

Peng Zhu

Department: Chemical Engineering

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Education and Work

- 09/2024-Present** **Postdoctoral Associate**, Stanford University, Stanford, U.S.A
Supervisor: Prof. Thomas Jaramillo
- 09/2023-08/2024** **Postdoctoral Associate**, Rice University, Houston, U.S.A
Supervisor: Prof. Haotian Wang
- 09/2018-08/2023** **Ph.D. of Chemical Engineering**, Rice University, Houston, U.S.A
Supervisor: Prof. Haotian Wang
- 09/2014-07/2018** **B.S. of Chemical Engineering**, Tsinghua University, Beijing, China
Minor Degree: Mathematics

Work and Research Experience

Postdoctoral Associates, Stanford University, Stanford, CA, USA ***9/2024-NOW***

Department of Chemical Engineering

Host: Prof. Thomas Jaramillo

- Commercialization of electrochemical systems for carbon dioxide (CO₂) capture and conversion, particularly from seawater

Postdoctoral Associates, Rice University, Houston, TX, USA ***9/2023-08/2024***

Department of Chemical and Biomolecular Engineering

Advisor: Prof. Haotian Wang

- Developing new strategies for enhanced CO₂ capture and utilization performance, and extending the reaction stability in solid electrolyte reactor
- Exploring the underlying reaction mechanism of CO₂RR using in-situ TEM (cooperated with *Senior Staff Scientist Haimei Zheng, LBNL*)
- Exploring and evaluating the synthesis of nanomaterials loaded with hierarchical porous carriers using hydrogels (cooperated with *Prof. Guihua Yu, UT Austin*)

Graduate Research Assistant, Rice University, Houston, TX, USA ***8/2019-8/2023***

Department of Chemical and Biomolecular Engineering

Advisor: Prof. Haotian Wang

- Conducting research on carbon dioxide capture and storage
- Exploring synthesis method for single-atom catalysts featuring controllable atomic and mesoporous structures
- Exploring the use of two-dimensional bismuth nanosheets for the generation of pure formic acid and the potential of Cu-based catalysts for the production of pure acetic acid
- Developing O₂/H₂O redox couples for enhanced CO₂ capture in solid electrolyte reactor

Honors and Awards

09/2024 Stanford Accelerator Fellowship

08/2024	Carbon Future Young Investigator Award
05/2023	1 st Prize of Carbon Hub Poster Session Award
08/2022	STS AIChE Best Applied Paper Award 2021
11/2021	SCI-STAR (Student Training for Advising Research) Award
09/2021	Riki Kobayashi Fellowship
10/2020	STS AIChE Best Applied Paper Award 2019

