Supplementary Information

Fast Cr(VI) wastewater remediation on Bi_xO_y/CdS heterostructure under simulated solar light induction

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1. Experimental Section

1.1 Chemicals

The $Cd(Ac)_2 \cdot 2H_2O$ (A.R.), $Na_2S \cdot 9H_2O$ (A.R.), $K_2Cr_2O_7$ (A.R.), $Bi(NO_3)_3 \cdot 5H_2O$ (A.R.), H_2SO_4 (98.0%), Diphenylcarbazide (DPC, A.R.), acetone (A.R.), ethylene glycol (EG, A.R.) were purchased from Aladdin Chemical and used directly without any treatment.

1.2 Characterization

The structures of the samples were analyzed on Raman imaging spectrometer (THEM, DXRxi, US), X-ray diffractometer (XRD, Bruker D8 Advance, UK) and X-ray photoelectron spectroscopy (XPS, Axis Supra, UK). The morphologies of the samples were observed on field emission scanning electron microscopy (FEISEM, Verios G4, US) and field emission transmission electron microscopy (FEITEM, Talos F200X, US). The optical properties of the samples were analyzed on UV-vis-NIR spectrometer (Agilent, Cary 5000, US) and fluorescence spectrophotometer (Edinburgh FS5, U.K.). The photoelectrochemical properties of the samples were analyzed on electrochemical analyzer (CHI660E, CN).

1.3 Photo-electrochemical property testing

All photo-electrochemical properties were tested on a CHI660 electrochemical analyzer. The platinum electrode, ITO glass coated by sample and $Ag^+/AgCl$ electrode served as counter electrode, working electrode and reference electrode to build the three-electrode system in 0.2 M Na_2SO_4 electrolyte. The detailed operation parameters are shown as below:

Linear sweep voltammetry (LSV) polarization curves were tested under illumination (xenon lamp, 300 W). The initial potential, final potential, scan rate, sample interval, quiet time and sensitivity were set as -1 V, -0.7 V, 0.01 V/s, 0.001 V, 1 s and 100 μA, respectively.

Mott-Schottky plots were tested in frequency of 1500 Hz, and the initial potential, final potential, increment potential, amplitude, cycles, and sensitivity were 0 V, 1 V, 0.01 V, 0.01 V, 100, 10 s and 1 mA, respectively.

Transient photocurrent responses were analyzed under chopped-illumination (xenon lamp, 300 W). The initial potential, sample interval, quiet time and sensitivity were set as -0.1 V, 0.1 s, 1 s and 10 μA, respectively.

Electrochemical impedance spectroscopy (EIS) was tested under illumination. The amplitude, initial frequency, final frequency, logarithmic current and step width were set as 0.01 V, 100000 Hz, 1 Hz, 100 mA and 12, respectively.

Tafel curves were tested under illumination. The initial potential, final potential, scan rate, sweep segment, sample interval, quiet time and sensitivity were set as -3 V, 1 V, 0.1V/s, 0.001 V, 1, 1 s and 10 mA, respectively.

1.4 Kubelka-Munk function

$$(\alpha h\vartheta)^{1/n} = A(h\vartheta - E_g)$$

Generally, n value equals to 1 for indirect semiconductor, and it is 4 to direct semiconductor. Here, CdS NPs is direct semiconductor, so its n value equals to 4. The Bi_xO_y is indirect semiconductor, so its n value equals to 1.

2. Supplemented data

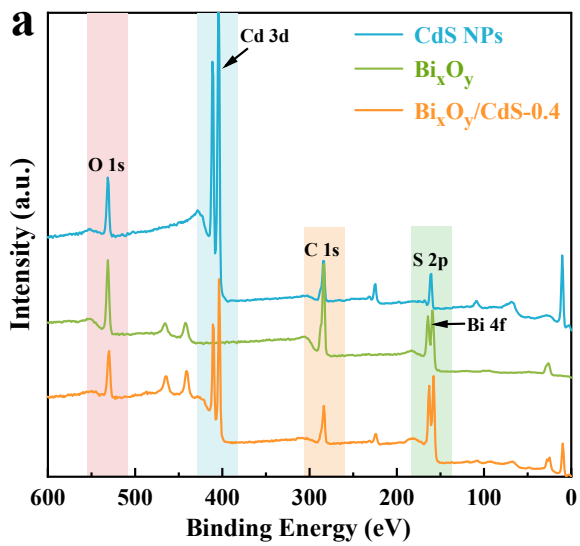

Fig.S1 XPS survey spectra of CdS NPs, Bi_xO_y and Bi_xO_y/CdS.

