

Supporting Information

In situ construction of all-solid-state Z-scheme g-C₃N₄/ZnNCN/ZnO with
carbodiimide bridges for superior photocatalytic H₂O₂ production

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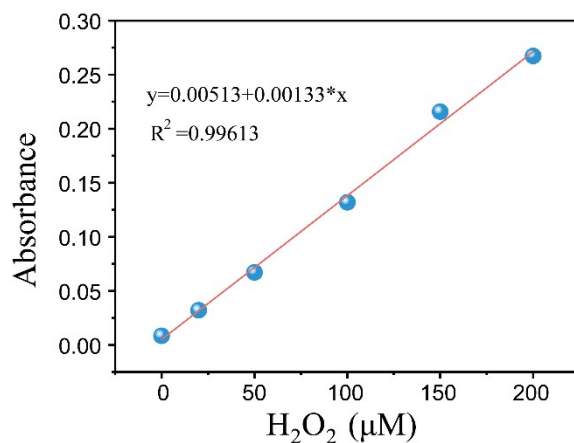


Fig. S1. Standard curve for the determination of H₂O₂ concentration by the DPD-POD.

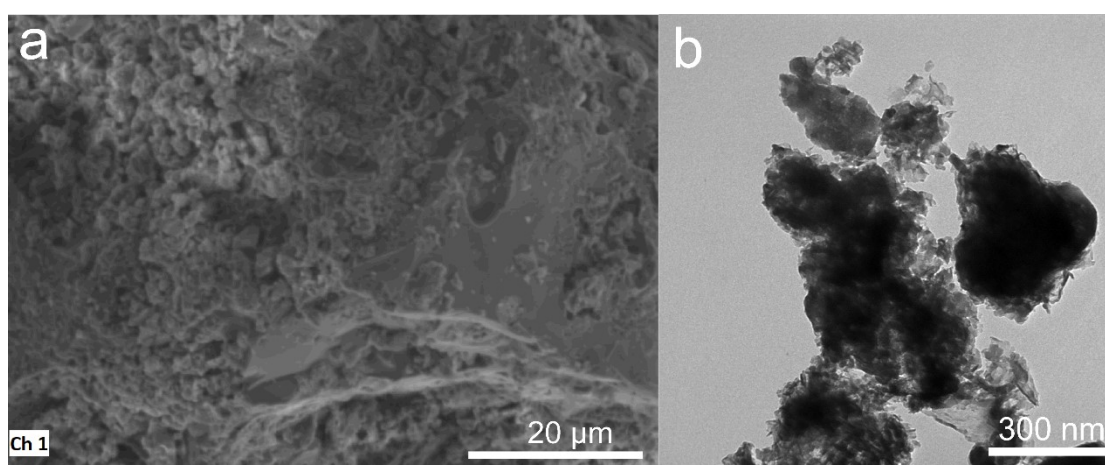


Fig. S2. (a) SEM and (b) TEM images of 1.25-ZnO.

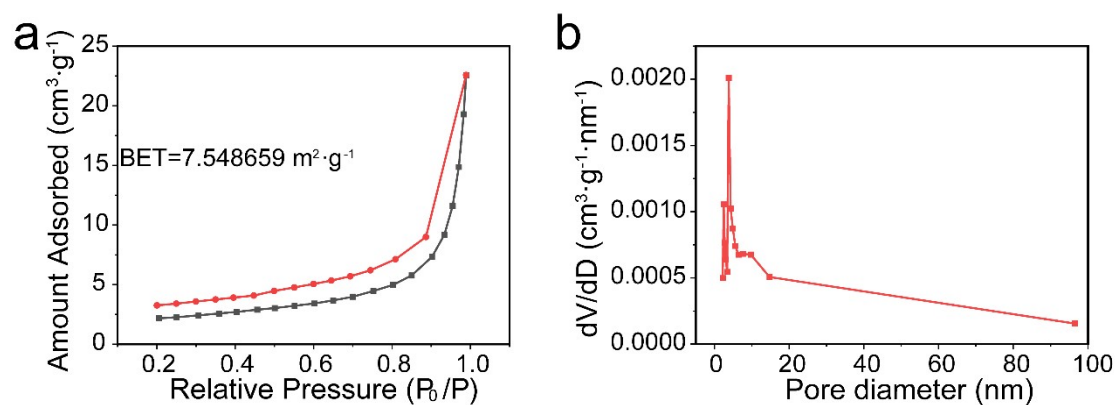


Fig. S3. (a) Nitrogen adsorption-desorption isotherms and (b) pore size distributions of 1.25-ZnO.