Publications

- 1 X. Zhang*, Z.W. Fang*, **P. Zhu*(co-first)**, Y. Xia, H. Wang. “[Electrochemical Regeneration of High Purity CO₂ from Carbonates for Efficient Carbon Capture](#)”, *Nat Energy* (2024).
- 2 Y. Wang*, **P. Zhu*(co-first)**, R. Wang, K.C. Matthews, M. Xie, M. Wang, C. Qiu, Y. Liu, H. Zhou, J. H. Warner, Y. Liu, H. Wang, G. Yu. “[Fluorine-Tuned Carbon-Based Nickel Single-Atom Catalysts for Scalable and Highly Efficient CO₂ Electrocatalytic Reduction](#)”, *ACS Nano* 2024, 18, 39, 26751–26758.
- 3 **P. Zhu**, Z.Y. Wu, A. Elgazzar, C. Dong, F.Y. Chen, Y. Xia, Y. Feng, M. Shakouri, J.Y. Kim, Z. Fang, T.A. Hatton, H. Wang., “[Continuous carbon capture in an electrochemical solid-electrolyte reactor](#)”. *Nature*, 618, 959–966 (2023).
- 4 J.Y. Kim*, **P. Zhu*(co-first)**, F.Y. Chen, Z.Y. Wu, D.A. Cullen & H. Wang. “[Recovering carbon losses in CO₂ electrolysis using a solid electrolyte reactor](#)”, *Nature Catalysis*, 5, 288–299 (2022).
- 5 Z.Y. Wu*, **P. Zhu*(co-first)**, D. Cullen, Y. Feng, Q.Q. Yan, S. C. Shen, F.Y. Chen, H.C. Liang, H. Wang, “[A general synthesis of single atom catalysts with controllable atomic and mesoporous structures](#)”, *Nature Synthesis*, 1, 658–667 (2022).
- 6 **P. Zhu**, H. Wang, “[High-purity and high-concentration liquid fuels through CO₂ electroreduction](#)”, *Nature Catalysis*, 4, 943–951 (2021).
- 7 **P. Zhu**, C. Xia, C.Y. Liu, K. Jiang, G. Gao, X. Zhang, Y. Xia, Y. Lei, H.N. Alshareef, T.P. Senftle, H. Wang, “[Direct and continuous generation of pure acetic acid solutions via electro-catalytic carbon monoxide reduction](#)”, *Proceedings of the National Academy of Sciences*, 118 (2), e2010868118 (2021).
- 8 **P. Zhu**, H. Wang, “[Structural evolution of oxide-/hydroxide-derived copper electrodes accounts for the enhanced C₂₊ product selectivity during electrochemical CO₂ reduction](#)”, *Science Bulletin*, 65 (12), 977-979 (2020).
- 9 C. Xia, **P. Zhu**, Q. Jiang, Y. Pan, W. Liang, E. Stavitsk, H.N. Alshareef, H. Wang, “[Continuous production of pure liquid fuel solutions via electrocatalytic CO₂ reduction using solid-electrolyte devices](#)”, *Nature Energy*, 4 (9), 776-785 (2019).
- 10 C. Xia, Y. Xia, **P. Zhu**, L. Fan, H. Wang, “[Direct electrosynthesis of pure aqueous H₂O₂ solutions up to 20% by weight using a solid electrolyte](#)”, *Science*, 366 (6462), 226-231 (2019).
- 11 L. Fan, C. Xia, **P. Zhu**, Y. Lu, H. Wang, “[Electrochemical CO₂ reduction to high-concentration pure formic acid solutions in an all-solid-state reactor](#)”, *Nature communications*, 11 (1), 1-9 (2020).
- 12 J. Li, J. Jiao, H. Zhang, **P. Zhu**, H. Ma, C. Chen, H. Xiao, Q. Lu, “[Two-Dimensional SnO₂ Nanosheets for Efficient Carbon Dioxide Electroreduction to Formate](#)”, *ACS Sustainable Chemistry & Engineering*, 8 (12), 4975-4982 (2020).
- 13 Z.Y. Wu, M. Karamad, X. Yong, Q. Huang, D. Cullen, **P. Zhu**, C. Xia, M. Wong, Q. Li, Y. Hu, Q. Xiao, M. Shakouri, I. Gates, S. Siahrostami, H. Wang, “[Electrochemical ammonia synthesis](#)

