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Synthesis and photocatalytic properties of magnetic separable and recyclable p-n heterojunction $CoFe_2O_4/Bi_{12}O_{17}Cl_2$ photocatalyst

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Characterization of catalyst

The X-ray diffraction (XRD) were detected on a D8 Advance X-ray powder diffractometer (Bruker). Thermo Fisher Scientific Escalab 250 was used to measure X-ray photoelectron spectroscopy (XPS), the shift of the binding energy was calibrated using an internal standard of C1s level at 284.6 eV. Then the relate element XPS spectra was fitted using the XPS PEAK 4.1. The surface feature was observed by Hitachi scanning electron microscope (SEM, SU8010), and elements mapping images were measured by Energy Dispersive Spectrometer (EDS). The microstructure was observed by transmission electron microscope (TEM, JEM-2010). The Agilent Cary 5000 UV–vis diffuse reflectance spectra (DRS) was used to record light response ability. Agilent Cary Eclipse spectrometer was used to record the photoluminescence spectra (PL), the excitation wavelength of PL spectrum is 375 nm. Photocurrent, electrochemical impedance spectra (EIS) and Mott-Schottky curves were recorded on a Chenhua electrochemical station (CHI660E) in a three electrodes system. Magnetic-hysteresis (M-H) loops were gained using vibrating sample magnetometer.

Degradation test

(1) RhB as a model pollutant was used in photocatalytic degradation experiments. A 300 W Xe lamp with 400 nm cut-off filter was applied as the visible-light source. 30 mg photocatalyst sample was added into 50 mL 10 mg/L RhB solution and stirred for an hour in the dark to reach adsorption-desorption equilibrium. During photocatalytic degradation reaction, 4 mL solution was taken every five minutes and centrifuged

(10000 rpm, 5 min) twice. The gained solution was measured at 553 nm on UV-vis spectrometer.

(2) A 300 W Xe lamp with 400 nm cut-off filter was applied as the visible-light source. 25 mg photocatalyst sample was added into 100 mL 20 mg/L RhB solution and stirred for an hour in the dark to reach adsorption-desorption equilibrium. During photocatalytic degradation reaction, 4 mL solution was taken every one hour and centrifuged (10000 rpm, 5 min) twice. The gained solution was measured at 553 nm on UV-vis spectrometer. (Simulating the same degradation conditions as the Reference [22])

Cycle test for the photocatalyst

The recycling experiments of CFO/$Bi_{12}O_{17}Cl_2$-3 was tested by degrading RhB. For the first cycle, it was the same as above "Photocatalytic degradation test" process. For the second cycle, the photocatalyst need go through one time the whole photocatalytic degradation process. In detail, 50 mL 10 mg/L RhB solution was photodegraded by 30 mg of CFO/$Bi_{12}O_{17}Cl_2$-3 nanocomposites under visible-light irradiation. When the color of solution was eliminated, photocatalyst in the solution was fixed by magnetic-iron, the solution was removed. Then a fresh 50 mL 10 mg/L RhB solution was added in the reactor, according to "Photocatalytic degradation test" step, the related degraded data was collected. For the third or fourth cycle, the photocatalyst need go through two or three times the whole photocatalytic degradation process. Other steps were the same as the second cycle experiment.

Detection of reactive species

This experimental process just like photocatalytic degradation test, the only difference was that the quencher was added to the RhB solution together with the photocatalyst. In this, the quenchers were needed including disodium ethylene diamine tetraacetate (EDTA-2Na, 10 mg), methyl alcohol (2 mL) and ascorbic acid (10 mg).