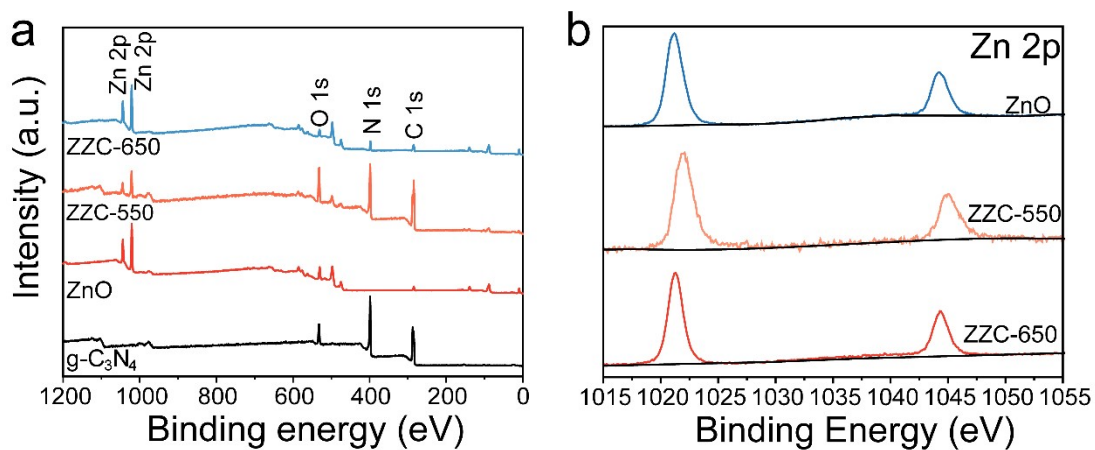


Fig. S4. Survey XPS spectra of 1.25-ZZC.

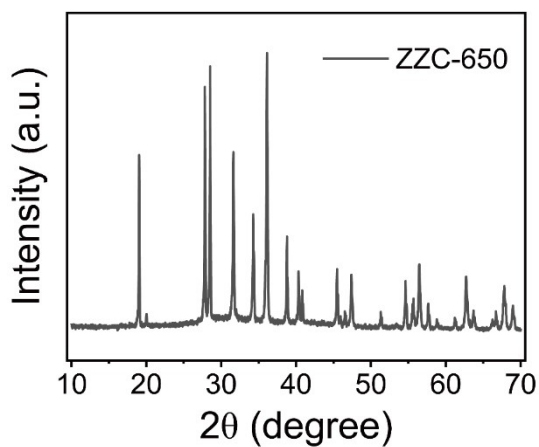


Fig. S5. XRD patterns of ZZC-650.

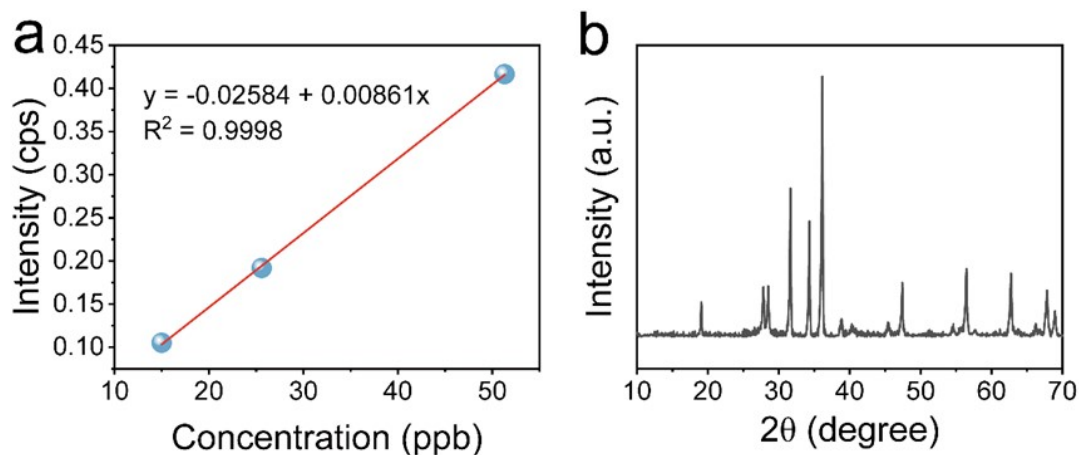


Fig. S6 Standard curve for the determination of Zn concentration by the ICP-MS (a) and XRD pattern (b) of 1.25-ZZC.

