

Supplementary Material

Visible-light activation of peroxymonosulfate by $\text{NiCo}_2\text{O}_4/\text{Bi}_{24}\text{O}_{31}\text{Br}_{10}$ to accelerate tetracycline degradation performance

Yueyu Song^{ab}, Jingjing Jiang^{ab}, Yuhan Ma^{ab}, Tianren Li^{ab}, Shuangshi Dong^{ab*}

^aKey Laboratory of Groundwater Resources and Environment (Jilin University),

Ministry of Education, Jilin University, Changchun, 130021, Jilin, China

^bJilin Provincial Key Laboratory of Water Resources and Environment, Jilin

University, Jilin University, Changchun, 130021, Jilin, China

*** Corresponding Author.**

(S. Dong) Phone: +86 13604331853; Fax: +86 43188502606; E-mail:

dongshuangshi@gmail.com

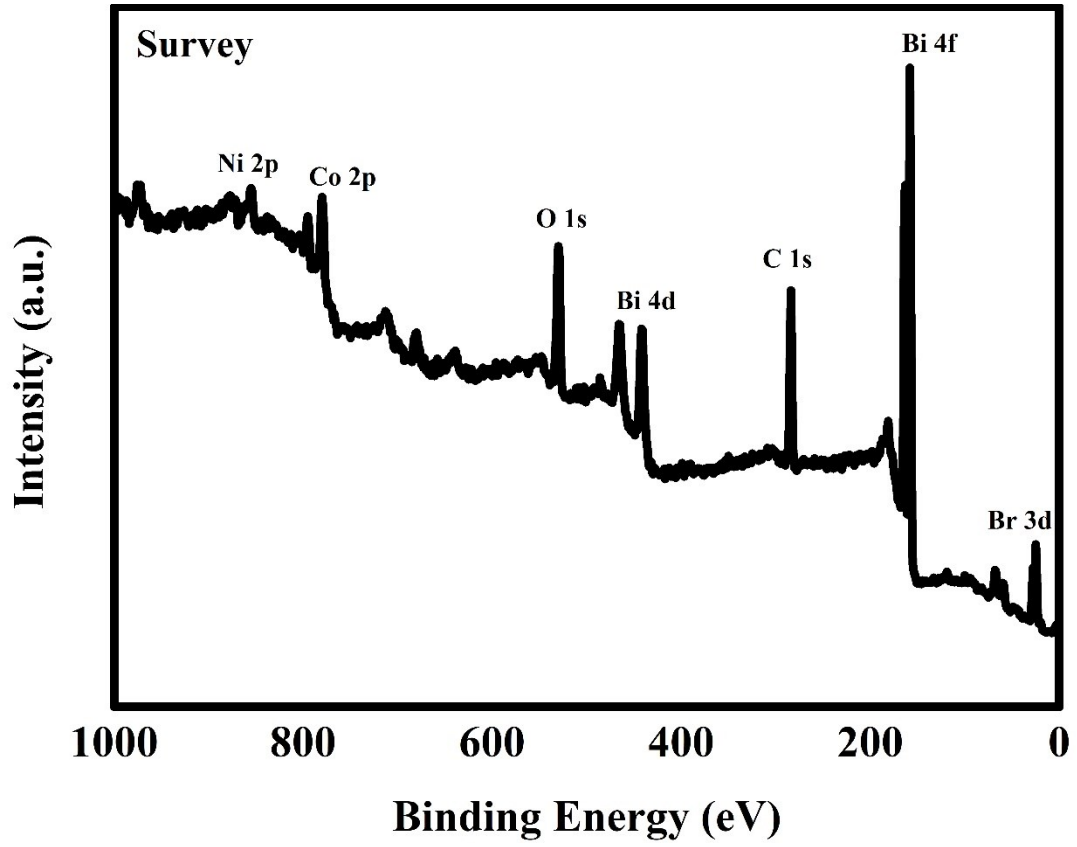


Fig. S1 The full XPS spectrum of 45% NiCo₂O₄/Bi₂₄O₃₁Br₁₀ composites

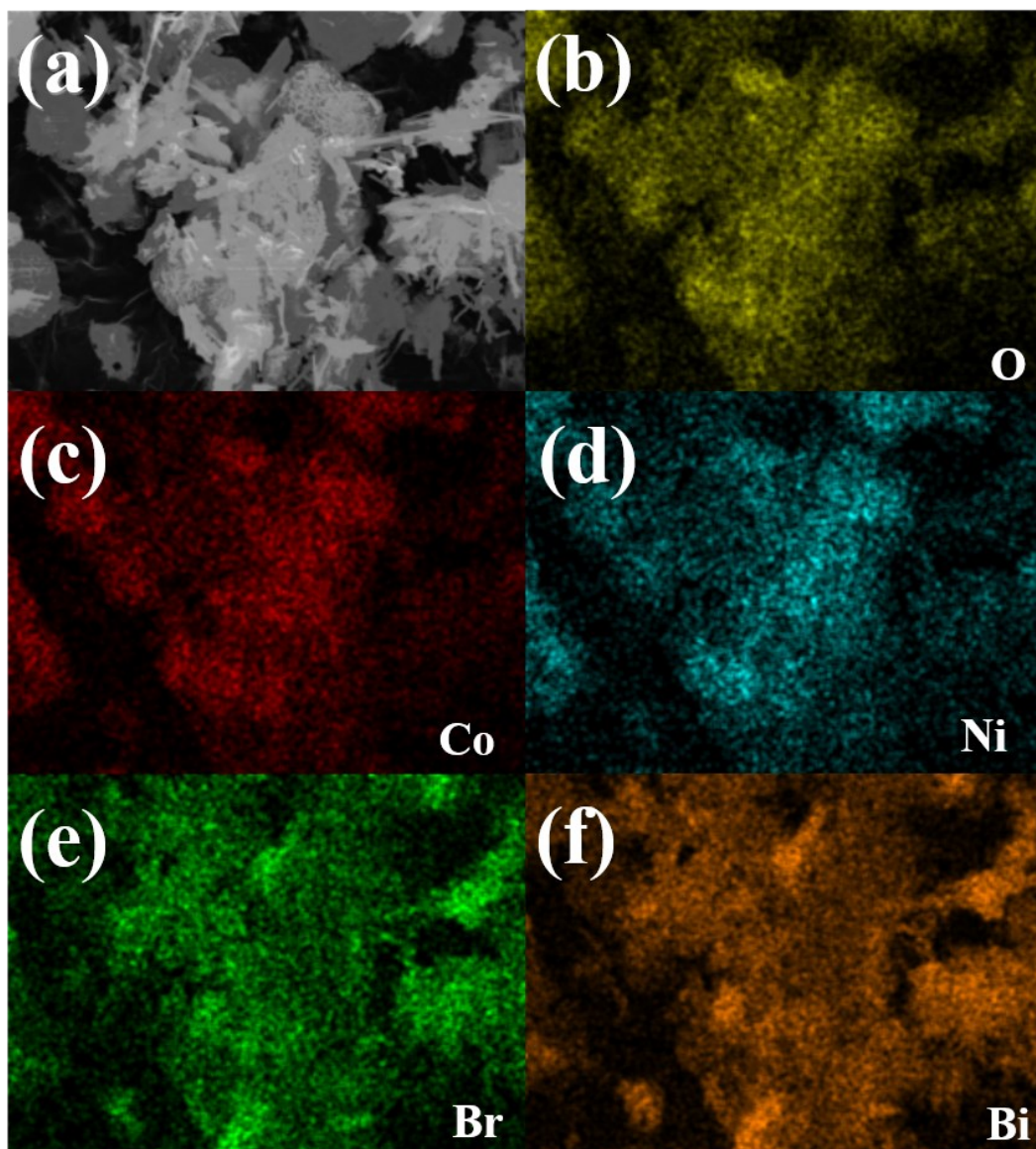


Fig. S2 EDS elemental mapping of the 45% NiCo₂O₄/Bi₂₄O₃₁Br₁₀ composites
Table S1. Comparison of diverse catalysts for TCH removal at 25°.

