Supplementary information

Synthesis of double Z-scheme $CdS/Bi_2O_2CO_3/BiOCl$ heterojunction photocatalysts for degradation of Rhodamine B under visible light

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2. Experimental Section

Materials.

two points of cadmium chloride pentahydrate ($CdCl_2 \cdot 2.5H_2O$), potassium chloride (KCl), thiourea (CH_4N_2S), Bismuth nitrate ($Bi(NO_3)_3 \cdot 5H_2O$), urea (CH_4N_2O), anhydrous ethanol (C_2H_6O), isopropyl alcohol (IPA), ethylenediaminetetraacetic acid disodium salt (EDTA-2Na) and benzoquinone (BQ), terephthalic acid (TA)，nitro blue tetrazolium (NBT) were all purchased from Aladdin Chemical Reagent Co. Ltd. and were of analytical grade purity. All reagents are not purified.

Synthesis of $Bi_2O_2CO_3$ (BSC).

$Bi(NO_3)_3 \cdot 5H_2O$ (1.947 g), KCl (0.1 g) and CH_4N_2O (1.21 g) were added to 40 ml of deionized water and stirred for 1 hour. After stirring, the solution was placed in a PTFE-lined reaction vessel and kept at 160°C for 24 hours. After being cooled to room temperature, the obtained white powders were washed 3 times each with deionized water and ethanol, filtered and dried (60°C, 24h).

Synthesis of BiOCl (BOC).

$Bi(NO_3)_3 \cdot 5H_2O$ (2.021 g) and KCl (0.315 g) were added to 40 ml of deionized water and stirred for 1 hour. After stirring, the solution was put into a PTFE-lined reactor and kept at 160°C for 24 hours. After being cooled to room temperature, the obtained white powders were washed 3 times each with deionized water and ethanol, filtered and dried (60°C, 24h).

Synthesis of CdS.

$CdCl_2 \cdot 2.5H_2O$ (1.522 g) and CH_4N_2S (2.533 g) were added to 40 ml of deionized water and stirred for 1 hour. After stirring, the solution was put into a PTFE-lined reactor and kept at 160°C for 24 hours. After being cooled to room temperature, the obtained orange powders were washed 3 times each with deionized water and ethanol, filtered and dried (60°C, 24h).

Synthesis of $Bi_2O_2CO_3$/BiOCl (BSC/BOC).

$Bi(NO_3)_3 \cdot 5H_2O$ (2.021 g), KCl (0.0.315 g) and CH_4N_2O (0.25 g) were added to 40 ml of deionized water and stirred continuously for 1 hour. After stirring, the solution was placed in a PTFE-lined reactor and kept at 160°C for 24 hours. After being cooled to room temperature, the obtained composites were washed 3 times each with deionized water and ethanol, filtered and dried (60°C, 24h).

Synthesis of $Bi_2O_2CO_3$/10mol%CdS (BSC/10CdS).

$Bi(NO_3)_3 \cdot 5H_2O$ (1.947 g), KCl (0.1 g) and CH_4N_2O (1.21 g) were added to 25ml of deionized water and stirred for 1 h, record as solution A. Then $CdCl_2 \cdot 2.5H_2O$ (0.096 g) and CH_4N_2S (0.16 g) were dissolved in 15ml of deionized water and stirred for 1 hour, recorded as solution B. Solution B was added to solution A and stirred for another 1 hour. After stirring, put the mixed solution into a PTFE-lined reactor and kept at 160°C for 24 hours. After being cooled to room temperature, the obtained samples were washed 3 times each with deionized water and ethanol, filtered and dried (60°C, 24h).

Synthesis of BiOCl/10mol%CdS (BOC/10CdS).

$Bi(NO_3)_3 \cdot 5H_2O$ (2.021 g) and KCl (0.315 g) were added to 25ml of deionized water and stirred for 1 h, record as solution A. Then $CdCl_2 \cdot 2.5H_2O$ (0.096 g) and CH_4N_2S (0.16 g) were dissolved in 15ml of deionized water and stirred for 1 hour, recorded as solution B. Solution B was added to solution A and stirred for another 1 hour. After stirring, put the mixed solution into a PTFE-lined reactor and kept at 160°C for 24 hours. After being cooled to room temperature, the obtained samples were washed 3 times each with deionized water and ethanol, filtered and dried (60°C, 24h).

