

Synergistically Stabilizing Zinc Anodes by Molybdenum Dioxide Coating and Tween 80 Electrolyte Additive for High-Performance Aqueous Zinc-Ion Batteries

Nhat Anh Thieu¹, Wei Li¹, Xiujuan Chen¹, Qingyuan Li¹, Qingsong Wang², Murugesan Velayutham^{3,4}, Zane M. Grady⁵, Xuemei Li⁶, Wenyuan Li⁶, Valery V. Khramtsov^{3,4}, David M. Reed⁵, Xiaolin Li^{5,*}, and Xingbo Liu^{1,*}

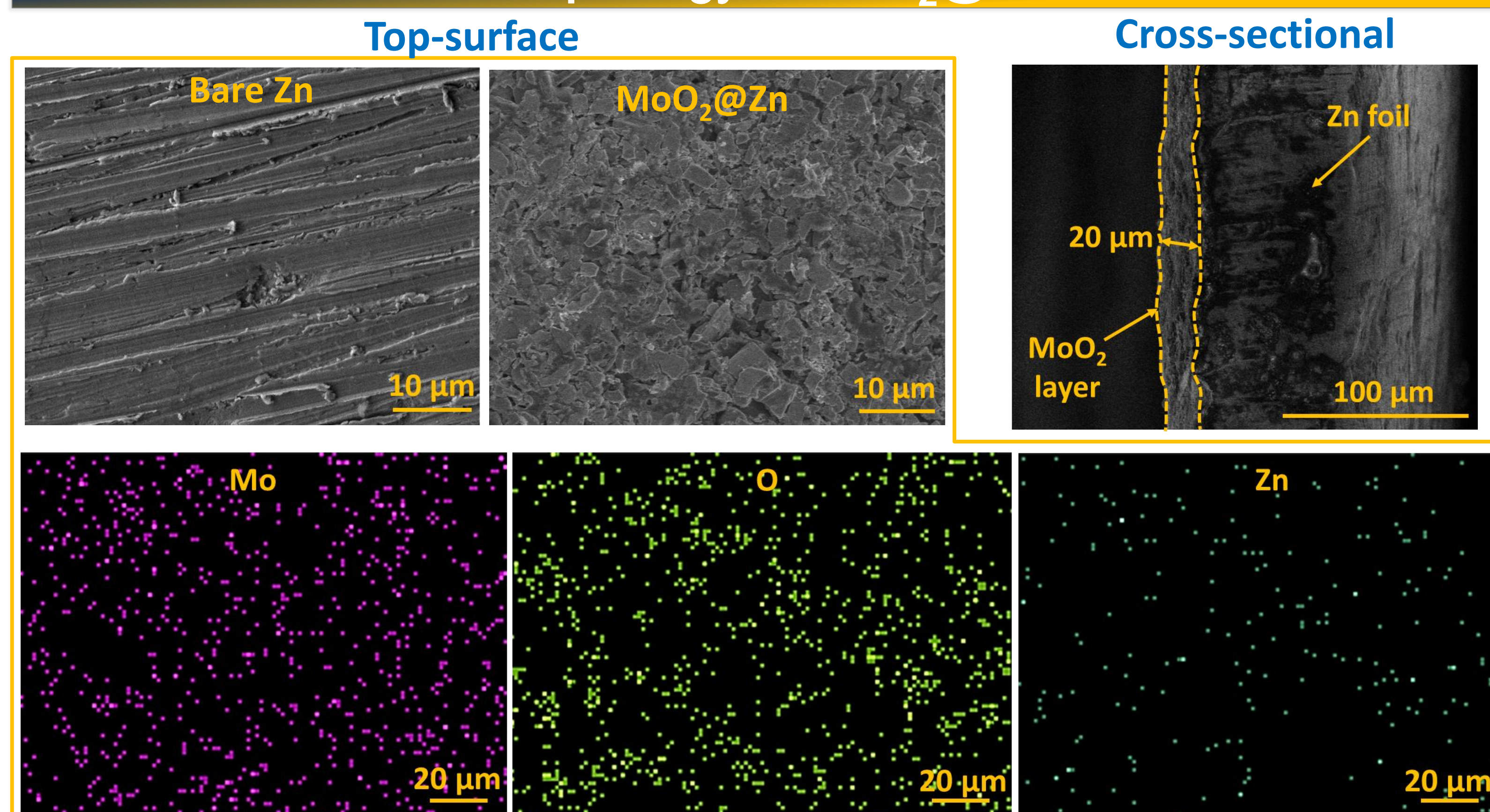
Introduction

As a grid-scale energy storage solution, aqueous zinc-ion batteries (ZIBs) are increasingly attractive thanks to their safety, low cost, and environmental friendliness. However, ZIBs often exhibit poor cyclability due to severe dendrite