Catalyst	TCH concentration (mg/L)	Catalyst conc. (mg/L)	Interaction time	Oxidant loading	TCH Removal (%)	Ref
NiCo ₂ O ₄ /Bi ₂₄ O ₃₁ Br ₁₀	20	40	18 min	PMS 1 mM	90.3%	This study
CoFeLa-LDH ₂	30	50	10 min	PMS 1 mM	81.6%-90.1%	Li et al. (2020)
Co ₃ O ₄ /g-C ₃ N ₄	20	200	60 min	PMS 0.1 mM	90.2%	Jin et al. (2020)

Fe ₃ O ₄ -NCS	20	200	90 min	PMS 2.4mM	97.1%	Yang et al. (2021)
Fe-Ce-DIA	50	100	120 min	PS 0.67 g/L	80 %	Lv et al. (2020)
Cu/BC700	120	500	300 min	PS 300 mg/L	47.4 %	Chen et al. (2020)

Table S2. The calculated conduction band edge and valence band edges for NiCo₂O₄ and Bi₂₄O₃₁Br₁₀

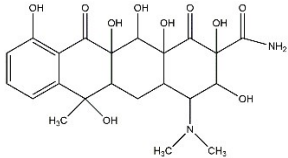
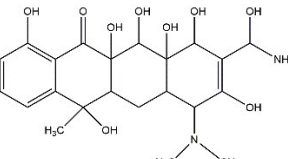
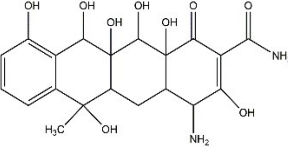
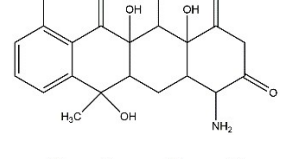
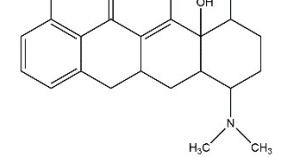
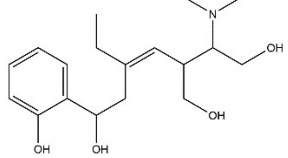
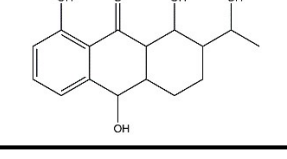
Semiconductors	Band edge energy Eg/eV	Conduction band edge (eV vs.NHE)	Valence band edge (eV vs.NHE)
Bi ₂₄ O ₃₁ Br ₁₀	2.55	-1.02	+1.53
NiCo ₂ O ₄	1.53	-1.21	+0.32

