Electronic Supplementary Material (ESI) for Environmental Science: Nano.

One-step fabrication of bimetallic CuCoOS as an efficient catalyst for Cr(VI) reduction

Xueqing Li, Dongyun Chen, Najun Li, Qingfeng Xu, Hua Li, Jinghui He, and Jianmei Lu**

College of Chemistry, Chemical Engineering and Materials Science, Collaborative Innovation Center of Suzhou Nano Science and Technology, Soochow University, Suzhou, Jiangsu 215123, China.

*Corresponding author.

E-mail addresses: dychen@suda.edu.cn; lujm@suda.edu.cn

Supporting Information

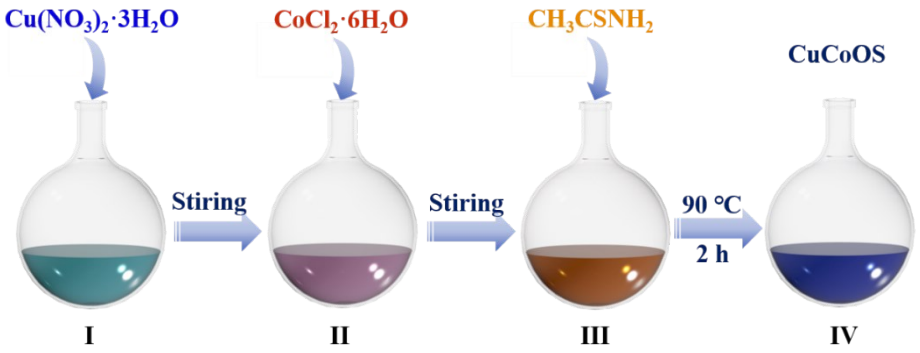

Fig. S1 Preparation scheme of CuCoOS catalyst via co-precipitation method followed by oil bath.

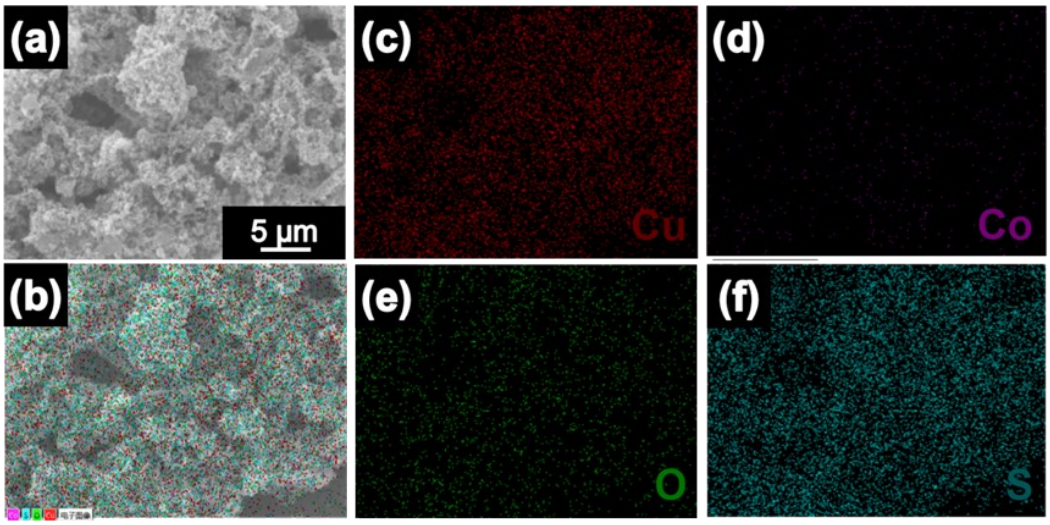

Fig. S2 EDS mapping images of CuCoOS-1/3 and corresponding elements.