growth, self-corrosion, hydrogen evolution, and irreversible side reactions occurring at Zn anodes. The practical application of ZIBs can be greatly enhanced through surface coating and electrolyte engineering strategies. This work focuses on developing stable ZIBs through the synergistic effect of surface coating and electrolyte additive approaches on Zn anodes.

Approach and Objective

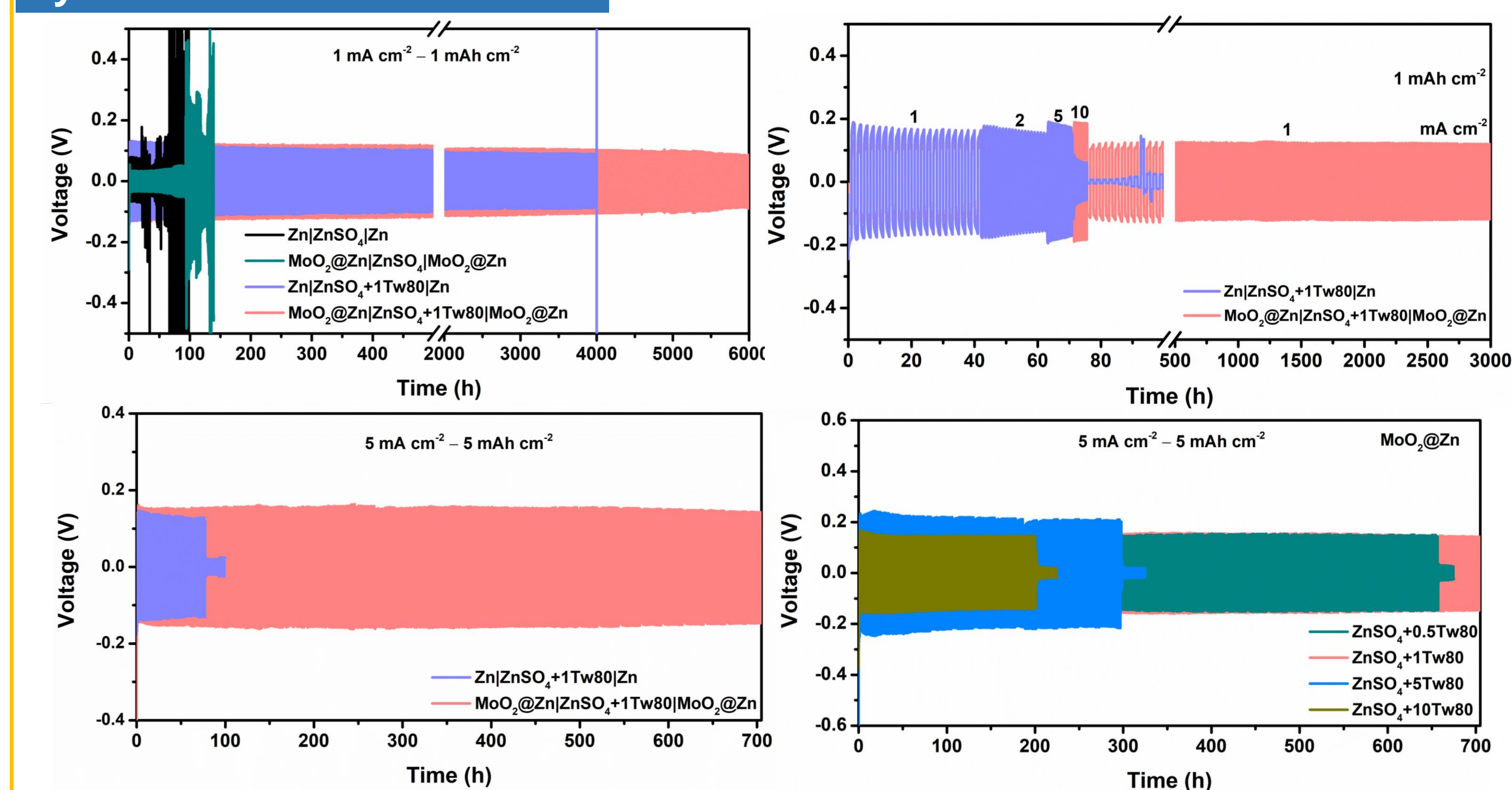
- ❖ Providing a novel method for stabilizing Zn anodes by combining the MoO₂ coating layer and nonionic surfactant additive, Tween 80.
- ❖ Exploring the protective mechanism of the MoO₂ coating layer and Tween 80 additive for Zn anode stabilization.

