Electronic Supplementary Material (ESI) for Journal of Materials Chemistry B.
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Supporting Information

Near-infrared light-driven photoelectrochemical aptasensing platform for adenosine triphosphate detection based on Yb-doped Bi_2S_3 nanorods

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Chemicals and materials

Ytterbium(III) chloride hexahydrate ($YbCl_3 \cdot 6H_2O$) and sodium sulfide nonahydrate ($Na_2S \cdot 9H_2O$) were acquired from Aladdin Bio-Chem TechnologyCo., Ltd. (Shanghai, China).Bismuth nitrate pentahydrate ($Bi(NO_3)_3 \cdot 5H_2O$), urea ($CO(NH_2)_2$), ammonium phosphate monobasic ($NH_4H_2PO_4$), methanol and ethylene glycol were supplied by Sinopharm Chemical Reagent Co. Ltd. (Shanghai, China).Adenosine triphosphate (ATP) was obtained from Sigma-AldrichCo., Ltd. ATP-binding DNA aptamer with sequence of 5'-AGA GAA CCT GGG GGA GTA TTG CGG AGG AAG GTC ATA GTA ACT-3'was synthesized by Shanghai Sangon BiotechCo., Ltd. (Shanghai, China). The aptamer was diluted with TE buffer (pH 8.0) and stored at 4 °C for further use.

Apparatus and procedure

The morphology and composition of samples were performed on a SU8010 field emission scanning electron microscope (SEM, Hitachi, Japan) equipped with energy dispersive spectroscopy (EDS). The crystalline phase was characterized by an Empyrean X-ray diffractometer (XRD, PANalytical B.V., Netherlands). The X-ray photoelectron spectra (XPS) were recorded onan AXIS ULTRADLD-600W spectrometer (Kratos Company, England). The diffuse reflectance spectra (DRS) were analyzed by using a UV-3600 spectrophotometer (SHIMADZU, Japan).

The PEC measurements were carried out on a CHI830D electrochemical working station (Shanghai Chenhua Instrument Co. Ltd.,China) using a conventional three-electrode system. In PEC system, a CEL-S500/350 xenon lamp (CEAULIGHT Co., China) with an optical filter (λ >800 nm) was employed as the irradiation source, and

the distance between the lamp and working electrode surface was 2 cm.

The high-performance liquid chromatograph (HPLC) measurements were performed on an Agilent (USA) 1100 module system with C18 column (150 mm × 4.6 mm). The mobile phase was a 90:10 (v/v) mixture of 20 mmol·L^{-1} $NH_4H_2PO_4$/methanol with flow rate of 1 mL/min. Detection wavelength was set at 260 nm and the column temperature was 30 ℃.

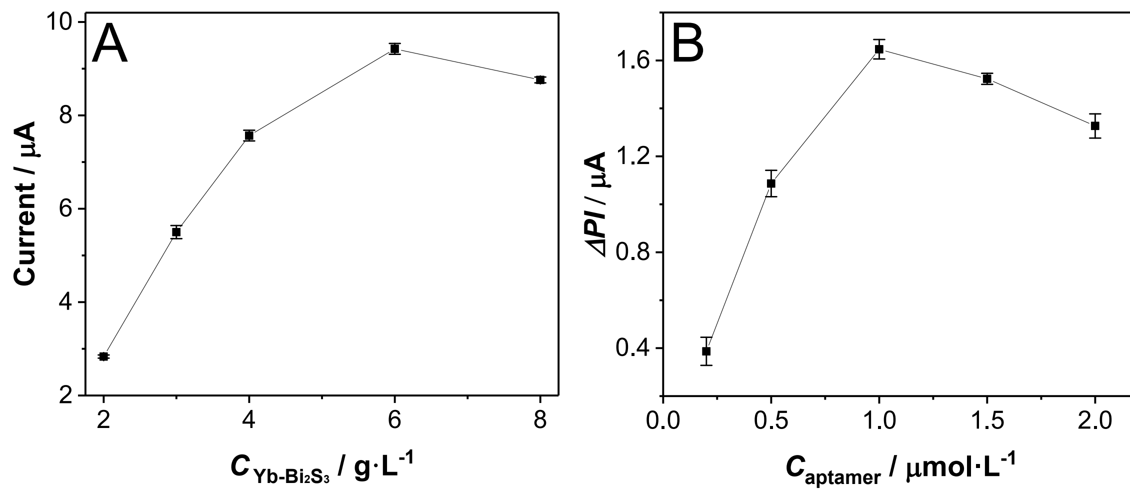

Fig. S1 Influence of (A) the concentration of Yb-Bi_2S_3 and (B) aptamer concentration. Error bars are derived from the standard deviation of three measurements.

Table S1 Analytical performances of different methods for ATP detection.

Detection methods	Linear range ($nmol \cdot L^{-1}$)	LOD ($nmol \cdot L^{-1}$)	Reference
Electrochemiluminescence	$10 \sim 1\times10^{6}$	10	1
Electrochemiluminescence	$1\times10^{-2} \sim 1\times10^{8}$	2.9×10^{-3}	2
Electrochemistry	$10 \sim 850$	5	3
Electrochemistry	$1\times10^{-4} \sim 5$	1×10^{-4}	4
Electrochemistry	$1\times10^{-3} \sim 1\times10^{4}$	3.76×10^{-5}	5
Colorimetry	$50 \sim 1000$	50	6
Fluorescence	$10 \sim 4.5\times10^{5}$	5	7
Fluorescence	$0 \sim 100$	0.6	8
PEC	$0.3 \sim 200$	0.1	9
PEC	$1\times10^{-4} \sim 10$	2.5×10^{-5}	10
PEC	$0.5 \sim 300$	0.1	This work

Table S2 Determination of ATP in human serum by the proposed sensor and HPLC method (n = 3).

Spiked ($nmol\cdot L^{-1}$)	Found ($nmol\cdot L^{-1}$)	Recovery (%)	RSD (%)	HPLC method ($nmol\cdot L^{-1}$)
50.00	54.39	108.8	6.74	55.27
100.0	103.4	103.4	3.81	104.3
200.0	205.7	102.9	5.16	194.6

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