Electronic Supplementary Information

Cobalt disulfide nanowires as an effective fluorescent sensing platform for DNA detection

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Experimental section

Materials: Cobalt(II) sulfate heptahydrate ($CoSO_4 \cdot 7H_2O$), glycerol, sodium chloride (NaCl), potassium chloride (KCl), and urea were purchased from Beijing Chemical Corp. Fetal bovine serum was purchased from DingGuo Biotech. Ltd. (Beijing, China). All chemically synthesized oligonucleotides were purchased from Shanghai Sangon Biotechnology Co. Ltd. (Shanghai, China). The water used throughout all experiments was purified through a Millipore system.

Synthesis of CoS_2 NWs: $Co(CO_3)_{0.5}(OH) \cdot 0.11H_2O$ nanowires (NWs) were prepared according to our previous report.[1] Typically, 0.28 g $CoSO_4 \cdot 7H_2O$ was dissolved in 20 mL of a glycerol 20% (v/v) aqueous solution under stirring. Then, urea (0.05 g) was dissolved into the above solution. The obtained solution was transferred into a Teflon-lined stainless autoclave (25 mL), the autoclave was sealed and maintained at 170 °C for 24 h in an electric oven. After the autoclave cooled down slowly at room temperature, the precipitate was collected and washed with water and ethanol several times by centrifugation and dried at 60 °C.

To prepare CoS_2 NWs, the resulting $Co(CO_3)_{0.5}(OH)\cdot 0.11H_2O$ NWs were treated in a hydrothermal environment with sodium sulfide. In brief, 25 mM $Na_2S\cdot 9H_2O$ was dissolved in 20 mL of deionized water, and then the $Co(CO_3)_{0.5}(OH)\cdot 0.11H_2O$ NWs were added into above solution and transferred into a 25 mL Teflon-lined stainless autoclave. The autoclave was heated to 150 °C for 6 h in an electric oven. The CoS_2 NWs were obtained, washed with ethanol and deionized water, and dried at 60 °C for 5 h. The yield of CoS_2 NWs is about 120 mg.

Characterizations: Powder X-ray diffraction (XRD) datum was recorded on a RigakuD/MAX 2550 diffractometer. Scanning electron microscopy (SEM) measurements were made on a XL30 ESEM FEG scanning electron microscope at an accelerating voltage of 20 kV. Transmission electron microscopy (TEM) measurements were made on a HITACHI H-8100 electron microscopy (Hitachi, Tokyo, Japan) with an accelerating voltage of 200 kV. XPS measurements were performed on an ESCALABMK II X-ray photoelectron spectrometer using Mg as the exciting source. Fluorescent emission spectra were recorded on a RF-5301PC spectrofluorometer (Shimadzu, Japan).

Fluorescence sensing assays: The fluorescent DNA sensing was performed at room temperature in 10 mM Tris-HCl buffer (pH 7.4, containing 100 nM NaCl, 5 mM KCl and 5 mM $MgCl_2$). The photoluminescence emission spectra were recorded after reaction for 10 min at room temperature. The fluorescent probe P_{HIV} (50 nM) was hybridized with different amounts of target for 10 min in 300-μL buffer solution.

Then CoS_2 NWs suspension (5 μl, 5 mg/ml) was added. The final target concentration ranged from 10 pM to 300 nM. For kinetic study of fluorescence quenching, fluorescence spectra were recorded immediately after addition of CoS_2 NWs. Excitation was at 480 nm, emission was monitored at 518 nm.

Oligonucleotide sequences used are listed below (mismatch underlined):

P_{HIV} (FAM dye-labeled ssDNA):

5'-FAM-AGT CAG TGT GGA AAA TCT CTA GC-3'

T_1 (complementary target):

5'-GCT AGA GAT TTT CCA CAC TGA CT-3'

T_2 (single-base mismatched target):

5'-GCT AGA GAT T<u>G</u>T CCA CAC TGA CT-3'