Morphology of MoO₂@Zn



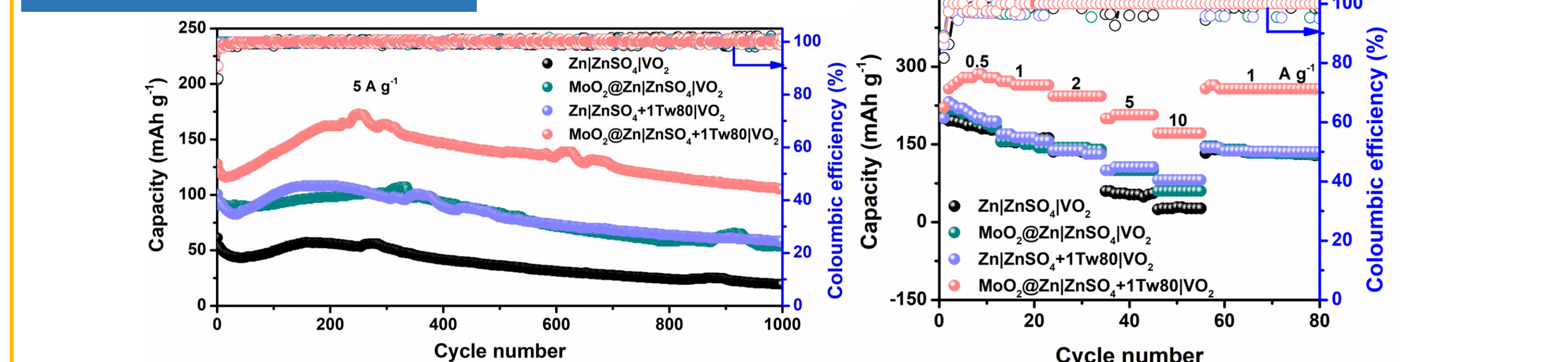
Electrochemical performance

Symmetric Cell Performance



Benefiting from the dual synergistic effects of the coating layer and electrolyte additive, the MoO₂@Zn anode exhibits excellent electrochemical stability in 1 M ZnSO₄ containing 1 mM Tween 80 electrolyte.

Full Cell Performance



The full cell with MoO₂@Zn anode in ZnSO₄+Tween 80 electrolyte delivered higher cycling stability with nearly 82.4% capacity retention after 1000 cycles and superior rate capability.