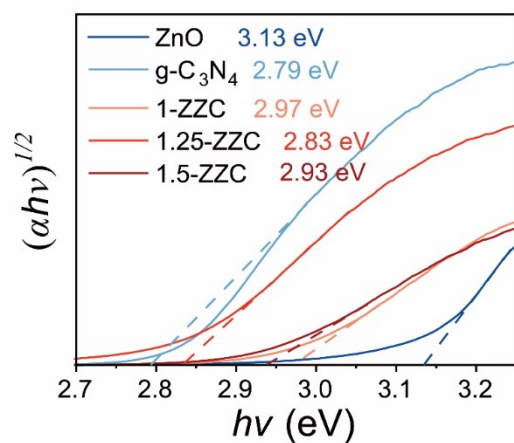


Fig. S7. Tauc plots of various catalysts.

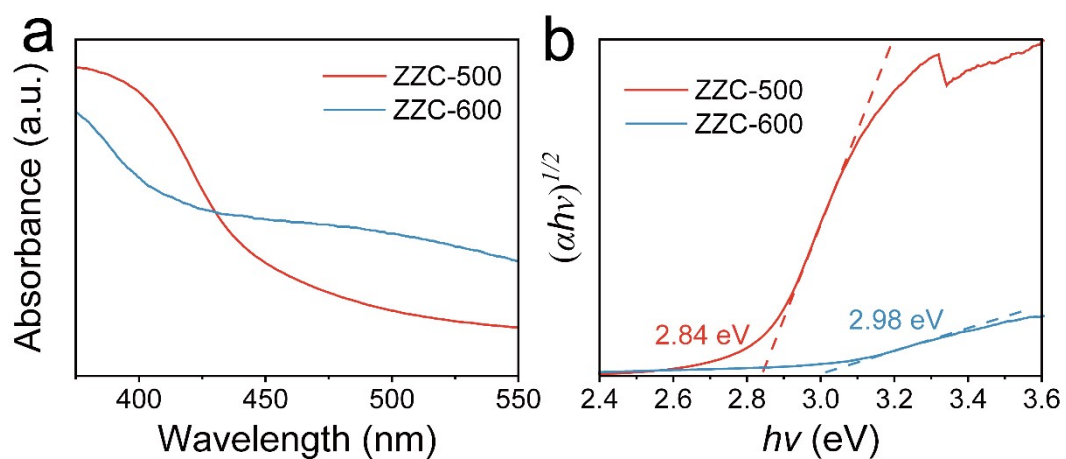


Fig. S8. UV-vis diffuse reflection spectra (a) and Tauc plots (b) of ZZC-500 and ZZC-600.

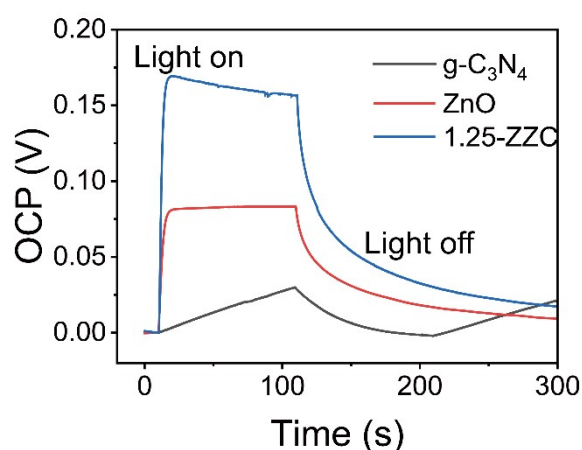


Fig. S9 The OCP of g-C₃N₄, ZnO and 1.25-ZZC.