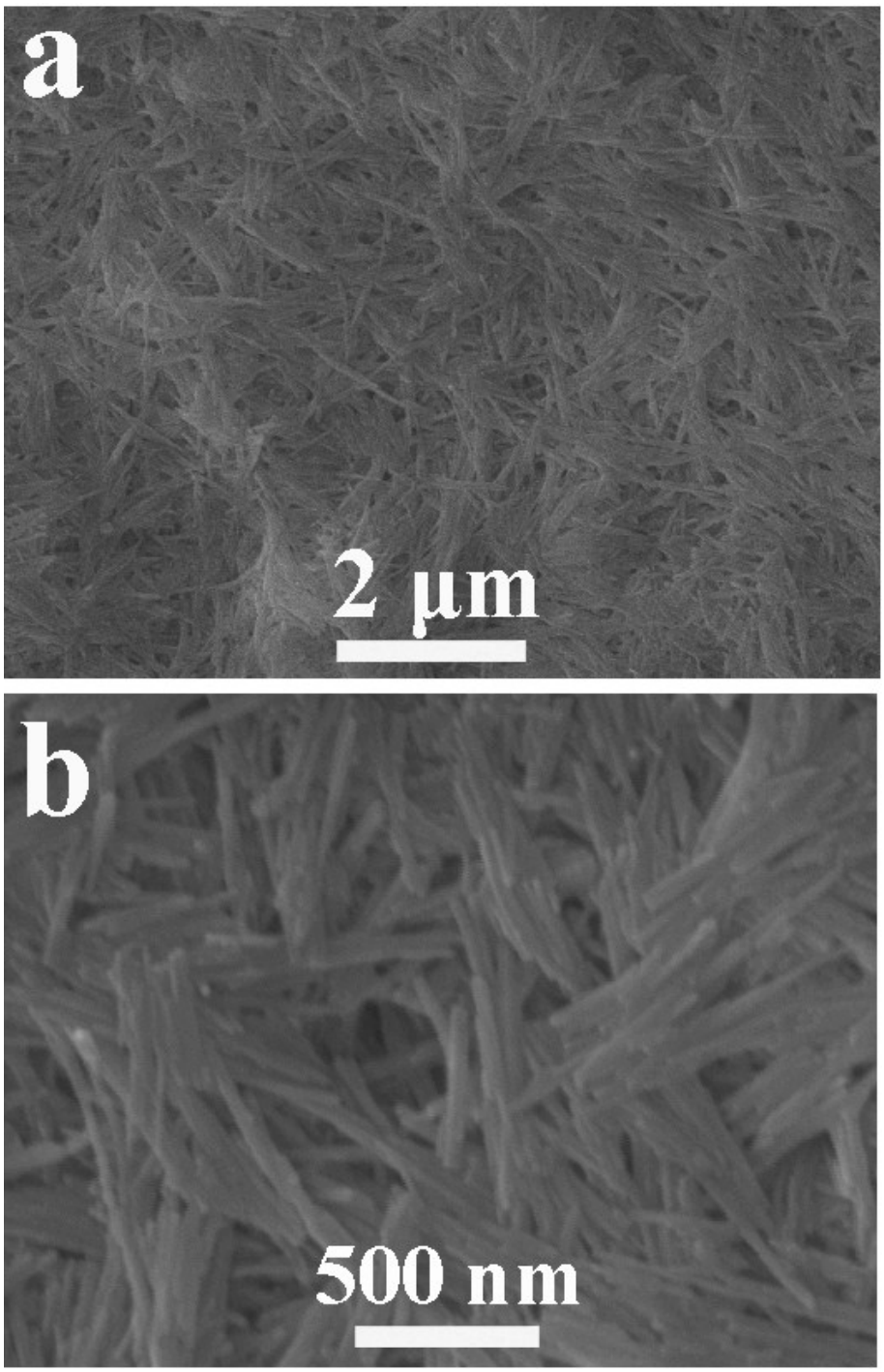

Fig. S1 SEM images of the $Co(CO_3)_{0.5}(OH)\cdot 0.11H_2O$ NWs.

