



OPEN ACCESS

EDITED AND REVIEWED BY
Nosang Vincent Myung,
University of Notre Dame, United States

*CORRESPONDENCE

Dafeng Yan,
✉ dafengyan@hnu.edu.cn
Longlu Wang,
✉ wanglonglu@njupt.edu.cn
Feng Zeng,
✉ zeng@njtech.edu.cn
Huawei Huang,
✉ huawei.huang@kaust.edu.sa

RECEIVED 17 April 2025

ACCEPTED 17 April 2025

PUBLISHED 25 April 2025

CITATION

Yan D, Wang L, Zeng F and Huang H (2025)
Editorial: Defect chemistry in electrocatalysis -
volume II.
Front. Chem. 13:1613443.
doi: 10.3389/fchem.2025.1613443

COPYRIGHT

© 2025 Yan, Wang, Zeng and Huang. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](#). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

Editorial: Defect chemistry in electrocatalysis - volume II

Dafeng Yan^{1*}, Longlu Wang^{2*}, Feng Zeng^{3*} and Huawei Huang^{4*}

¹College of Chemistry and Chemical Engineering, Hubei University, Wuhan, China, ²College of Flexible Electronics (Future Technology), Nanjing University of Posts and Telecommunications (NJUPT), Nanjing, China, ³State Key Laboratory of Materials-Oriented Chemical Engineering, College of Chemical Engineering, Nanjing Tech University, Nanjing, Jiangsu, China, ⁴KAUST Catalysis Center (KCC), King Abdullah University of Science and Technology (KAUST), Thuwal, Saudi Arabia

KEYWORDS

defect, electrocatalysis, energy storage and conversion, electrocatalysts, defect engineering

Editorial on the Research Topic

Defect chemistry in electrocatalysis - volume II

The second volume of the Defect Chemistry in Electrocatalysis series continues to explore the vital role of defect engineering in advancing electrocatalytic technologies (Yan et al., 2022a). Electrocatalysis is essential to the operation of devices used for electrochemical energy storage and conversion. Because the efficiency of these systems is heavily dependent on the kinetics of electrochemical reactions, developing high-performance electrocatalysts to accelerate these processes is crucial (Yan et al., 2023). Since these reactions primarily take place at the catalyst surface, the surface electronic structure significantly influences the catalytic activity (Xie et al., 2021). Defect engineering—through the intentional introduction of vacancies, dopants, or structural modifications—has emerged as a powerful strategy to tune catalyst behavior. By manipulating defects, researchers can enhance active site accessibility, modulate electronic structures, and improve reaction kinetics, ultimately boosting catalytic efficiency and selectivity (Yan et al., 2022b; Yan et al., 2019; Yan et al., 2017). In recent years, this area has witnessed rapid progress, with a surge of new research efforts emerging in response to the foundational studies presented in the previous Research Topic.

This Research Topic features recent advances that deepen our understanding of defect chemistry. Maseko et al. reveal that potassium and manganese co-promoters significantly enhance olefin selectivity in CoFe-ZSM-5 zeolites for CO₂ hydrogenation, demonstrating the effectiveness of targeted metal modification in zeolite catalysts. Zhang et al. develop a nitrogen and boron dual-doped porous defect-rich carbon catalyst derived from saccharina japonica, achieving enhanced oxygen reduction activity. Their combined computational and experimental approach highlights the potential of biomass-based materials in sustainable electrocatalysis. Linling et al. review strategies for NO electroreduction to NH₃, emphasizing the role of vacancy and doping defects in improving activity. Their work presents defect engineering as a viable strategy to achieve efficient electrocatalytic ammonia synthesis replacing the energy-intensive Haber-Bosch process. Chen et al. focus on the electrooxidation of 5-hydroxymethylfurfural, outlining how engineered anionic and cationic vacancies can accelerate reaction kinetics and improve catalyst performance for biomass valorization.

As guest editors, we extend our sincere gratitude to all the authors for their outstanding contributions, and to the reviewers for their insightful and constructive feedback. These

contributions underscore the transformative impact of defect chemistry on electrocatalyst design. By elucidating the structure–performance relationship, this Research Topic advances the development of next-generation catalysts with greater efficiency, selectivity, and durability. Continued exploration in this field holds promise for breakthroughs in clean energy and environmental sustainability.

Author contributions

DY: Writing – original draft. LW: Formal Analysis, Writing – review and editing. FZ: Writing – original draft. HH: Writing – review and editing.

Funding

The author(s) declare that no financial support was received for the research and/or publication of this article.

References

- Xie, L., Wang, L., Zhao, W., Liu, S., Huang, W., and Zhao, Q. (2021). WS₂ moiré superlattices derived from mechanical flexibility for hydrogen evolution reaction. *Nat. Commun.* 12, 5070. doi:10.1038/s41467-021-25381-1
- Yan, D., Li, H., Chen, C., Zou, Y., and Wang, S. (2019). Defect engineering strategies for nitrogen reduction reactions under ambient conditions. *Small Methods* 3, 1800331. doi:10.1002/smt.201800331
- Yan, D., Li, Y., Huo, J., Chen, R., Dai, L., and Wang, S. (2017). Defect chemistry of nonprecious-metal electrocatalysts for oxygen reactions. *Adv. Mater.* 29, 1606459. doi:10.1002/adma.201606459

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that no Generative AI was used in the creation of this manuscript.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

- Yan, D., Mebrahtu, C., Wang, S., and Palkovits, R. (2023). Innovative electrochemical strategies for hydrogen production: from electricity input to electricity output. *Angew. Chem. Int. Ed.* 62, e202214333. doi:10.1002/anie.202214333

- Yan, D., Wang, L., Zeng, F., and Huang, H. (2022a). Editorial: defect chemistry in electrocatalysis. *Front. Chem.* 10, 1118783. doi:10.3389/fchem.2022.1118783

- Yan, D., Xia, C., Zhang, W., Hu, Q., He, C., Xia, B. Y., et al. (2022b). Cation defect engineering of transition metal electrocatalysts for oxygen evolution reaction. *Adv. Energy Mater.* 12, 2202317. doi:10.1002/aenm.202202317