Supporting Information

Versatile dendritical amplification photoelectric biosensing platform based on Bi_2S_3 nanorods and perylenebased polymer for signal "on" and "off" double detection of DNA

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Experimental section

Chemicals and Reagents

Phi29 DNA polymerase, T_4 DNA ligase, Exonuclease I (Exo I), Exonuclease (Exo III), 10 × exonuclease I buffer, 10 × exonuclease III buffer and dNTPs were purchased from New England Biolabs Ltd. (Beijing, China). L(+)-Ascorbic acid (AA) was purchased from Sinopharm Chemical Reagent Co. Trichloroauric acid trihydrate ($HAuCl_4 \cdot 3H_2O$) were purchased from Alfa Aesar (Tianjin) Chemical Co.. $Bi_2(NO_3)_3 \cdot 5H_2O$, Mn (III) meso-Tetra (N-methyi-4-pyridyl) porphine pentachloride (MnPP) was purchased from Sigma-Aldrich (St. Louis, MO, USA). $Na_2S.9H_2O$ and perylene-3,4,9,10-tetracarboxylic dianhydride (PTDA) were were purchased from Aladdin Co., Ltd. (Shanghai, China). All reagents were of analytical grade and used as received. Ultrapure water was used throughout the experiment from a Millipore water purification system (≥18 MΩ, Milli-Q, Millipore). All the DNA sequences were synthesized and purified by Sangon Biotech (Shanghai) Co., Ltd. The DNA sequences used in this work are listed in Table S1.

Table S1. The Sequences of DNA

Name	From (5'-3')
HP	**TCTCAGATGGATTCGGCGTGAAT*T*T*T*TTCACGCCGAATCCATC TGAGAGGCCGTCTATGCGTGAACTG**
Target	**CAG TTC ACG CAT AGA CGG* C*C***
PD	**TCGATCTCAGATCCTAAGCCGCACCCAAAGACTG**
AS	**GATCGACAGTCT**
H1	**TCTGACAGCTAGAGTCTAGGATTCGGCGTGGGTTTTTCACGCCGA ATCCATCTGAGATTTTTTT-SH**
H2	**AACCCACGCCGAATGGGGGGATTCGGCG**
H3	**ATTCGGCGTGGGTTCGCCGAATCCCCCC**

Apparatus

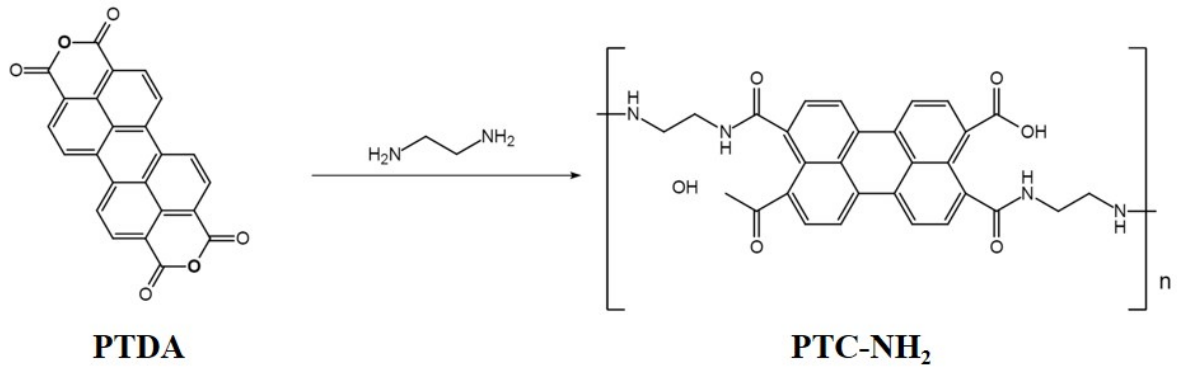
Transmission electron micrograph (TEM) image was acquired using a JEM-2100 instrument (JEOL, Japan). Atomic force microscope (AFM) images were recorded on a Dimension FastScan TM Atomic

force microscope (Bruker AXS GmbH, Germany). All of the photoelectrochemical (PEC) signals were recorded on a PEAC 200A PEC analyzer (Aida Hengyi Technology Development Co., Ltd., Tianjin, China). Electrochemical impedance spectroscopy (EIS) was measured on CHI 660E electrochemical workstation (Shanghai Chenhua Instrument Co., China). The reference electrode was an Ag/AgCl electrode, the working electrode was a gold electrode (5 mm), and a Pt wire was the counter electrode. UV-vis absorption spectra were measured with Lambda 35 UV Visible Spectrometer (Japan). Polyacrylamide gel electrophoresis (PAGE) analysis was performed on the Beijing JUNYI electrophoresis analyzer and imaged on the Biorad ChemDoc XRS (USA). X-ray photoelectron spectroscopy (XPS) was obtained on Multifunctional imaging electron spectrometer (Thermo ESCALAB 250Xi). JSM-6700F field emission scanning electron microscopy (FESEM, Japan). X-ray diffraction (XRD) analysis was performed with Cu Kα radiation on a D/Max 2500V/PC Rigaku diffractometer. Fourier transform infrared (FT-IR) spectra were obtained on a BRUKER OPUS 80V FT-IR spectrometer (BRUKER, Karlsruhe, Germany).