- [via nitrate reduction on Fe single atom catalyst](#)”, *Nature communication*, 12, 2870 (2021).
- 14 Y. Xia, X. Zhao, C. Xia, Z.Y. Wu, **P. Zhu**, J.Y. Kim, X. Bai, G. G, Y. Liu, H. Wang, “[Highly Active and Selective Oxygen Reduction to H₂O₂ on Boron-Doped Carbon for High Production Rates](#)”, *Nature communication*, 12, 4225 (2021).
 - 15 C. Xia, Y. Qiu, Y. Xia, **P. Zhu**, G. King, X. Zhang, Z.Y. Wu, J.Y. Kim, D.A, Cullen, D. Zheng, P. L, M. Shakouri, E. Heredia, P. Cui, H.N. Alshareef, Y. Hu, H. Wang. “[General synthesis of single-atom catalysts with high metal loading using graphene quantum dots](#)”. *Nature Chemistry*, 13, 887–894 (2021).
 - 16 L. Fan, C.Y. Liu, **P. Zhu**, C. Xia, X. Zhang, Z.Y. Wu, Y. Lu, T.P. Senftle, H. Wang. “[Proton sponge promotion of electrochemical CO₂ reduction to multi-carbon products](#)”, *Joule*, 6, 205–220 (2022).
 - 17 F.Y. Chen, Z.Y. Wu, S. Gupta, D.J. Rivera, S.V. Lamberts, S. Pecaut, J.Y. Timothy, **P. Zhu**, Y. Z. Finfrock, D.M. Meira, G. King, G. Gao, W. Xu, D. A. Cullen, H. Zhou, Y. Han, D.E. Perea, C.L. Muhich, H. Wang “[Efficient conversion of low-concentration nitrate sources into ammonia on a Ru-dispersed Cu nanowire electrocatalyst](#)”, *Nature Nanotechnology*, 17, 759–767 (2022).
 - 18 X. Zhang, X. Zhao, **P. Zhu**, Z. Adler, Z.Y. Wu, Y. Liu, H. Wang “[Electrochemical oxygen reduction to hydrogen peroxide at practical rates in strong acidic media](#)” *Nature Communications*, 13, 2880 (2022).
 - 19 Z.Y Wu, F. Y Chen, B. Li, S. W Yu, Z. Finfrock, D. Meira, Q.Q Yan, **P. Zhu**, M.X. Chen, T.W. Song, Z. Yin, H.W Liang, S. Zhang, G. Wang, H. Wang. “[Non-Iridium Based Electrocatalyst for Durable Acidic Oxygen Evolution Reaction in Proton Exchange Membrane Water Electrolysis](#)”, *Nature Material*, 22, 100–108 (2023).
 - 20 Z. Adler, X. Zhang, G. Feng, Y. Shi, **P. Zhu**, Y. Xia, X. Shan*, and H. Wang* “[Hydrogen Peroxide Electrosynthesis in a Strong Acidic Environment Using Cationic Surfactants](#)”, *Precision Chemistry*, 2024, 2, 4, 129–137 (2024).
 - 21 R. Nankya, A. Elgazzar, **P. Zhu**, FY. Chen, H. Wang. “[Catalyst Design and Reactor Engineering for Electrochemical CO₂ Reduction to Formate and Formic Acid](#)”, *Materials Today*, (2024).
 - 22 R. Nankya, Y. Xu, A. Elgazzar, P. Zhu, TU. Wi, C. Qiu, Y. Feng, F. Che, H. Wang. “[Cobalt-Doped Bismuth Nanosheet Catalyst for Enhanced Electrochemical CO₂ Reduction to Electrolyte-Free Formic Acid](#)”. *Angewandte Chemie*, e202403671, (2024).
 - 23 FY. Chen, A. Elgazzar, S. Pecaut, C. Qiu, Y. Feng, S. Ashokkumar, Z. Yu, C. Sellers, S. Hao, **P. Zhu**, H. Wang. “[Electrochemical Nitrate Reduction to Ammonia with Cation Shuttling in A Solid Electrolyte Reactor](#)”, *Nature Catalysis*, 1-12 (2024).
 - 24 TU. Wi, Y. Xie, Z.H. Levell, D. Feng, J.Y. Kim, **P. Zhu**, A. Elgazzar, T.H. Jeon, M. Shakouri, S. Hao, Z. Fang, C. Qiu, H. Lee, A. Hicks, Y. Liu, C. Liu, H. Wang. “[Upgrading Carbon Monoxide to Bioplastics via Integrated Electrochemical Reduction and Biosynthesis](#)”, *Nature Synthesis*, 1-12 (2024).
 - 25 Y. Feng, Y. Park, S. Hao, Z. Fang, T. Terlier, X. Zhang, C. Qiu, S. Zhang, F. Chen, **P. Zhu**, Q. Nguyen, H. Wang, S.L. Biswal, “[Three-Chamber Electrochemical Reactor for Selective Lithium Extraction from Brine](#)”, *Proc. Natl. Acad. Sci. U.S.A.* 121 (47) e2410033121 (2024).
 - 26 A. Elgazzar, **P. Zhu**, FY. Chen, S. Hao, TU. Wi, C. Qiu, V. Okatenko, H. Wang, “[Electrochemical CO₂ Reduction to Formic Acid with High Carbon Efficiency](#)”, *ACS Energy Letters* 0, 10 (2024).
 - 27 T-U. Wi, Z. H. Levell, S. Hao, A. Elgazzar, **P. Zhu**, Y. Feng, F-Y. Chen, W. P. Lam, M. Shakouri, Y. Liu, H. Wang. “[Selective and Stable Ethanol Synthesis via Electrochemical CO₂ Reduction in](#)