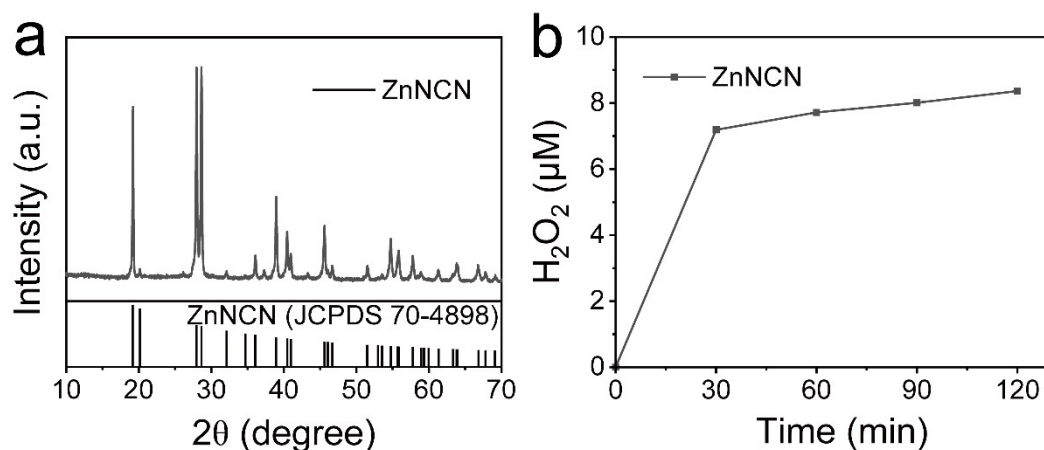


Fig. S10. XRD patterns (a) and H₂O₂ productivity (b) of ZCC-650 (0.5 g L⁻¹ catalyst, 4 vol% sacrificial agent, pH 7)

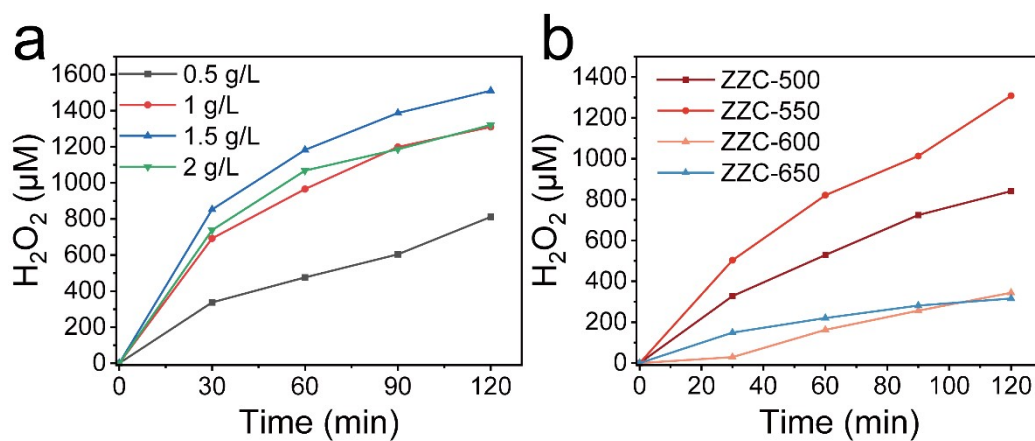


Fig. S11. (a) H₂O₂ productivity on 1.25-ZCC various catalyst dosages (4 vol% sacrificial agent, pH 7). (b) H₂O₂ productivity (4 vol% sacrificial agent, pH 7) of ZCC.

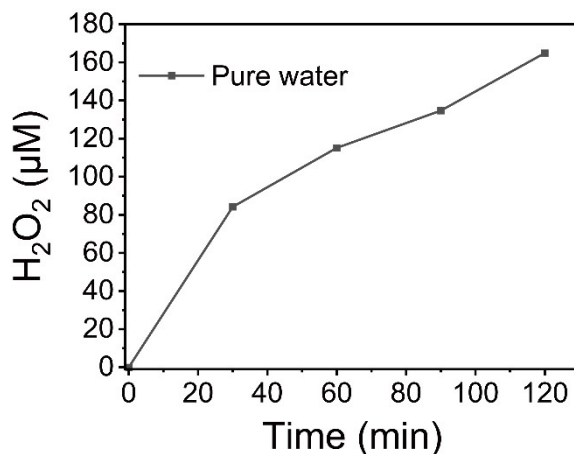


Fig. S12. H₂O₂ productivity on 1.25-ZCC in pure water ((1 g L⁻¹ catalyst, pH 7).