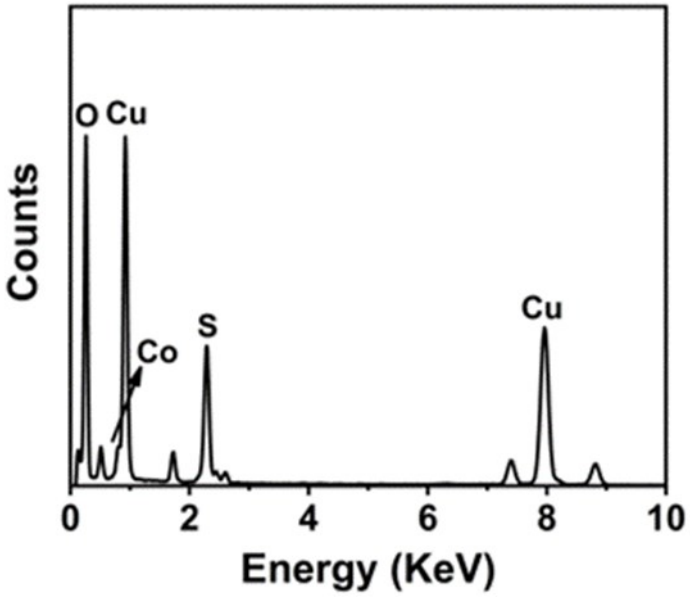

Fig. S3 EDX analysis of CuCoOS-1/3.

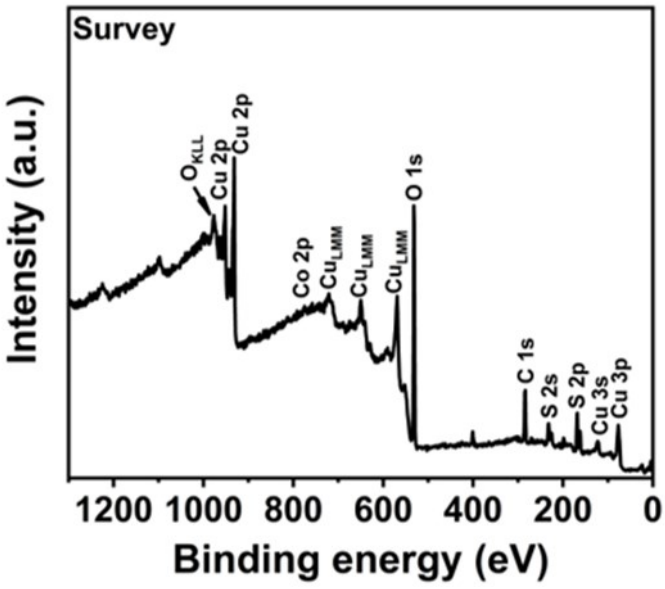

Fig. S4 XPS survey of CuCoOS-1/3.

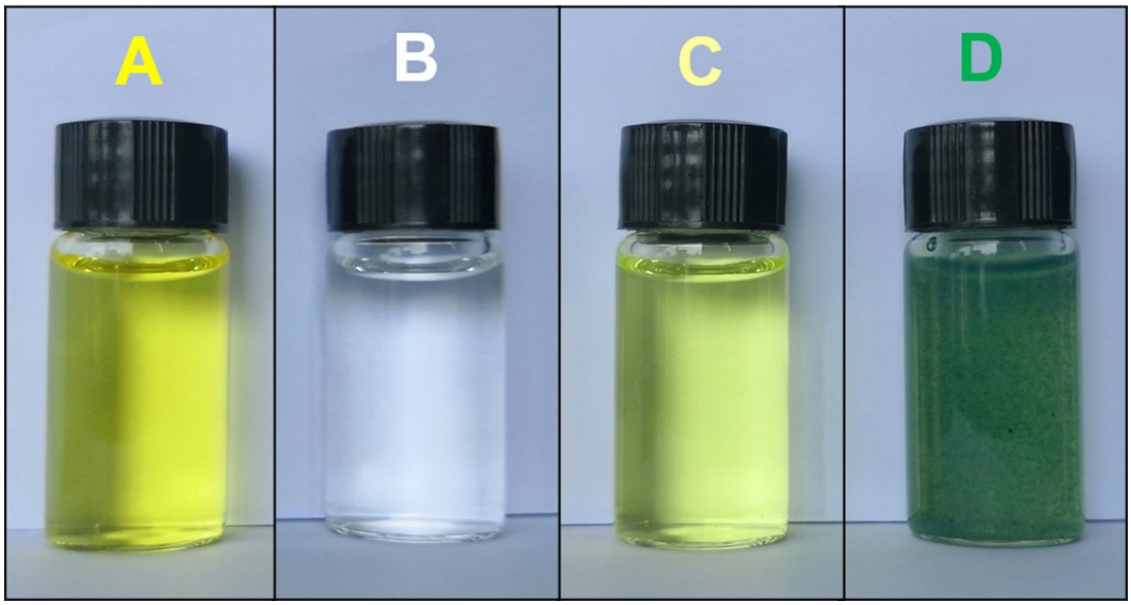

Fig. S5 Images of the Cr(VI) solution at different stages. (A) initial solution; (B) treated solution after precipitate settling; (C) initial solution after NaOH treatment; (D) treated solution after NaOH treatment.