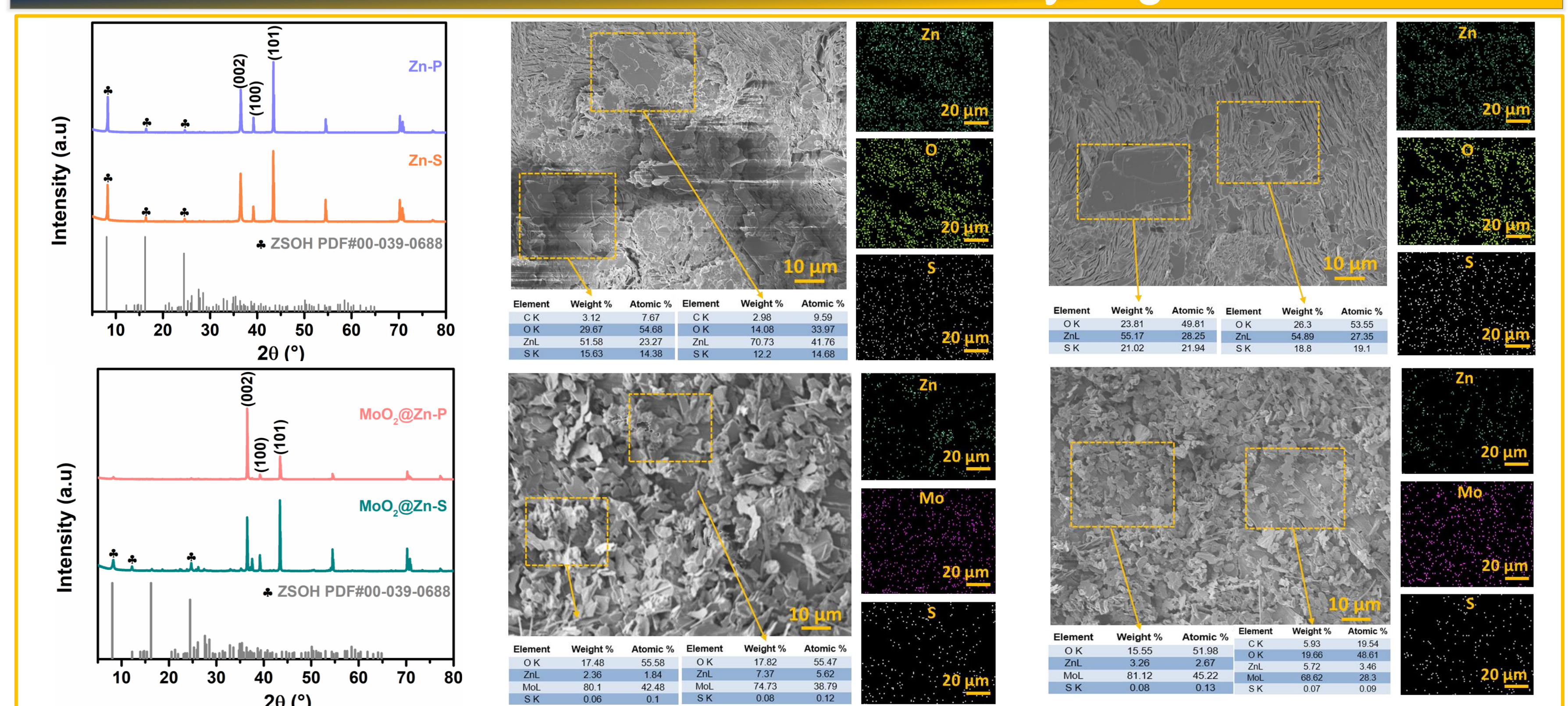
Reference:

N. A. Thieu, W. Li, X. Chen, Q. Li, Q. Wang, M. Velayutham, Z. M. Grady, X. Li, W. Li, V. V. Khramtsov, D. M. Reed, X. Li, X. Liu. Synergistically Stabilizing Zinc Anodes by Molybdenum Dioxide Coating and Tween 80 Electrolyte Additive for High-Performance Aqueous Zinc-Ion Batteries. *ACS Appl. Mater. Interfaces*, 2023, under review