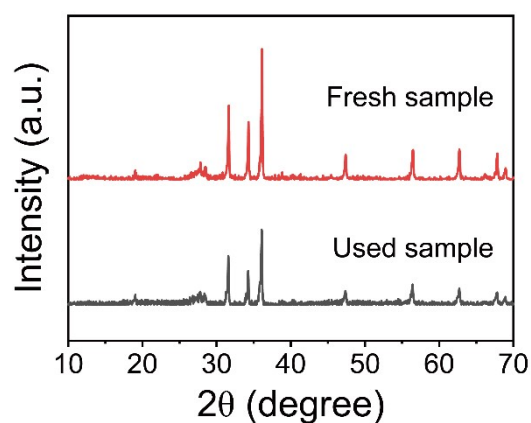


Fig. S13. XRD patterns of 1.25-ZZC before and after cycling tests.

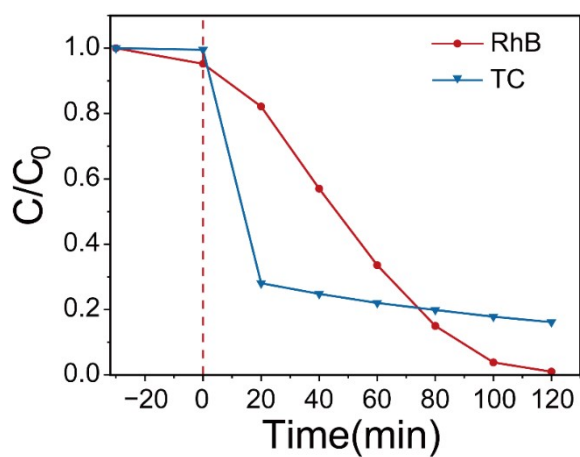


Fig. S14. Degradation behavior of 1.25-ZZC (0.5 g L^{-1} catalyst, 50 mg/L RhB, CIP and TC, pH 7).

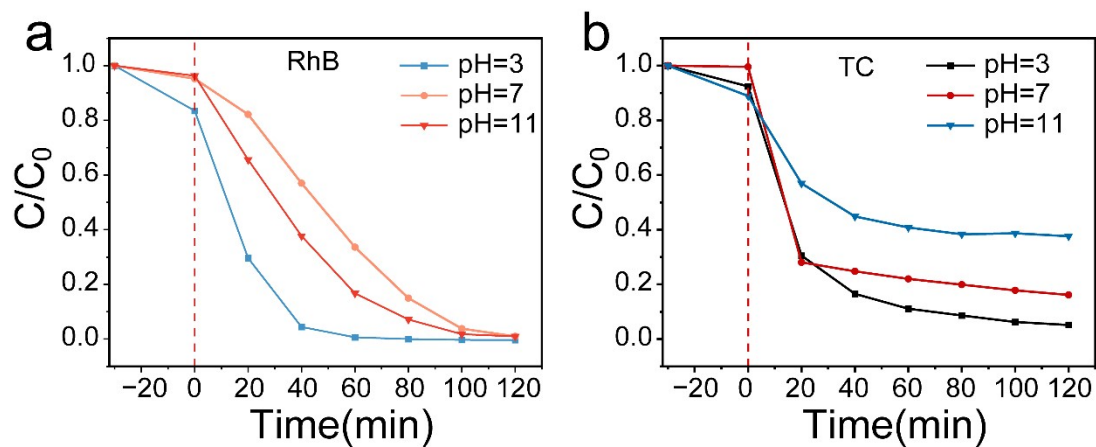


Fig. S15. (a) RhB-degradation and (b) TC-degradation at different pH of 1.25-ZZC (0.5 g L⁻¹ catalyst, pH 7).

Table S1. Elemental analysis results from EDS for 1.25-ZZC.

elements	Zn	O [At. %]	C [At. %]	N [At. %]	Zn/N
[Wt. %]	27.27	7.87	23.49	41.37	0.66
[At. %]	7.17	8.45	33.61	50.77	0.14

Table S2. Elemental analysis results from XPS for 1.25-ZZC.

elements	Zn	O	C	N	Zn/N
[Wt. %]	7.05	10.52	50.31	32.12	0.22
[At. %]	1.49	9.08	57.8	31.64	0.05

Table S3. Comparison of photocatalytic H₂O₂ production by different catalysts.