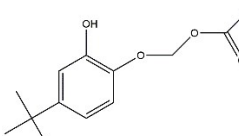
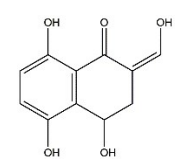
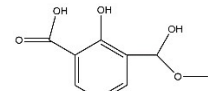
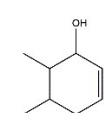
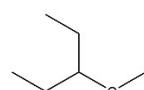
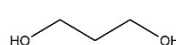
Table S3. Comparison of ion leaching by different catalyst

Catalyst	Co (II) Ion leaching (mg/L)	Ni (II) Ion leaching (mg/L)	Reference
NiCo ₂ O ₄ /Bi ₂₄ O ₃₁ Br ₁₀	0.14	0.13	This study
NiCo ₂ O ₄ /g-C ₃ N ₄	8.2	12.8	Jing et al. (2020)
CoFe ₂ O ₄ @3DG	0.35	–	Li et al. (2021)
Co-NP	2.6	2.5	

NiCo ₂ O ₄ -EG	0.07	0.08	Xu et al. (2020)
NiCo@NCNT	0.18	0.13	Zeng et al. (2017)
Co ₃ O ₄ -Bi ₂ O ₃	0.21	–	Hu et al. (2019)

Table S4. The possible intermediates products of TCH degradation

Product	Structure Fragment m/z	Possible Structure	Molecular formula
TCH	445		C ₂₂ H ₂₄ N ₂ O ₈
P1	465		C ₂₂ H ₂₈ N ₂ O ₉
P2	437		C ₂₀ H ₂₄ N ₂ O ₉
P3	392		C ₁₉ H ₂₂ NO ₈
P4	359		C ₂₀ H ₂₅ NO ₅
P5	324		C ₁₈ H ₂₇ NO ₄
P6	279		C ₁₅ H ₁₉ O ₅

P7	239		$C_{13}H_{19}O_4$
P8	220		$C_{11}H_8O_5$
P9	195		$C_{10}H_{19}O_5$
P10	124		$C_8H_{12}O$
P11	102		$C_6H_{14}O$
P12	90		$C_5H_8O_2$

Notes and references

1. J.J. Jiang, X.Y. Wang, C.J. Zhang, T.R. Li, Y.H. Lin, T.F. Xie, S.S. Dong, *Chem. Eng. J.* 2020, 397, 125356.
2. X.R. Li, Z.H. Liu, Y.J. Zhu, L. Song, Z.J. Dong, S. Niu, C. Lyu, *Sci Total Environ*, 2020, 749, 141466.
3. F. Liu, H.Y. Zhou, Z.C. Pan, Y. Liu, G. Yao, Y. Guo, B. Lai, *J. Hazard. Mater.*, 2020, 400, 123322.
4. M.J. Xu, H.Y. Zhou, Z.L. Wu, N.W. Li, Z.K. Xiong, G. Yao, B. Lai, *J. Hazard. Mater.*, 2020, 399, 123103.
5. L.M. Zeng, X.Z. Cui, L.S. Chen, T. Ye, W.M. Huang, R.G. Ma, X.H. Zhang, J.L. Shi, *Carbon*, 2017, 114, 347-355.
6. L.M. Hu, G.S. Zhang, M. Liu, Q. Wang, S.Y. Dong, P. Wang. 2019, *Sci.Total. Environ.*, 647, 352-361.
7. C.Y. Jin, M. Wang, Z.L. Li, J. Wang, Y. Zhao, J. Han, Z.M. Wu, *Chem. Eng. J.*, 2020, 398, 125569.
8. C.N. Lv, J.D. Shi, Q.J. Tang, Q. Hu, *MedSci*. 2020, 25, 5531.
9. J.H. Chen, X.L. Yu, C. Li, X. Tang, Y. Sun, *Chem. Eng. J.*, 2020, 382, 122916.
10. H.W. Yang, J. Zhou, E.X. Yang, H.X. Li, S.J. Wu, W. Yang, H. Wang, *Chemosphere*, 2021, 263, 128011.
11. X.G. Li, T.L. Hou, L.G. Yan, L.X. Shan, X. Meng, Y. X. Zhao, *J. Hazard. Mater.*,

2020, 398, 122884.