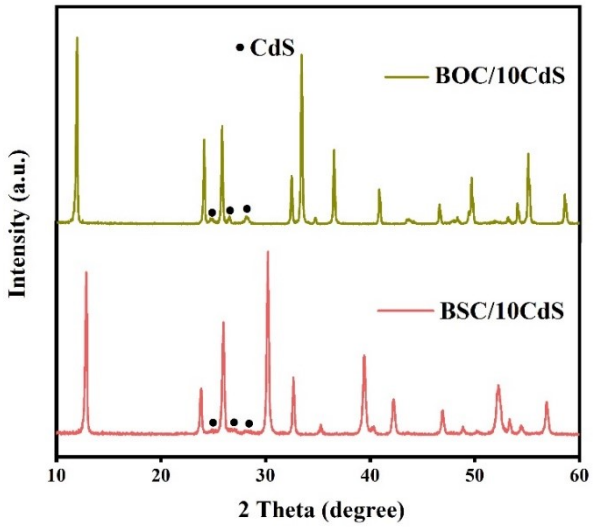


Fig. S1 XRD patterns of BSC/10CdS, BOC/10CdS

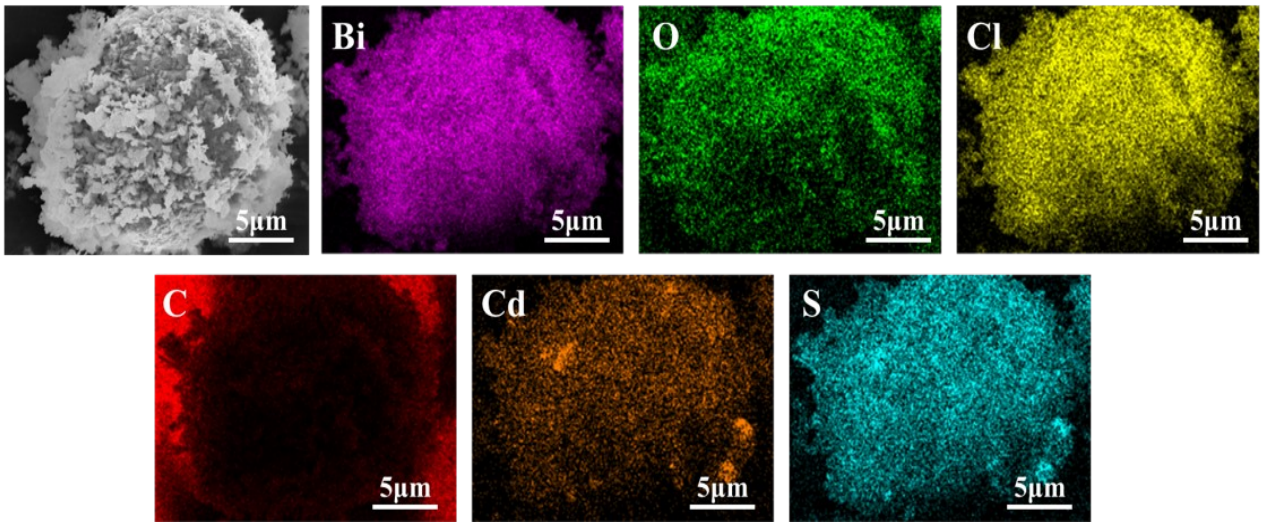
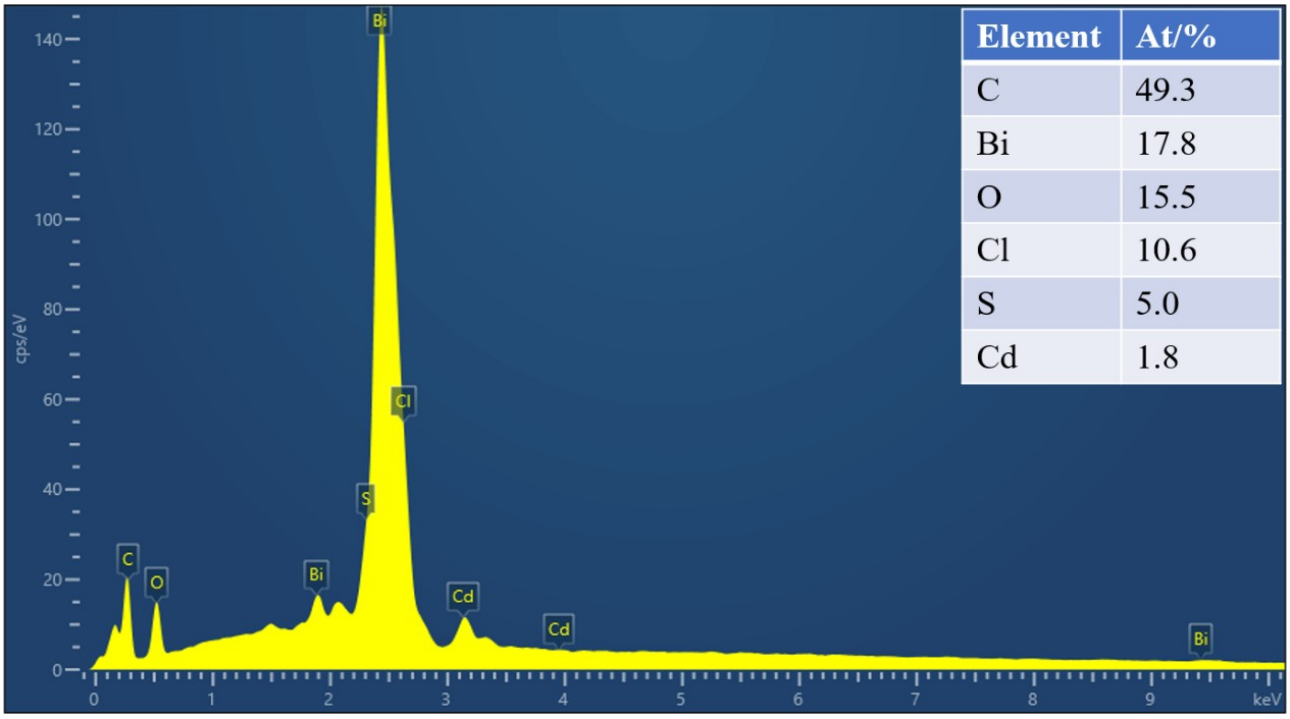