Photocatalyst	Catalyst dosage (mg)	Reaction solution	H ₂ O ₂ yield	Ref.
ZCN	50	50 mL water/IPA (4% IPA)/Air	0.81 mmol·g ⁻¹ h ⁻¹	This work
Trz-CN2	50	80 mL water/EDTA (7 mmol/L EDTA)/Air	0.56 mmol g ⁻¹ h ⁻¹	1
IO CN-Cv	20	20 mL water/EtOH (5% EtOH)/Air	0.06 mmol g ⁻¹ h ⁻¹	2
SPCN	25	50 mL water/ IPA (10% IPA)/ Air	0.32 mmol g ⁻¹ h ⁻¹	3
Dual P-doped porous g-C ₃ N ₄ (PCN-D)	50	100 mL water/IPA (10% IPA)/Air	0.41 mmol·g ⁻¹ h ⁻¹	4
M-CNNP	30	30 mL water/ EtOH (20% EtOH)/Air	0.04 mmol g ⁻¹ h ⁻¹	5
Ultra-thin g-C ₃ N ₄ (DCN)	20	50 mL water/IPA (10% IPA)/Air	0.65 mmol·g ⁻¹ h ⁻¹	6
SP-CN	25	30 mL water/IPA (10% EtOH)/Air	0.29 mmol g ⁻¹ h ⁻¹	7
KOH-doped g-C ₃ N ₄	30	30 mL water/IPA (10% IPA)/Air	0.13 mmol g ⁻¹ h ⁻¹	8
SCN	20	40 mL water/IPA (10% IPA)/Air	0.7 mmol·g ⁻¹ h ⁻¹	9
N-deficient and B-doped g-C ₃ N ₄	100	100 mL water/IPA (10% IPA)/Air	0.45 mmol g ⁻¹ h ⁻¹	10
MCN@CdS	40	100 mL water/ EtOH (10% EtOH)/Air	0.52 mmol g ⁻¹ h ⁻¹	11

References

1. H. Ma, W. Jiang, Y. Ma, Y. Song, L. Pei, H. Ban, S. Zhan and F. Zhou, *Small Methods*, 2025, 9, 2401347.

2. J. Lei, B. Chen, W. Lv, L. Zhou, L. Wang, Y. Liu and J. Zhang, *ACS Sustain. Chem. Eng.*, 2019, 7, 16467-16473.
3. W. Miao, Y. Wang, Y. Liu, H. Qin, C. Chu and S. Mao, *Engineering*, 2023, 25, 214-221.
4. G. Yu, K. Gong, C. Xing, L. Hu, H. Huang, L. Gao, D. Wang and X. Li, *Chem. Eng. J.*, 2023, 461, 142140.
5. W. Liu, C. Song, M. Kou, Y. Wang, Y. Deng, T. Shimada and L. Ye, *Chem. Eng. J.*, 2021, 425, 130615.
6. J. Hu, P. Zhang, T. Yang, Y. Cai, J. Qu and X. Yang, *Appl. Surf. Sci.*, 2022, 576, 151841.
7. Z. Guo, K. Sun, S. Zou, B. Xiong, L. Wang, W. Shi, Y. Sun and F. Guo, *J. Colloid Interface Sci.*, 2025, 699, 138118.
8. H. Zhang, L. Jia, P. Wu, R. Xu, J. He and W. Jiang, *Appl. Surf. Sci.*, 2020, 527, 146584.
9. C. Chu, W. Miao, Q. Li, D. Wang, Y. Liu and S. Mao, *Chem. Eng. J.*, 2022, 428, 132531.
10. J. Luo, C. Fan, L. Tang, Y. Liu, Z. Gong, T. Wu, X. Zhen, C. Feng, H. Feng, L. Wang, L. Xu and M. Yan, *Appl. Catal. B: Environ.*, 2022, 301, 120757.
11. S. Jing, J. Zhao, A. Wang, Q. Ji, R. Cheng, H. Liang, F. Chen, P. Kannan, A. Brouzgou and P. Tsiakaras, *Chem. Eng. J.*, 2024, 479, 147150.