- [a Solid Electrolyte Reactor](#)”, *ACS Energy Letters*, 10, 822-829 (2025).
- 28 S. Hao, A. Elgazzar, N. Ravi, T-U. Wi, **P. Zhu**, Y. Feng, Y. Xia, F-Y. Chen, X. Shan, H. Wang. “[Improving the operational stability of electrochemical CO₂ reduction reaction via salt precipitation understanding and management](#)”, *Nat Energy* 10, 266–277 (2025).
- 29 Y. Xia, **P. Zhu**, Y. Yang, C. Qiu, H. Wang. “[Electrochemical Manufacturing of Hydrogen Peroxide with High Concentration and Durability](#)”. *ACS Catalysis*, 15, 4560-4569 (2025).

Selected Conferences

- 1 “Continuous Carbon Capture via Oxygen/Water Electrolysis in a Modular Solid electrolyte Reactor,” 2023 AIChE Annual Meeting, Orlando, November 5–10, 2023.
- 2 “Recovering Carbon Losses in CO₂ Electrolysis Using a Solid Electrolyte Reactor,” 2023 MRS Fall Meeting & Exhibit, Boston, November 26–December 1, 2023.
- 3 *Travel support*, “CCU TEA and LCA Guidance – A Harmonized Approach”, Ann arbor, May 19–20, 2022.
- 4 “Direct and Continuous Generation of Pure Liquid Fuels via Electrocatalytic Carbon Dioxide Reduction,” 2022 AIChE Annual Meeting, November 13–18, 2022.
- 5 “Direct and Continuous Generation of Pure Acetic Acid Solutions via Electrocatalytic Carbon Monoxide Reduction,” 2021 MRS Fall Meeting & Exhibit, November 29–December 1, 2021.

Teaching and Mentoring

Teaching Assistant of Chemical Kinetics and Reactor Design, Rice University

Teaching Assistant of Thermodynamics I & II, Rice University

Energy and Environmental Engineering Academy Summer Program (2021 & 2022)

Guided 9th and 10th grade students through hands-on sustainability and clean energy projects.

Graduate Student Mentorship

Yu Zhou – Rice University, Department of Chemical Engineering

Ahmad Elgazzar – Rice University, Department of Chemical Engineering

Undergraduate Student Mentorship

Lyla Dong – Rice University, Department of Materials Science

Yun Rui Qiu – University of Science and Technology of China (USTC), Department of Chemistry

Lab Leadership

CO₂ Capture Subgroup Leader, Wang Lab at Rice University

Professional Services

Academic Society:

Materials Research Society: 2022 - Present

American Institute of Chemical Engineers: 2018 - Present

Summit Peer Review (20 Reviews):

Nature Communication, Catalysts, Chemical Engineering Journal, Journal of CO₂ Utilization, Rare Metals.