Fig. S2 Elemental mapping to the SEM image of 10CBB



Element	At/%
C	49.3
Bi	17.8
O	15.5
Cl	10.6
S	5.0
Cd	1.8

Fig. S3 EDS spectrum of 10CBB

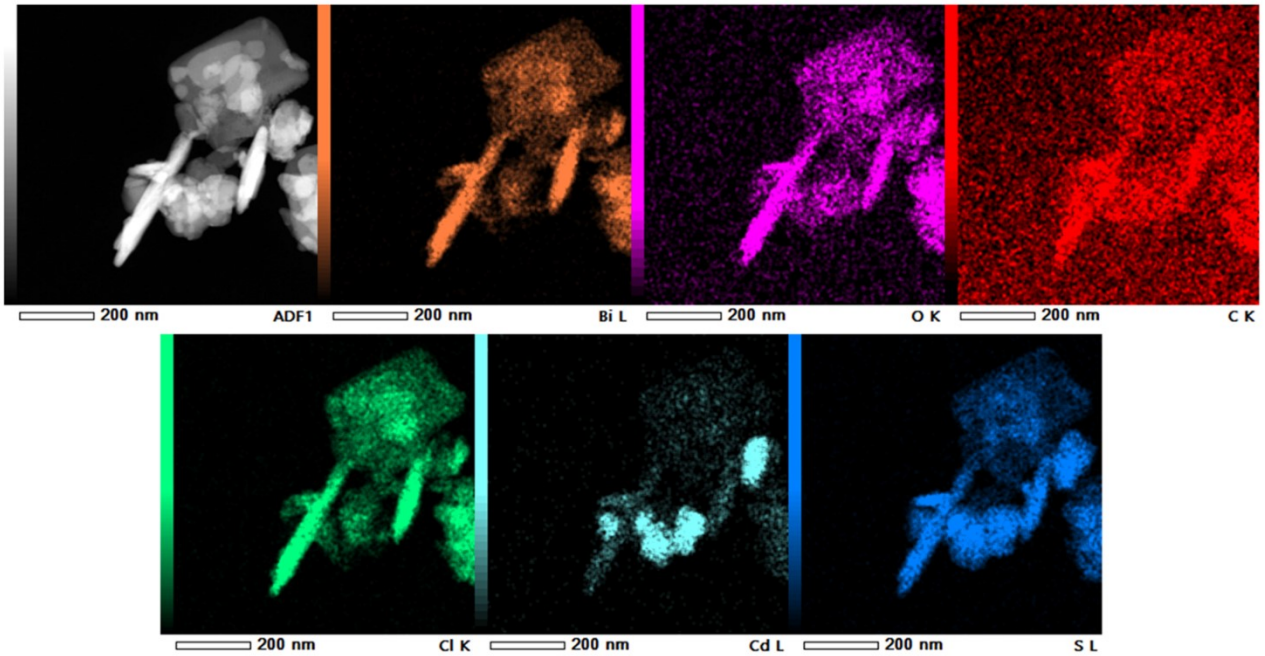


Fig. S4 Elemental mapping to the TEM image of 10CBB

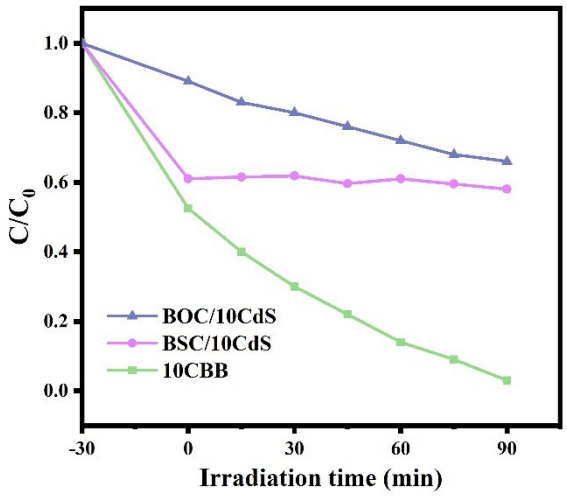


Fig. S5 Comparison of photocatalytic activity of 10CBB with BOC/10CdS and BSC/10CdS

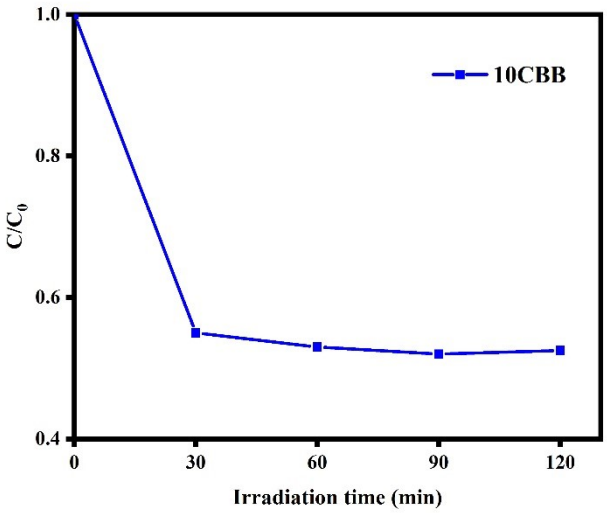


Fig. S6 Adsorption curve of 10CBB in the dark conditions

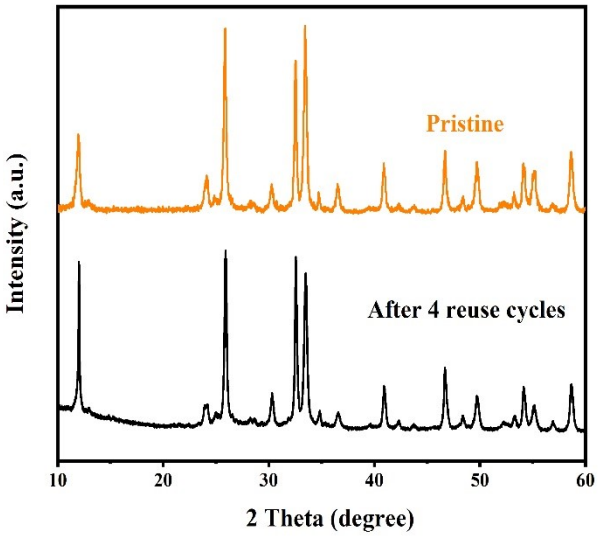


Fig. S7 XRD patterns of 10BB before and after cycling

Table S1 Comparison of the catalytic effect of CdS/ $Bi_2O_2CO_3$/BiOCl with other catalysts for degradation of RhB

Photocatalysts	Catalysts dosage (g)	Pollutant Concentration	Light source	Removal Efficiency (%)	Time (min)	Ref.
