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二维/一维 $BiOBr_{0.5}Cl_{0.5}/WO_3$ S 型异质结助力光催化 CO_2 还原

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Enhanced Photocatalytic CO_2 Reduction over S-scheme Heterostructure of 2D/1D $BiOBr_{0.5}Cl_{0.5}/WO_3$

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Preparation of WO_3 nanoparticles

First, Tungsten trioxide (WO_3) nanoparticles were prepared by the wet precipitation method. The required amount of Sodium tungstate dihydrate ($Na_2WO_4 \cdot 2H_2O$) was dissolved in 100 mL distilled water and heated to a temperature of 353 K. To it, 6 $mol \cdot L^{-1}$ hydrochloric acid (30 mL) was added dropwise while stirring was in progress, and the resultant solution was kept at 353 K with continuous stirring for 120 min. The obtained bright yellow coloured tungstic acid precursor was collected and washed several times with distilled water and methanol. It was then dried in an air oven at 373 K for 1 h. After drying, the precipitate was calcined at 723 K for 2 h [R1].

Synthesis of WO_3 nanosheets

WO_3 nanosheets were prepared by a mild hydrothermal method. Briefly, 1 mmol of $Na_2WO_4 \cdot 2H_2O$ was initially added into 30 mL of H_2O to prepare a transparent solution, into which 1.5 mmol of citric acid and 5 mmol of glucose were then added in order. After vigorous stirring for 10 min, 3 mL of HCl solution (6 $mol \cdot L^{-1}$) was added into the mixed solution, followed by another 30-min stirring. The mixture was transferred into a 50-mL Teflon-lined autoclave, which was then sealed and heated at 393 K for 24 h. After the autoclave had cooled down to room temperature, the resultant product was separated by centrifugation, washed with water and anhydrous ethanol for several times until the organics were completely removed. Finally, the product was dried at 333 K in vacuum oven for 24 h for further use and characterization [R2].

References

[R1] Jineesh, P.; Bhagya, T. C.; Remya, R.; Shibli, S. M. A. *Int. J. Hydrog. Energy* **2020,** *45*, 18946. doi: 10.1016/j.ijhydene.2020.05.043

[R2] Zhang, N.; Li, X. Y.; Ye, H. C.; Chen, S. M.; Ju, H. X.; Liu, D. B.; Lin, Y.; Ye, W.; Wang, C. M.; Xu, Q.; *et al*. J. *J. Am. Chem. Soc.* **2016,** *138*, 8928. doi: 10.1021/jacs.6b04629

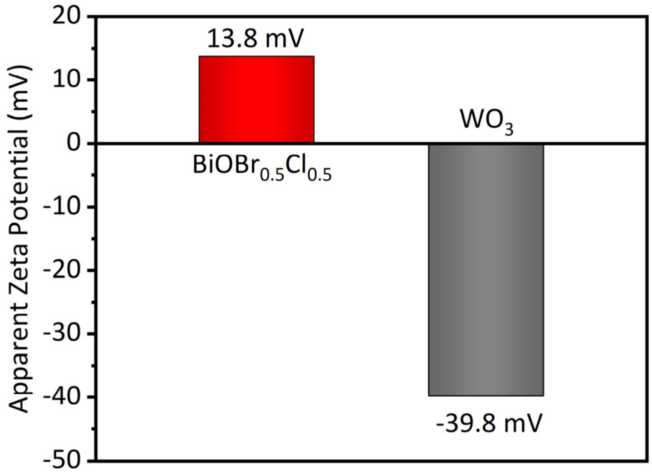

Fig. S1 Zeta Potentials of $BiOBr_{0.5}Cl_{0.5}$ and WO_3.