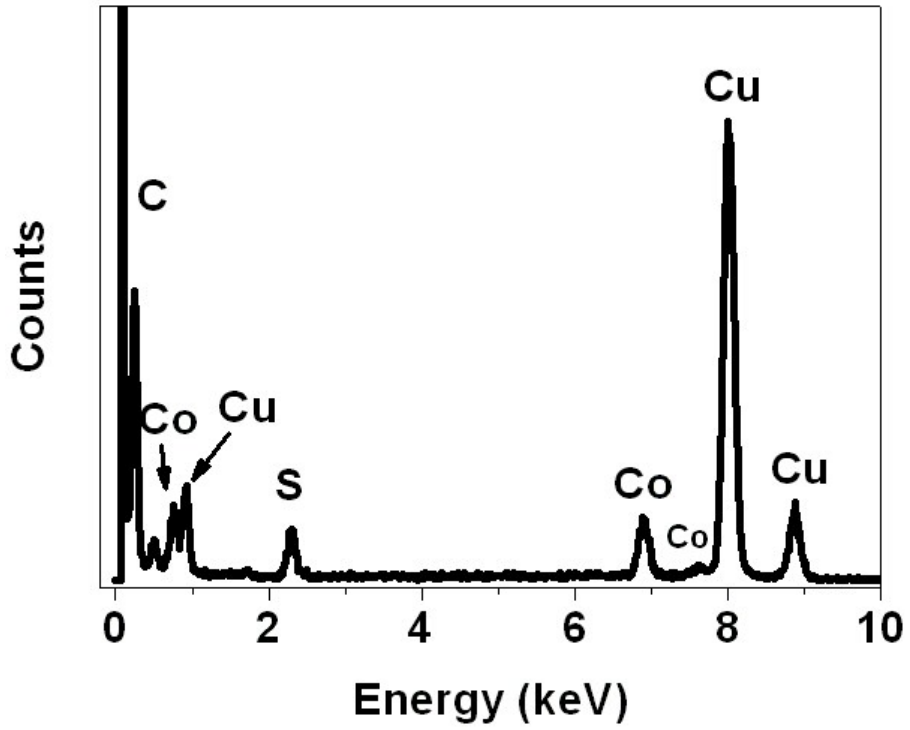

Fig. S2 EDX spectrum of CoS_2 NWs.