CdS/$Bi_2O_2CO_3$/BiOCl	0.1	20 mg/L, 100 mL	300W, λ>420 nm	97	90	This Work
Ag/g-C_3N_4/$BiVO_4$	0.0125	5 mg/L, 25 mL	300W, λ>400 nm	99	90	[1]
Cu-In_2S_3	0.02	5 mg/L, 50 mL	300W, λ>420 nm	About 92	60	[2]
Biochar/Bi_2WO_6	0.05	10 mg/L, 50 mL	500W, λ>420 nm	99.9	270	[3]
CC/ZnO@Ag_3PO_4	~	10^{-5}M, 60 mL	LED, λ=420 nm	87.1	100	[4]
ZnO/$ZnMoO_4$	0.01	$2*10^{-4}$M, 50 mL	125W lamp, λ=420 nm	83.7	120	[5]
C/F-Ag-TiO_2	0.05	10 mg/L, 100 mL	150W	84.2	240	[6]
BOC-CTAB	0.05	10 mg/L, 100 mL	300W, λ>420 nm	99	20	[7]
$NiTiO_3$-BiOBr	0.03	20 mg/L, 30 mL	400W, λ>420 nm	96.6	90	[8]
g-C_3N_4/$Bi_4O_5Br_2$	0.1	10 mg/L, 100 mL	500W, λ>420 nm	98.1	90	[9]

References

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