The process of Gel Electrophoresis

At first, we prepared 50×TAE buffer (tris 24.2 g, EDTA 3.72 g, glacial acetic acid 5.71 mL, adding water to 100 mL). Next, we take 10 mL centrifugal tube and add water (4256 μL), 40% Polyacrylamide gel (3500 μL), 50×TAE buffer (160 μL), APS (80 μL), TEMED (4 μL), then we pour it into the electrophoresis tank, and insert the comb into the electrophoresis tank, holding it for about 2 hours. We moved the whole electrophoresis tank into the tank, pulled out the comb, and added the 1×TAE buffer to 2/3 of the tank. The electrophoresis was carried in 1× tris-acetic acid EDTA (TAE) (pH 8.0) at 180 V constant voltage for 3 min and 135 V for 1.5 h. After EB staining, the gel was scanned using a gel imaging analyzer (Saizhi Venture Technology Co., Ltd. Beijing, China).

Results and discussion



Scheme S1. Synthetic illustration of PTC-NH_2 samples.

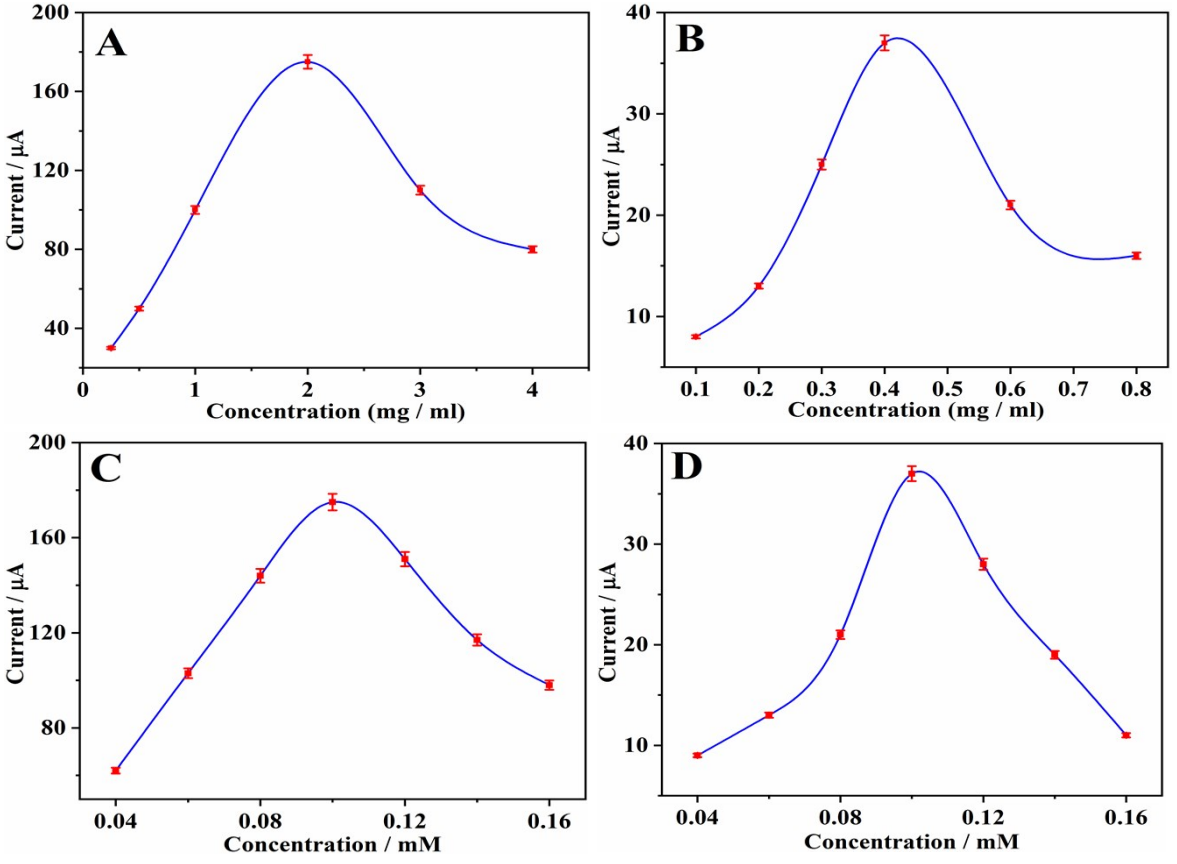


Fig. S1. The optimization for concentration of Bi_2S_3 (A), PTC-NH_2 (B), AA for Bi_2S_3 (C), AA for PTC-NH_2 (D).