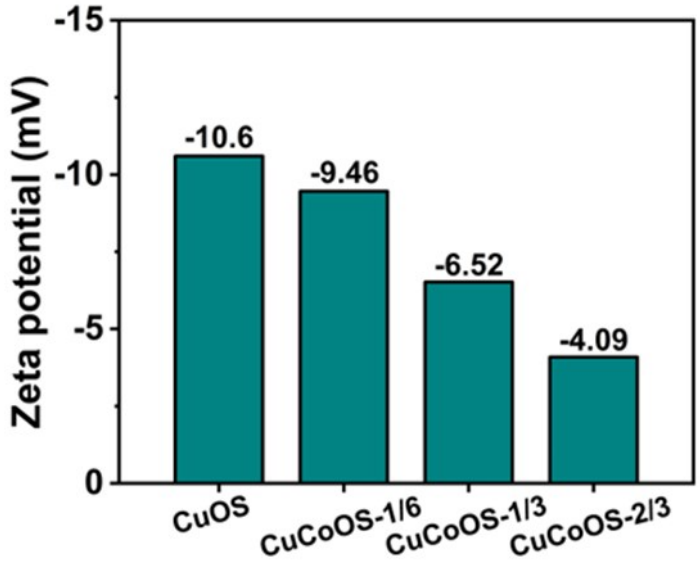

Fig. S6 Zeta potential of CuOS and CuCoOS.

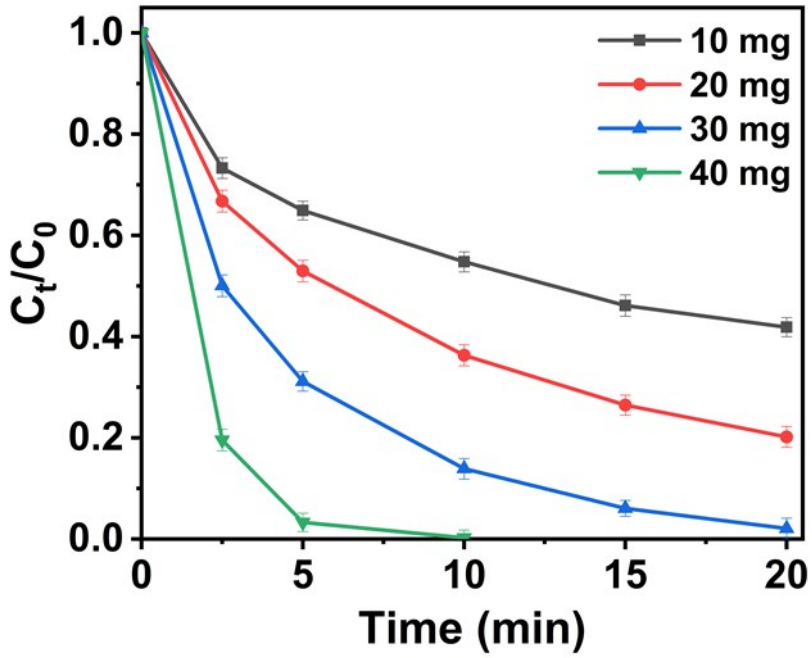

Fig. S7 The UV-vis spectra changes of Cr(VI) solution over CuCoOS-1/3.