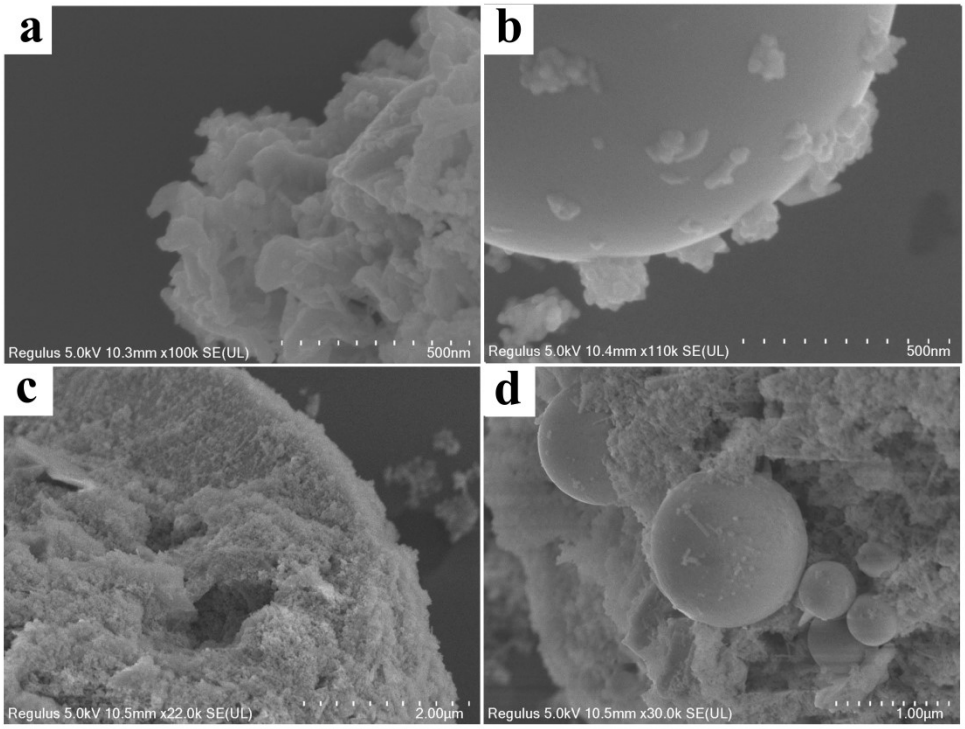

Fig.S2 SEM images of Bi_xO_y/CdS composites with different amount of CdS NPs: (a) 0.1 g, (b) 0.2 g, (c) 0.4 g and (d) 0.5 g.