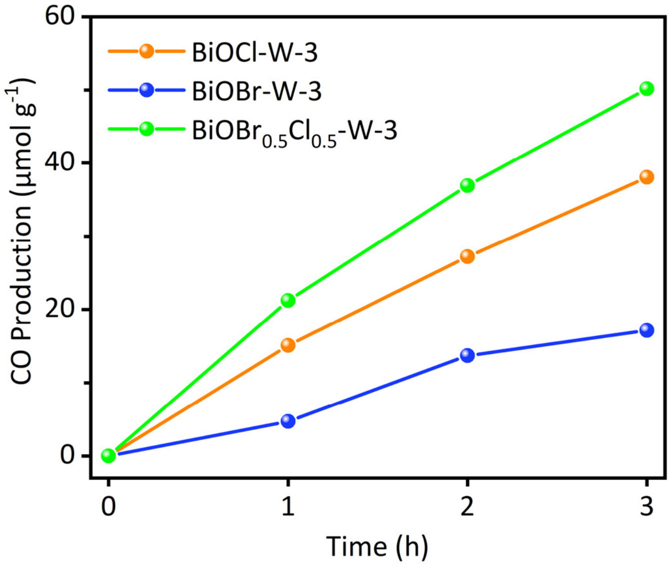

Fig. S2 The CO production rates of BiOCl-WO_3, BiOBr-WO_3 and $BiOBr_{0.5}Cl_{0.5}$-WO_3 samples.

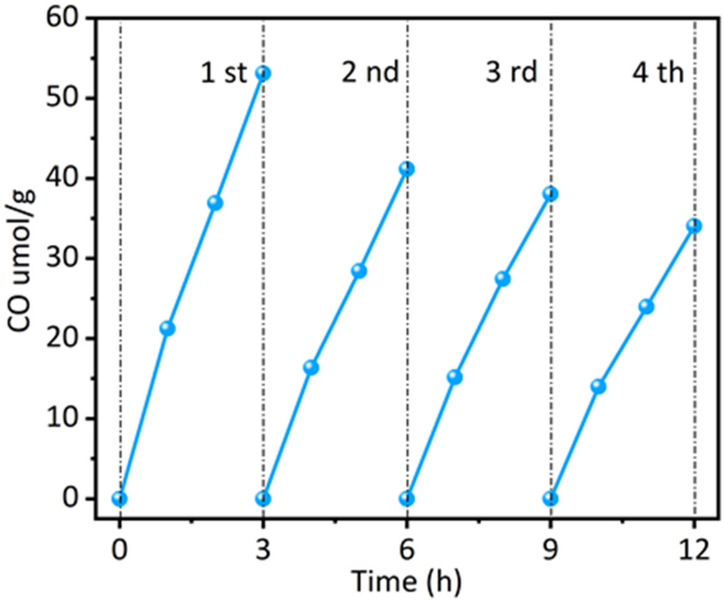

Fig. S3 The recycling stability of the composite.

