detection
of procalcitonin based on g-C₃N₄-NiCo₂S₄-CNTs-Ag NPs**

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1. Experimental section

1.1 Reagents and apparatuses

CNTs was purchased from China Chemical Reagent Co., Ltd. nickel acetate tetrahydrate ($\text{Ni}(\text{Ac})_2 \cdot 4\text{H}_2\text{O}$) and Cobalt acetate tetrahydrate ($\text{Co}(\text{Ac})_2 \cdot 4\text{H}_2\text{O}$) were purchased from Macklin Biochemical Co., Ltd (Shanghai, China). Isopropanol was obtained from fuyu Fiine Chemical Co., Ltd (Tianjin, China). BSA was purchased from Sigma-Aldrich (Beijing, China). AgNO_3 was purchased from Aladdin Reagent Database Inc. (Shanghai, China). PCT and antibody-PCT was purchased from Nanjing Jinrui Technology Co., Ltd. (Nanjing, China).

Scanning electron microscope (SEM) was obtained from a field emission SEM (Zeiss, Germany). Energy dispersive X-ray spectroscopy (EDX) obtained from QuantaFEG 50 (FEI, USA). Electrochemical measurements were performed on a CHI760D electrochemical workstation (Chenhua Instrument Shanghai Co., Ltd., China).

2. Real sample analysis

To evaluate the accuracy and feasibility of the immunosensor, the recovery of PCT in the serum sample was assessed by standard addition method. Firstly, the human blood was pretreated by centrifugation to remove the blood cells and other blood sediment. Then, the human serum was taken out and the samples were diluted with PBS (pH=7.38) until a level that was during the calibration range.

Table.S1 Comparison of different electrochemical technique used to detect PCT

Electrochemical technique	Analysis scope	LOD	References
automated immunoassays	0.02 ng/mL -50 ng/mL	0.06 ng/mL	1
multicenter comparison of automated procalcitonin immunoassays	0.02 ng/mL -50 ng/mL	0.05 ng/mL	2
fluorescence immunoassay	25 pg/mL -100 ng/mL	0.04 ng/mL	3
label-free competitive electrochemical immunosensor	0.05 ng/mL-50 ng/mL	16.7 pg/mL	This work
dual-mode label-free electrochemical immunosensor	1 pg/mL-10 ng/mL	0.33 pg/mL	This work

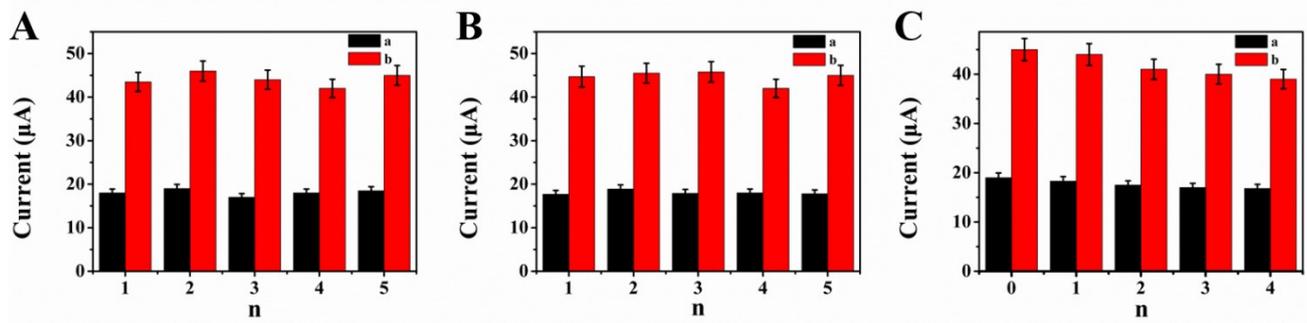


Fig. S1 (A) stability of the sensor: DPV (a), i-t (b), Error bar = SD (n=5); (B)selectivity of the sensor: (1) 1 ng/mL PCT+10 ng/mL A β , (2) 1 ng/mL PCT+ 10 ng/mL PSA, (3) 1 ng/mL PCT+10 ng/mL BNP, (4) 1 ng/mL PCT+10 ng/mL CEA, (5) 1 ng/mL PCT+10 ng/mL insulin; (C) reproducibility of the sensor;

References

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