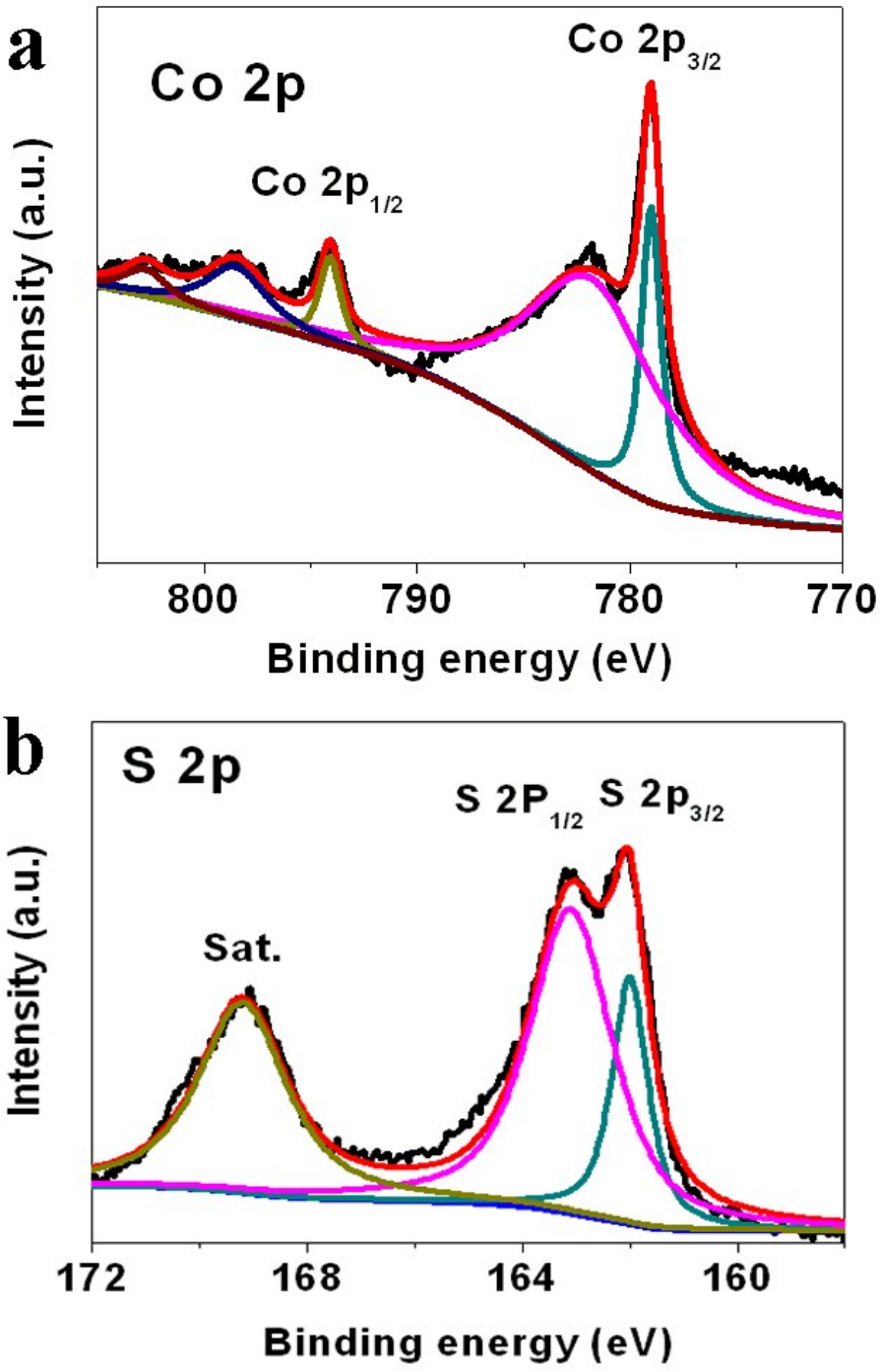

Fig. S3 XPS spectra in the (a) Co 2p and (b) S 2p regions for CoS_2 NWs.

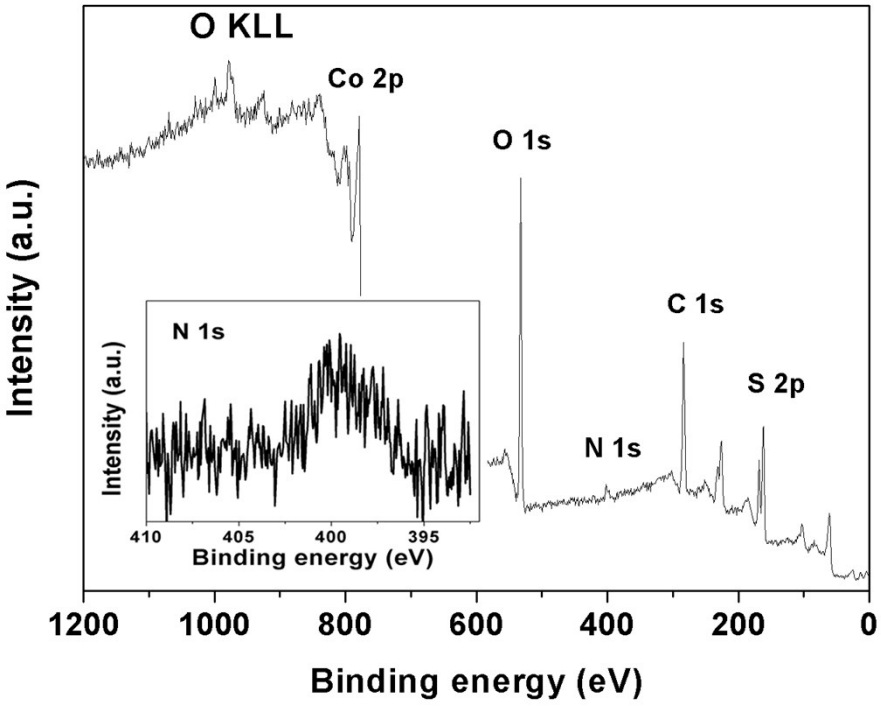

Fig. S4 Survey and high-resolution N 1s (inset) for P_{HIV}/CoS_2.

Reference

1. J. Tian, N. Cheng, Q. Liu, W. Xing and X. Sun, *Angew. Chem. Int. Ed.*, 2015, **54**, 5493.