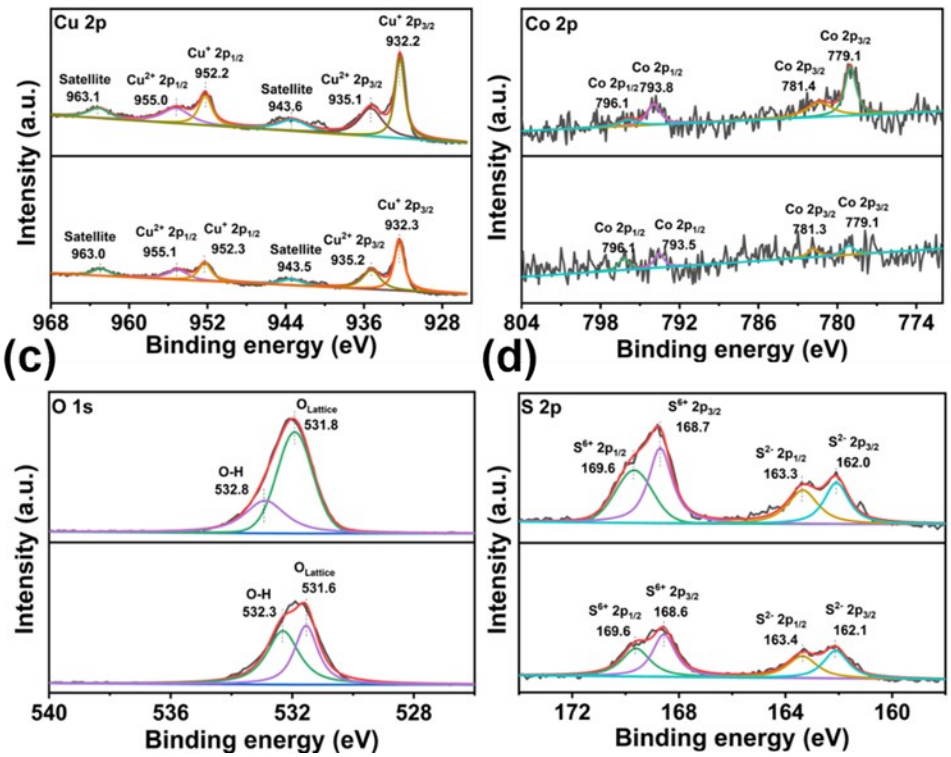

Fig. S8 XPS spectra of CuCoOS-1/3 before and after reaction, (a) Cu 2p, (b) Co 2p, (c) O 1s and (d) S 2p orbitals.

Fig. S9 EDS mapping images of CuCoOS-1/3 after reaction and corresponding elements.

Table. S1 Special surface area, pore volume and pore diameter of the prepared samples.

Sample	Surface area (m^2g^{-1})	Pore volume (cm^3g^{-1})	Pore diameter (nm)
CuOS	43.5014	0.327870	29.9072
CuCoOS-1/6	61.8502	0.277066	17.0456
CuCoOS-1/3	68.7751	0.354502	21.2740
CuCoOS-2/3	31.4839	0.200479	20.7272

Table. S2 Data comparison on Cr(VI) reduction over different catalysts.

Catalyst	Cr(VI) solution	Experimental details	Time (min)	Degradation rate (%)	Ref
p-nZVI	5 mg/L	Catalyst=0.2 g/L A shaker with a speed of 200 rmp	180	100	[1]
$CuAl_2O_4/Bi_2MoO_6$	10 mg/L	Catalyst=1.0 g/L A 150W Xe lamp ($\lambda > 420$ nm)	149	100	[2]
$Au/BiVO_4$	10 mg/L	Catalyst=0.5 g/L An ultrasonic cleaner with a frequency of 40 kHz and a power of 120 W	120	80	[3]
$AgI/BiVO_4$	15 mg/L	Catalyst=0.4 g/L A 500W Xe lamp ($\lambda > 420$ nm)	100	70	[4]
$N\text{-}TiO_2/CNO_{NV}$	15 mg/L	Catalyst=1.0 g/L A 300 W xenon lamp ($\lambda > 420$ nm)	120	89.5	[5]
CeO_2/Bi_2MoO_6	10 mg/L	Catalyst=1.0 g/L A 5W White LED ($\lambda > 400$ nm)	90	97	[6]
$Bi_{.333}(Bi_6S_9)Br/Bi_2S_3$	5 mg/L	Catalyst=0.2 g/L A 300W Xe lamp ($\lambda > 420$ nm)	60	98	[7]
110-BiOBr	10 mg/L	Catalyst=0.4 g/L A 500W Xe arc lamp ($\lambda > 420$ nm)	120	100	[8]
Zn-doped $AgFeO_2$	10 mg/L	Catalyst=0.5 g/L A single wavelength	90	90.8	[9]

		lamp (λ > 420 nm)			
NH_2-MIL-125(Ti)@Bi_2MoO_6	10 mg/L	Catalyst=1.4 g/L A 300W Xe lamp (λ > 420 nm)	180	93.28	[10]
NH_2-UiO-66/BiOBr	10 mg/L	Catalyst=0.4 g/L A 250W Xe lamp (λ > 400 nm)	360	88	[11]
CuCoOS	**50 mg/L**	**Catalyst=0.6 g/L In the dark**	**20**	**100**	**This work**

Reference

[1] M. Li, Y. Mu, H. Shang, C. Mao, S. Cao, Z. Ai, L. Zhang, Phosphate modification enables high efficiency and electron selectivity of nZVI toward Cr(VI) removal, Appl. Catal. B: Environ., 263 (2020), 118364.