Contact: Xingbo Liu

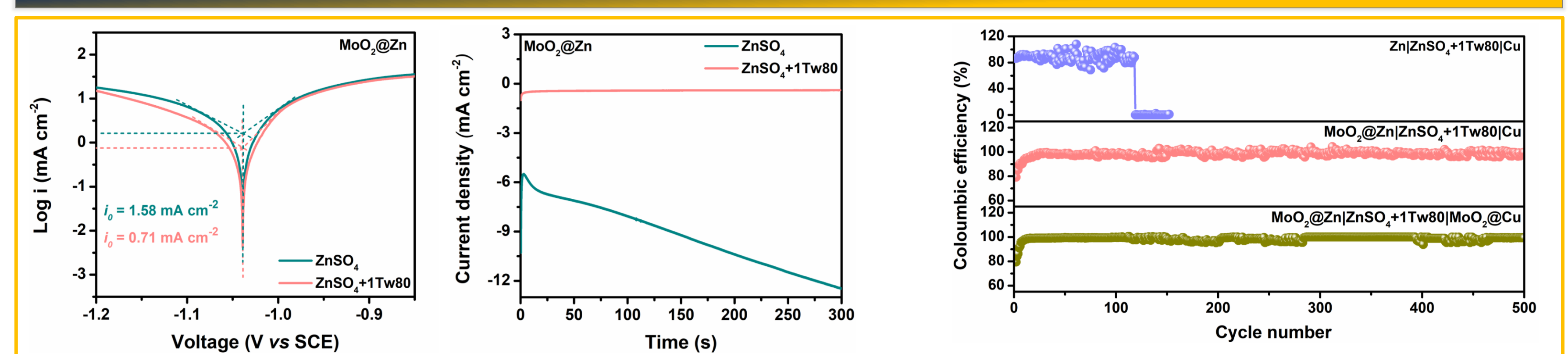
West Virginia University
Tel.: 304-293-0120
Email: xingbo.liu@mail.wvu.edu