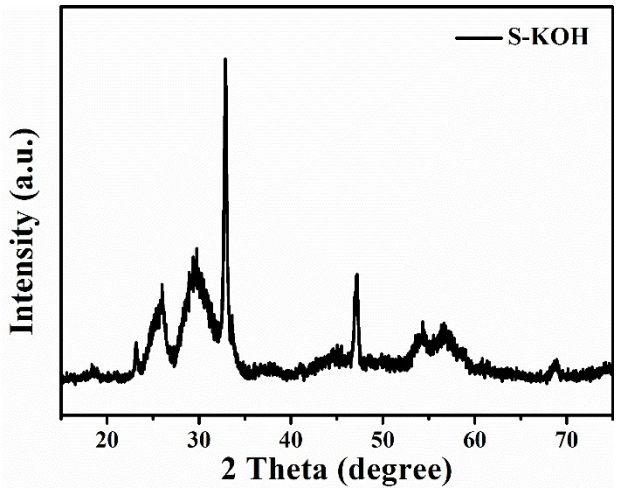

Fig. S1 XRD patterns of S-KOH

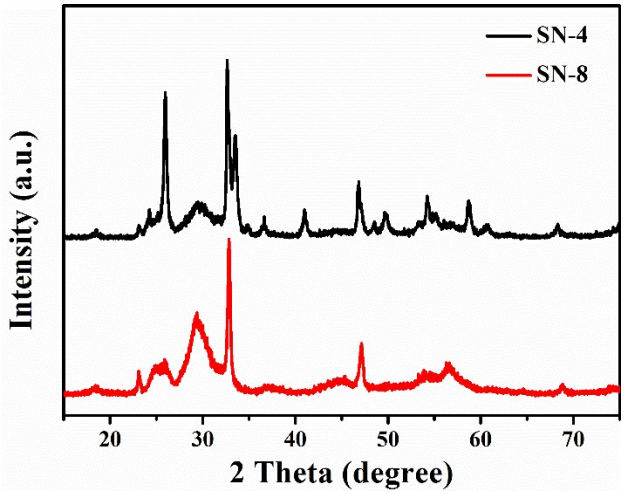

Fig. S2 XRD patterns of SN-4 and SN-8

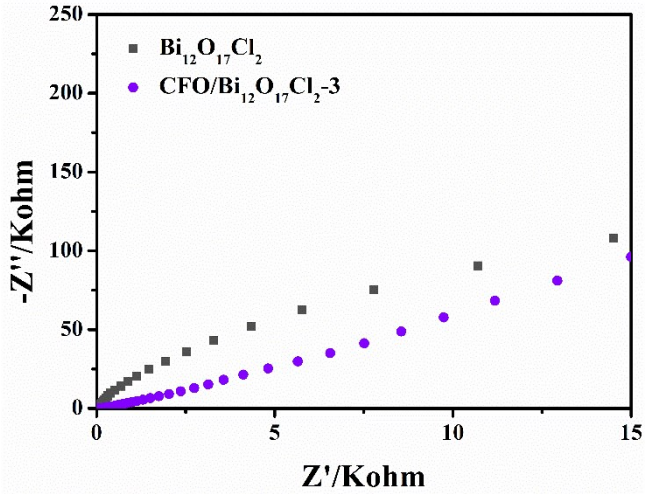

Fig. S3 EIS Nynquist plots of $Bi_{12}O_{17}Cl_2$ and CFO/$Bi_{12}O_{17}Cl_2$-3.

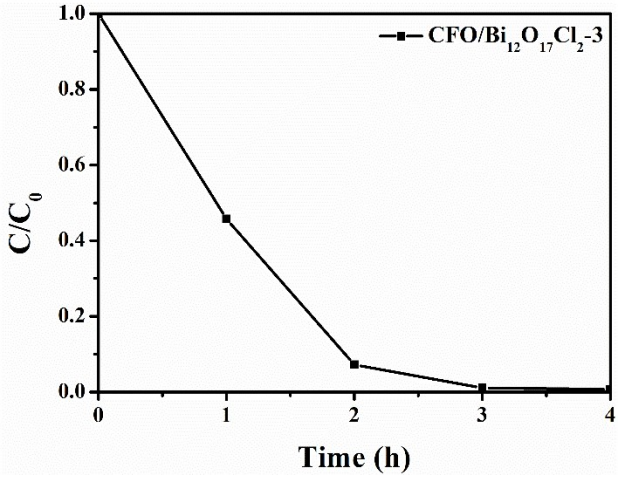

Fig. S4 Photocatalytic degradation curves of RhB for CFO/$Bi_{12}O_{17}Cl_2$-3 under visible light.