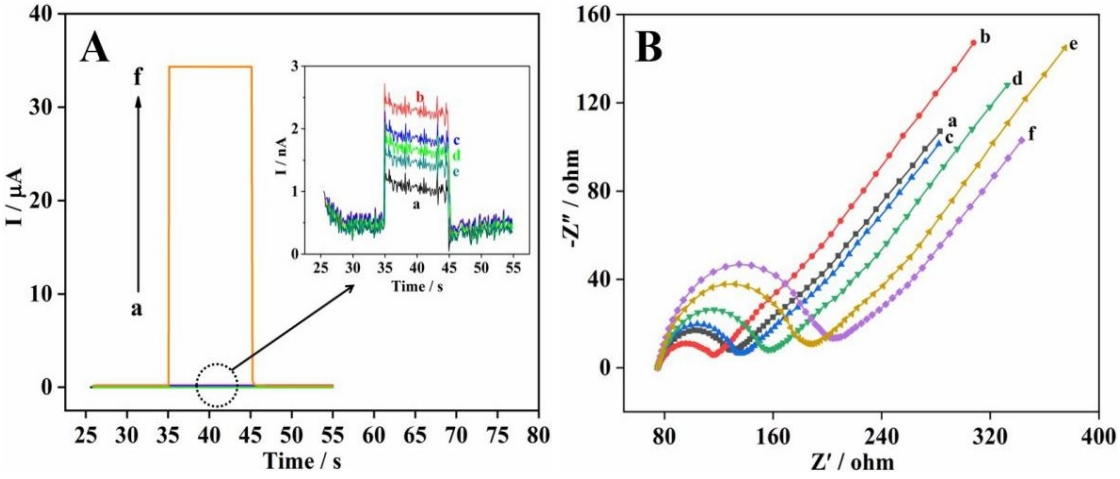


Fig. S2. (A) Photocurrent responses and (B) EIS of the " signal on " PEC biosensor at different stages. (a) bare ITO, (b) ITO/Au NPs, (c) ITO/Au NPs/H1/MCH, (d) ITO/Au NPs/H1/MCH/PC/RC, (e) ITO/Au NPs/H1/MCH/PC/RC/H2+H3, (f) ITO/Bi_2S_3/AuNPs/H1/MCH/PC/RC/H2+H3/PTC-NH_2 in the presence of target DNA (10 nM).

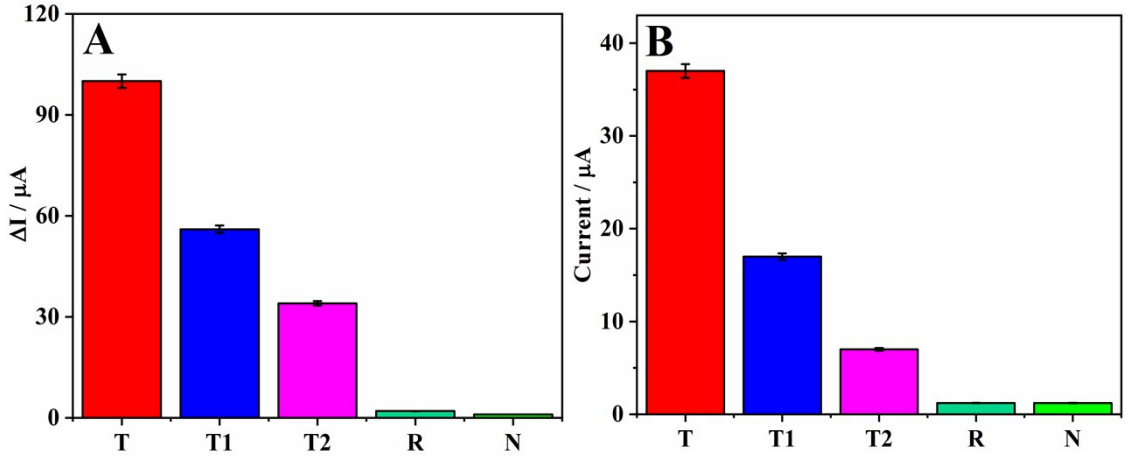


Fig. S3. The selectivity of the "signal off" (A), and "signal on" (B) PEC biosensor.