[2] J. Zhang, C. Shao, X. Li, J. Xin, R. Tao, Y. Liu, Assembling n-Bi_2MoO_6 nanosheets on electrospun p-$CuAl_2O_4$ hollow nanofibers: enhanced photocatalytic activity based on highly efficient charge separation and transfer, ACS Sustain. Chem. Eng. 6 (2018) 10714-10723.

[3] Y. Wei, Y. Zhang, W. Geng, H. Su, M. Long, Efficient bifunctional piezocatalysis of Au/$BiVO_4$ for simultaneous removal of 4-chlorophenol and Cr(VI) in water, Appl. Catal. B: Environ., 259 (2019), 118084.

[4] W. Zhao, J. Li, B. Dai, Z. Cheng, J. Xu, K. Ma, L. Zhang, N. Sheng, G. Mao, H. Wu, K. Wei, D.Y.C. Leung, Simultaneous removal of tetracycline and Cr(VI) by a novel three-dimensional AgI/$BiVO_4$ p-n junction photocatalyst and insight into the photocatalytic mechanism, Chem. Eng. J. 369 (2019) 716-725.

[5] Y. Wang, L. Rao, P. Wang, Z. Shi, L. Zhang, Photocatalytic activity of N-TiO_2/O-doped N vacancy g-C_3N_4 and the intermediates toxicity evaluation under tetracycline hydrochloride and Cr(VI) coexistence environment, Appl. Catal. B: Environ., 262 (2020), 118308.

[6] G. Yang, Y. Liang, K. Li, J. Yang, R. Xu and X. Xie, Construction of Ce^{3+} doped CeO_2/Bi_2MoO_6 heterojunction with a mutual component activation system for highly enhancing visible-light photocatalytic activity for removal of TC or Cr (VI), Inorg. Chem. Front. 6 (2019) 1507-1517.

[7] L. Ai, L. Wang, M. Xu, S. Zhang, N. Guo, D. Jia, L. Jia, Defective $Bi_{.333}(Bi_6S_9)Br/Bi_2S_3$ heterostructure nanorods: Boosting the activity for efficient visible-light photocatalytic Cr(VI) reduction, Appl. Catal. B: Environ., 284 (2021),

119730.
[8] T. Li, Y. Gao, L. Zhang, X. Xing, X. Huang, F. Li, Y. Jin, C. Hu, Enhanced Cr(VI) reduction by direct transfer of photo-generated electrons to Cr 3d orbitals in CrO_4^{2-}-intercalated BiOBr with exposed (110) facets, Appl. Catal. B: Environ., 277 (2020), 119065.
[9] C. Li, Y. Guo, D. Tang, Y. Guo, G. Wang, H. Jiang, J. Li, Optimizing electron structure of Zn–doped $AgFeO_2$ with abundant oxygen vacancies to boost photocatalytic activity for Cr(VI) reduction and organic pollutants decomposition: DFT insights and Experimental, Chem. Eng. J., 3 (2021), 128515.
[10] S. Zhang, M. Du, J. Kuang, Z. Xing, Z. Li, K. Pan, Q. Zhu, W. Zhou, Surface-defect-rich mesoporous NH_2-MIL-125 (Ti)@Bi_2MoO_6 core-shell heterojunction with improved charge separation and enhanced visible-light-driven photocatalytic performance, J. Colloid Interface Sci. 554 (2019) 324-334.
[11] Q. Hu, Y. Chen, M. Li, Y. Zhang, B. Wang, Y. Zhao, J. Xia, S. Yin, H. Li, Construction of NH_2-UiO-66/BiOBr composites with boosted photocatalytic activity for the removal of contaminants, Colloids Surf. A Physicochem. Eng. Asp. 579 (2019), 123625.