Characterization results after cycling

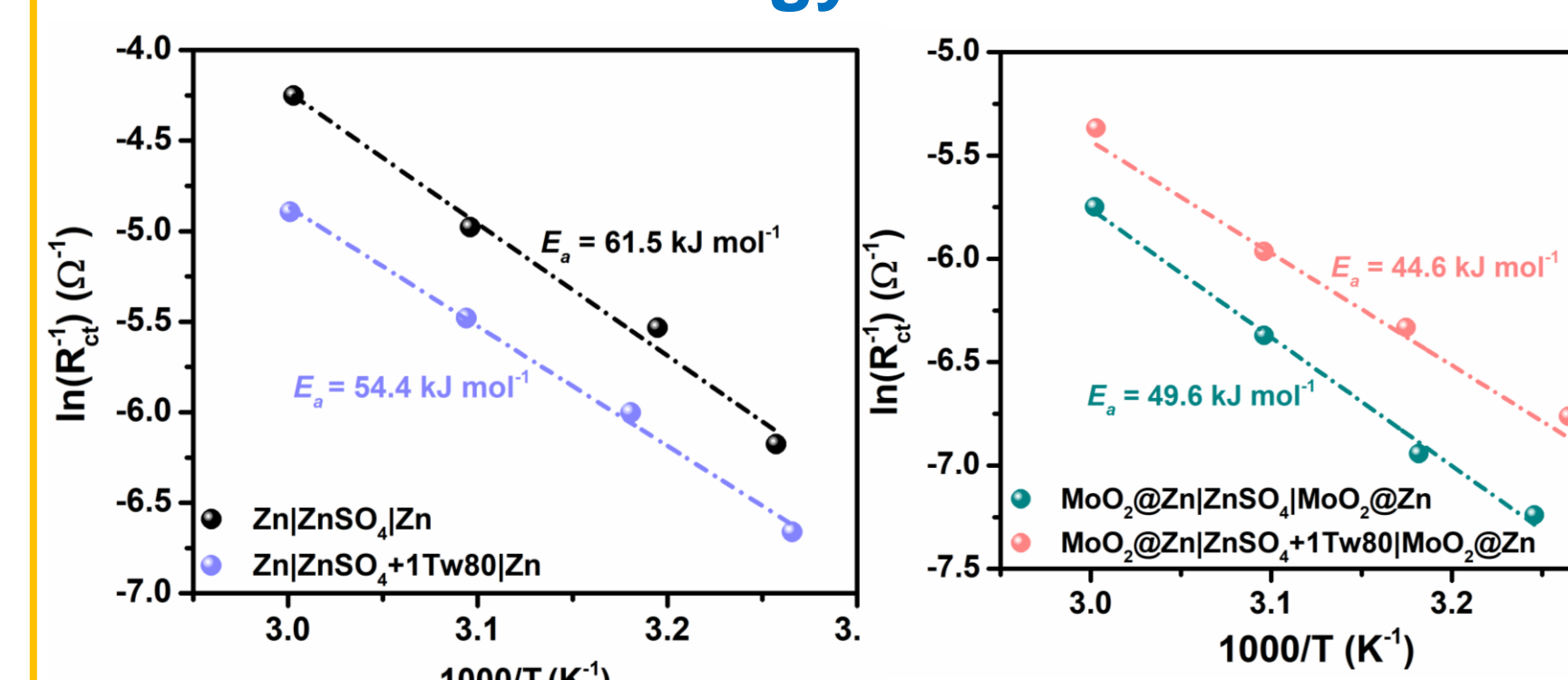


The MoO₂ coating layer serves as a protective layer on Zn surface to minimize the direct contact between Zn electrodes and the electrolyte and suppress side reactions.