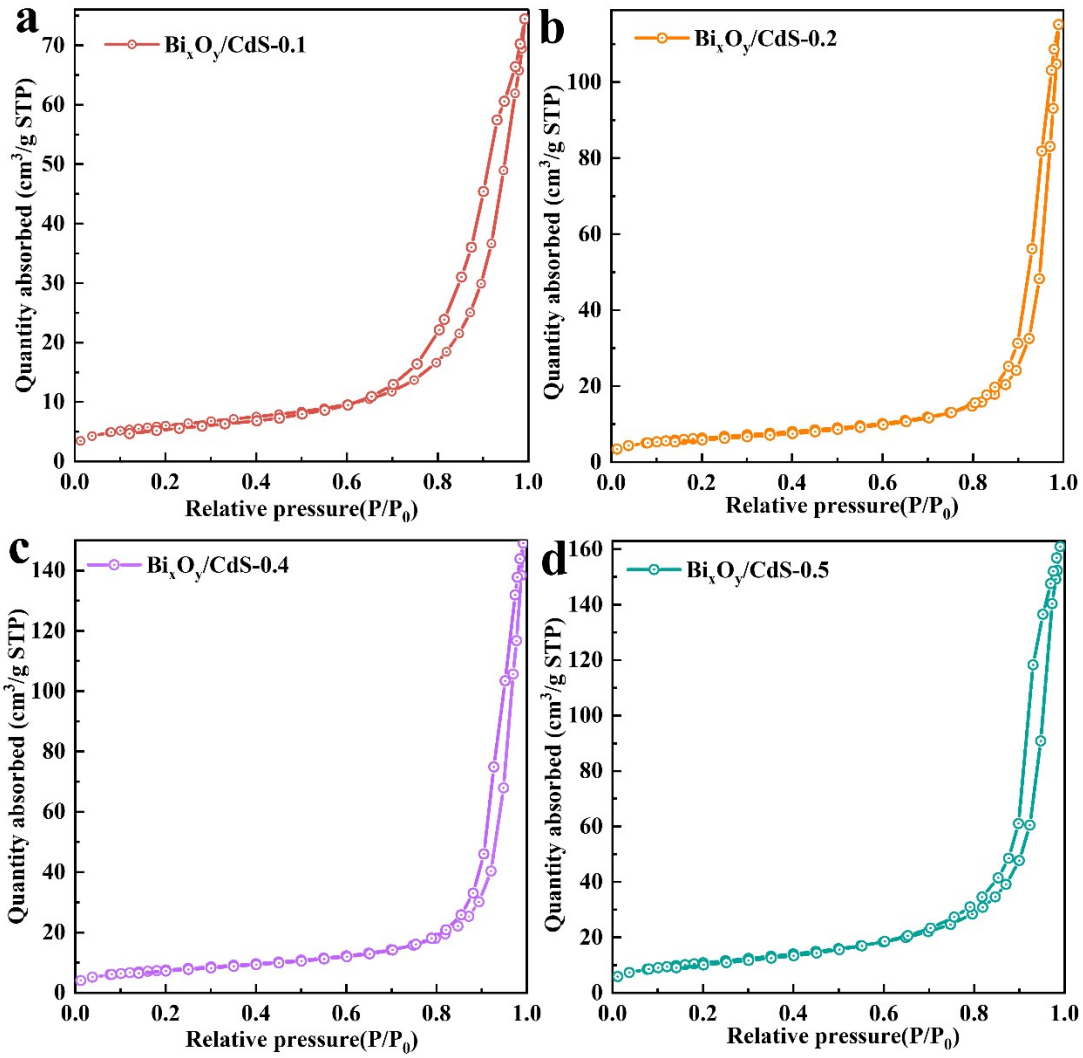

Fig.S3 N_2 adsorption-desorption isotherms of Bi_xO_y/CdS composites with different amount of CdS NPs: (a) 0.1 g, (b) 0.2 g, (c) 0.4 g and (d) 0.5 g.

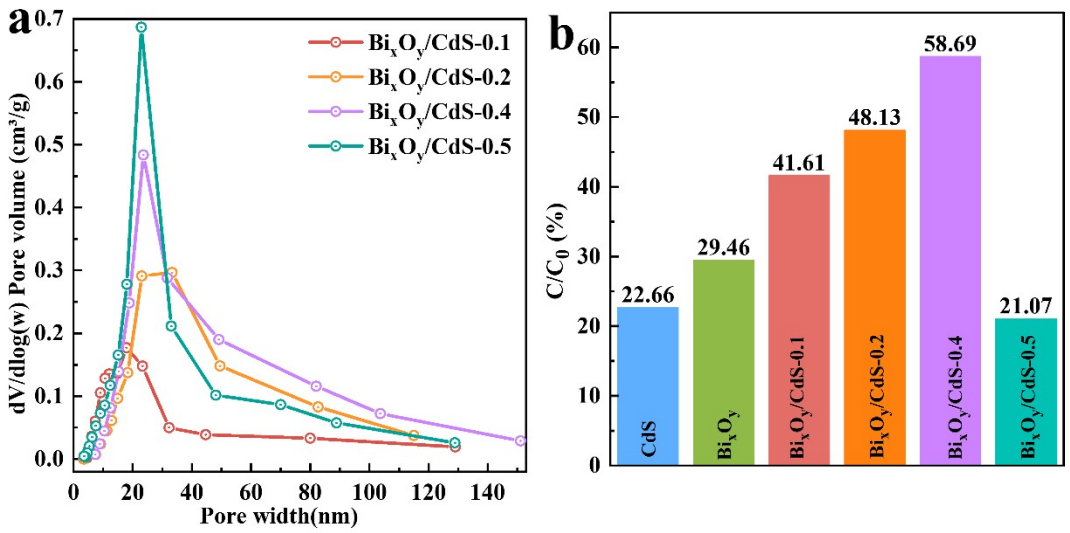

Fig.S4 (a) Pore size distributions of Bi_xO_y/CdS composites with different amount of CdS NPs (0.1 g, 0.2 g, 0.4 g and 0.5 g). (b) The saturated adsorption capacities of Cr (VI) on the samples.