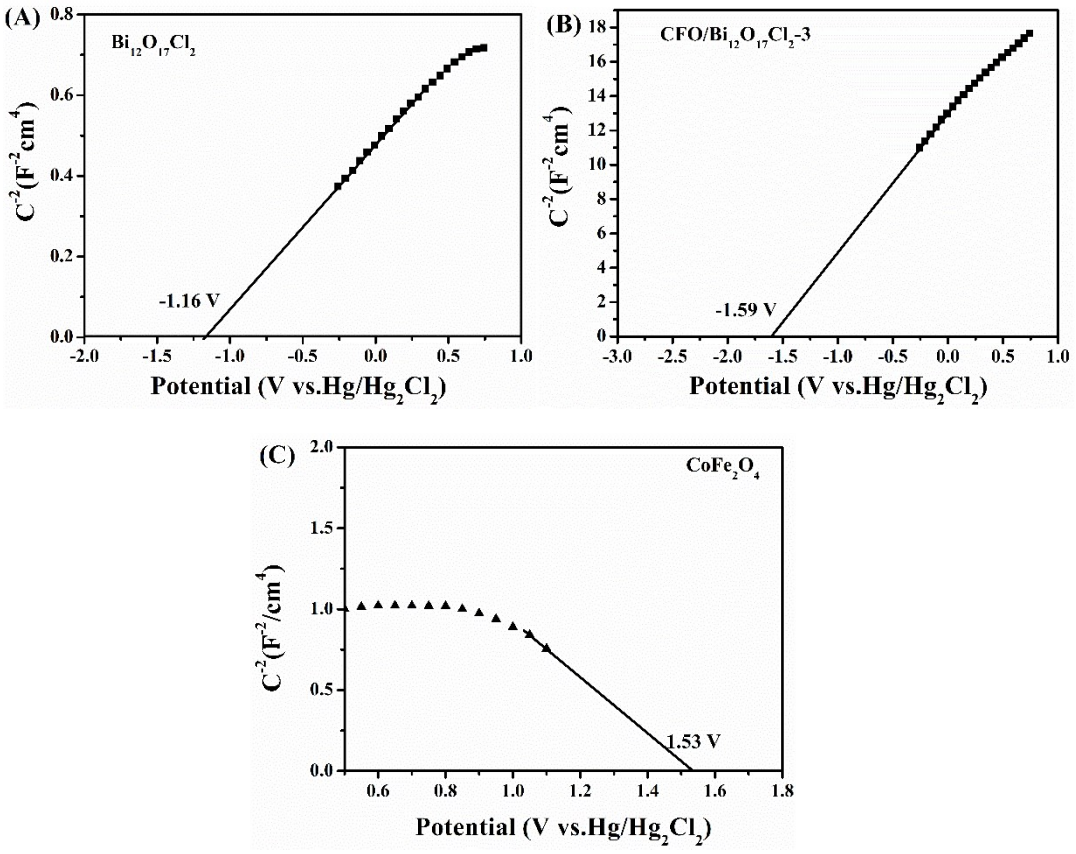

Fig. S5 Mott-Schottky curve of (A) $Bi_{12}O_{17}Cl_2$, (B) CFO/$Bi_{12}O_{17}Cl_2$-3 and (C) $CoFe_2O_4$.

Table S1 Performance comparison between $CoFe_2O_4/Bi_{12}O_{17}Cl_2$ and $CoFe_2O_4$/BiOCl under visible light

Sample	Catalyst dosage	C_0(RhB)	Degradation time	Degradation efficiency
$CoFe_2O_4/Bi_{12}O_{17}Cl_2$	0.25 g/L	20 mg/L	3 hrs	>95%
$CoFe_2O_4$/BiOCl	0.25 g/L	20 mg/L	6 hrs	>95%(Reference[22])