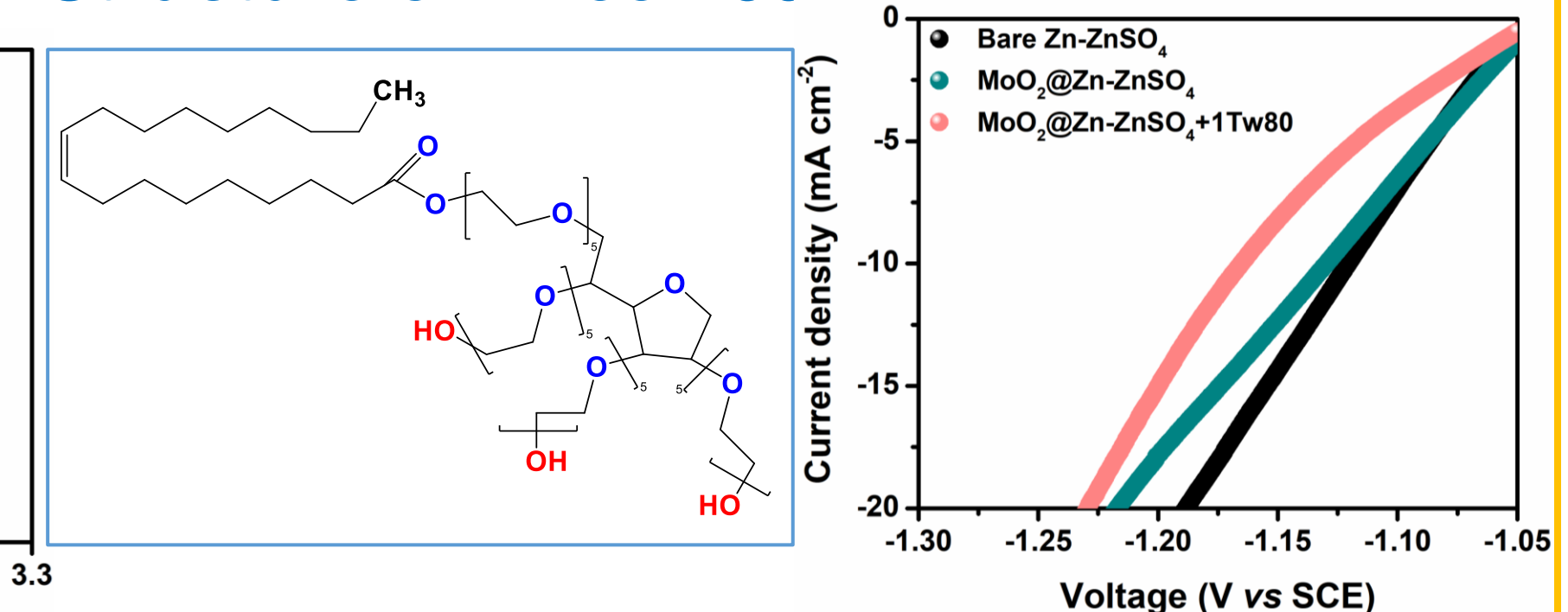
Protective mechanism



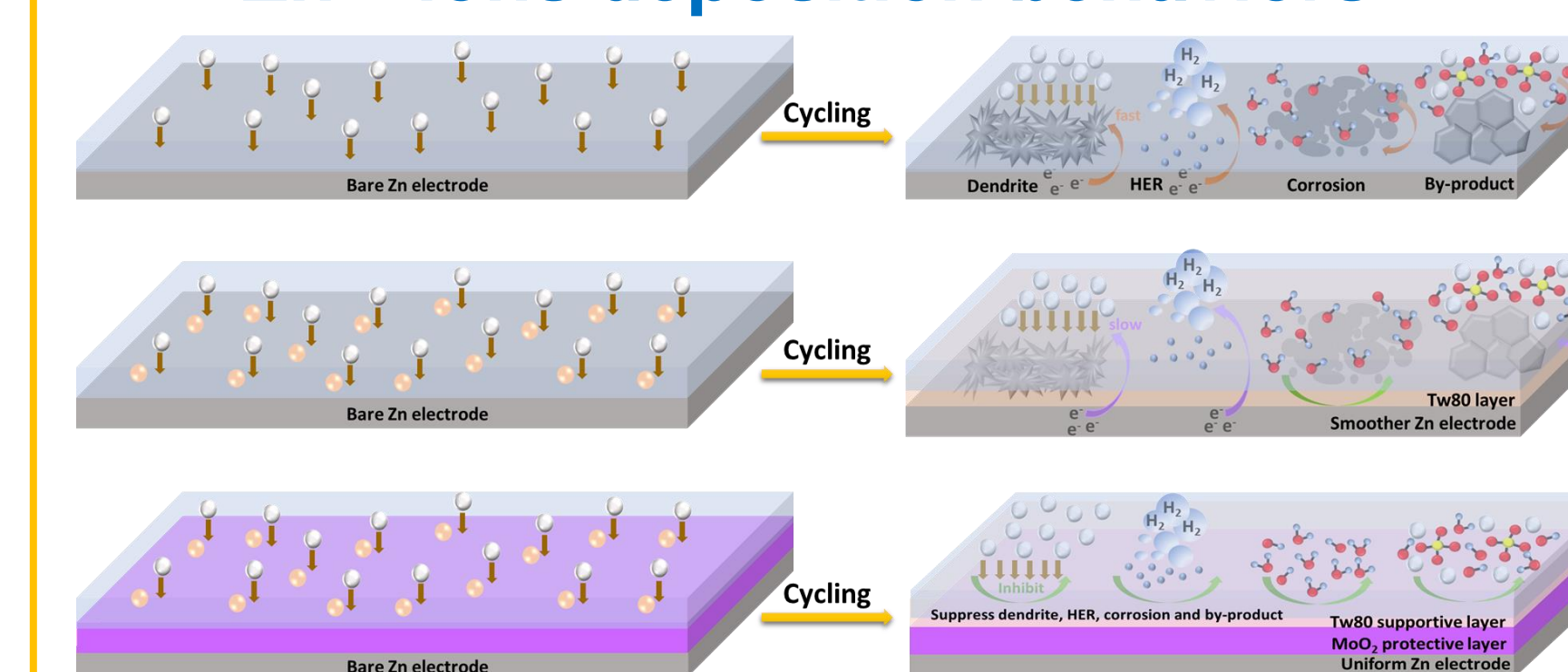
Activation energy of Zn²⁺ desolvation



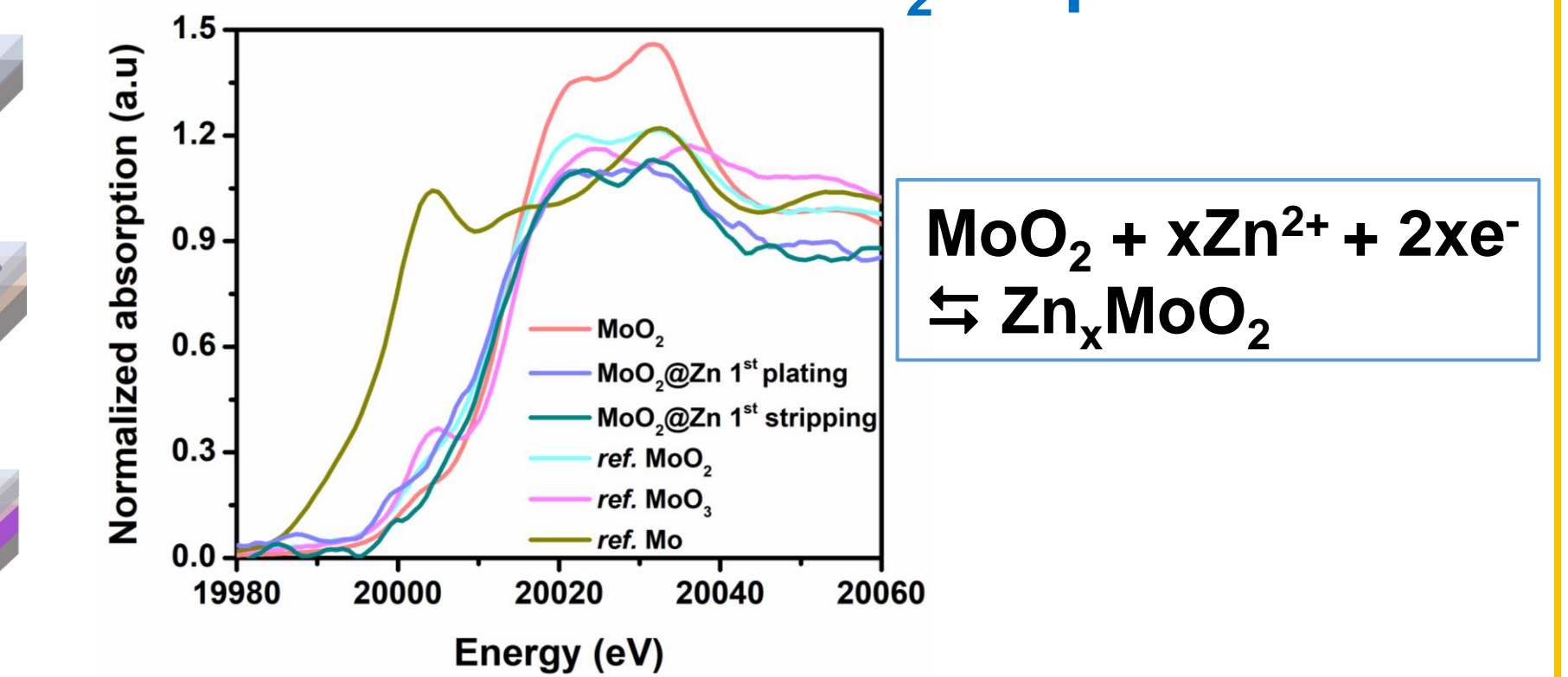
Structure of Tween 80



Zn²⁺ ions deposition behaviors



Redox behavior of MoO₂ on protective Zn



- ✓ Suppressing corrosion, HER and Zn plating-stripping kinetics
- ✓ Promoting uniform Zn deposition and inhibiting Zn dendrite growth
- ✓ Facilitating the desolvation-reduction process of hydrated Zn ions.

Conclusions

- ❖ Combining the MoO₂ coating layer with the Tw80 additive can synergistically prevent corrosion and side reactions.
- ❖ Their combination can also synergistically work to reduce the desolvation energy of hydrated Zn ions and stabilize the Zn anodes.

Future work

- ❖ Exploring amphiphilic triblock copolymer to stabilize Zn anodes by molecularly engineering.

Acknowledgments

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Author affiliation

1. Department of Mechanical and Aerospace Engineering, Benjamin M. Statler College of Engineering and Mineral Resources, West Virginia University, Morgantown, WV 26506, USA
2. Bavarian Center for Battery Technology (BayBatt), Department of Chemistry, University of Bayreuth, Universitätsstrasse 30, 95447 Bayreuth, Germany
3. In Vivo Multifunctional Magnetic Resonance Center, Robert C. Byrd Health Sciences Center, West Virginia University, Morgantown, WV 26506, USA
4. Department of Biochemistry and Molecular Medicine, School of Medicine, West Virginia University, Morgantown, WV 26506, USA
5. Energy and Environmental Directorate, Pacific Northwest National Laboratory, Richland, WA 99352, USA
6. Department of Chemical and Biomedical Engineering, Benjamin M. Statler College of Engineering and Mineral Resources, West Virginia University, Morgantown, WV 26506, USA