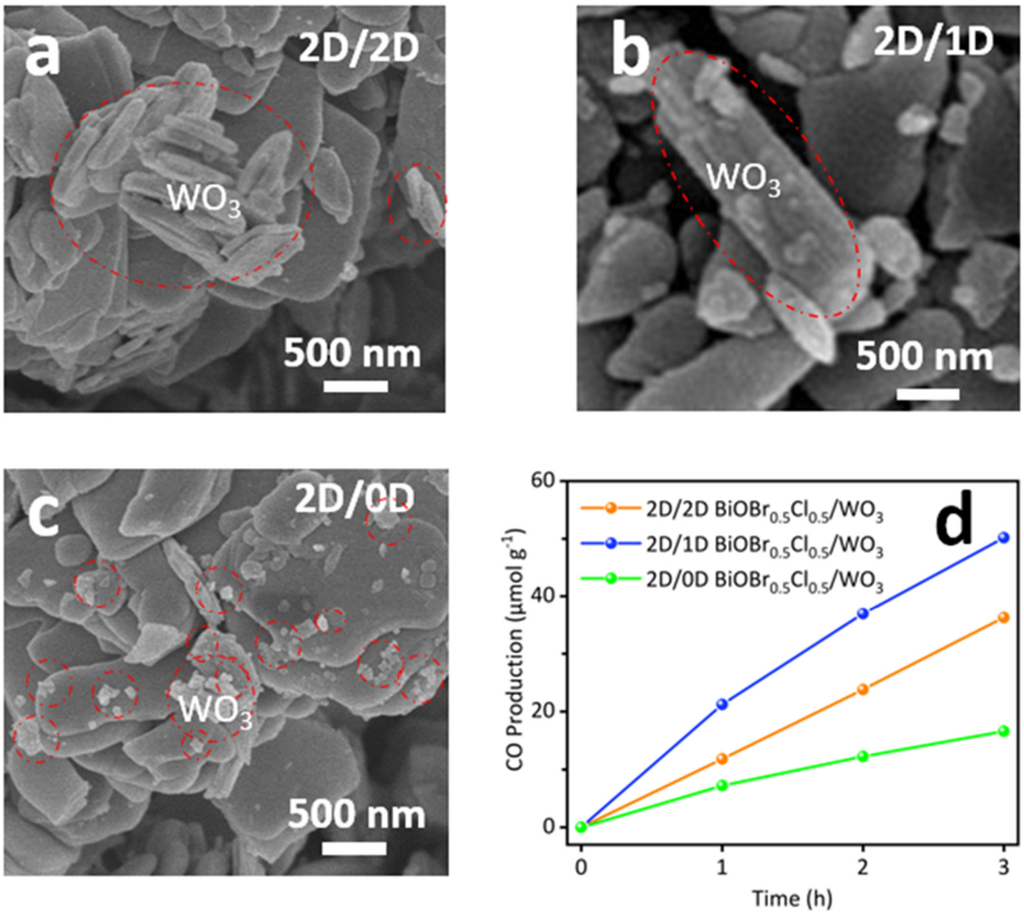

Fig. S4 The SEM patterns of (a) 2D/2D $BiOBr_{0.5}Cl_{0.5}/WO_3$ (b) 2D/1D $BiOBr_{0.5}Cl_{0.5}/WO_3$ (c) 2D/0D $BiOBr_{0.5}Cl_{0.5}/WO_3$ and CO yield of the samples (d).

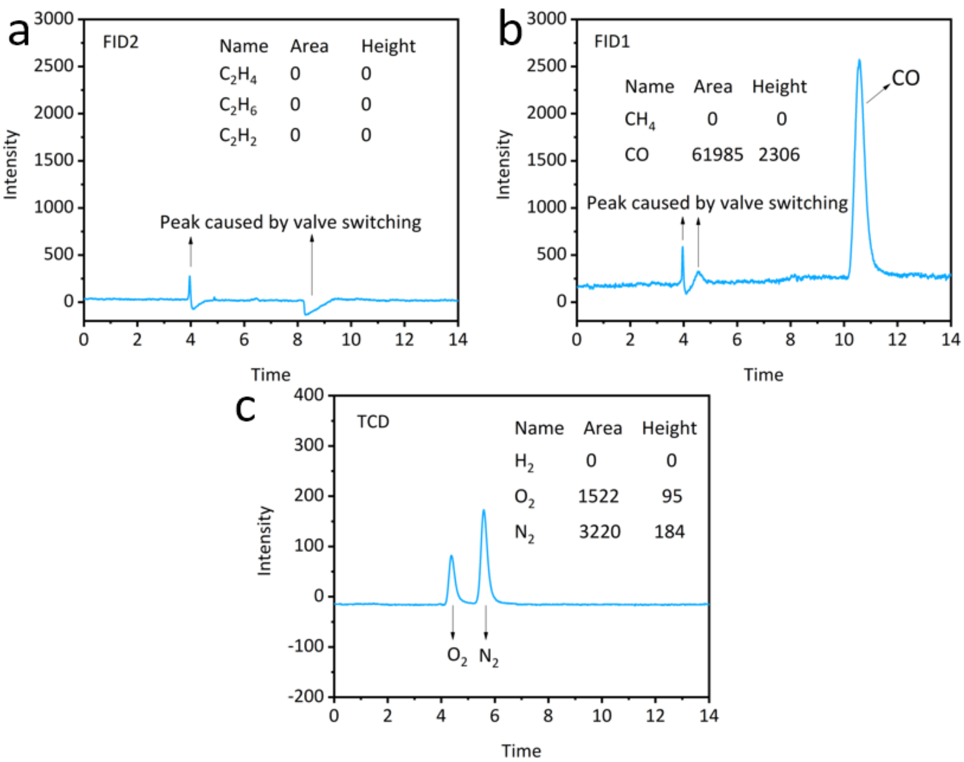

Fig. S5 The chromatographic patterns of the gas-phase of the reaction mixture when using BiW-3 as photocatalyst (a) FID2 (Detection of C_2H_4, C_2H_6, C_2H_2) patterns, (b) FID1 (Detection of CH_4, CO) patterns, (c) TCD (Detection of H_2, O_2, N_2) patterns.