

Minghao Zhang, Ph.D.

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Professional Preparation:

University of California, San Diego	Ph.D.	2012--2017	Materials Sci. & Engr.
Chinese Academy of Sciences	M.S.	2009--2012	Materials Chem. & Phys.
NanKai University	B.S.	2005--2009	Physics

Professional Appointments:

University of Chicago	Research Professor	2026--now	Molecular Engineering
University of Chicago	Research Associate Professor	2024--2026	Molecular Engineering
University of California, San Diego	Assistant Project Scientist	2020--2024	NanoEngineering
University of California, San Diego	Postdoctoral Scholar	2018--2020	NanoEngineering

Research Interest and Technical Skills:

- Rational design of advanced materials, interfaces, and manufacturing strategies for next-generation energy technologies
- Materials metrology through correlative characterization such as SXRD, STEM/EELS, XPS, soft XAS, TXM, plasma-FIB, etc.
- AI-driven discovery, multiscale computational modeling, and predictive understanding of energy storage systems

Selected Peer-Reviewed Journal Publications: († authors with equal contribution, * corresponding author)

- S. Bai, **M. Zhang***, Y. S. Meng et al, "Guidelines for correlative imaging and analysis of reactive alkali metal battery materials", *Joule*, 2026, 10, 102311
- M. Zhang**, B. K. Stoychev, X. Zhang, Y.S. Meng et al, "Dry electrode architecture design to push energy density limits at the cell level", *Nature Energy*, 2026, <https://doi.org/10.1038/s41560-026-01981-3>
- G. Raghavendran, **M. Zhang***, Y. S. Meng et al, "Recoverable aggregate-rich liquefied gas electrolytes for enabling high-voltage lithium metal batteries", *Energy & Environmental Science*, 2025, 18, 8889–8906
- B. Sreenarayanan, **M. Zhang***, Y. S. Meng et al, "Resistive switching of spinel $\text{Li}_4\text{Ti}_5\text{O}_{12}$ lithium-ion battery material for neuromorphic computing", *ACS Applied Engineering Materials*, 2025, 3, 2624–2637
- Z. Liu, S. Bai, **M. Zhang*** et al. "FIB-SEM: emerging multimodal/multiscale characterization techniques for advanced battery development", *Chemical Reviews*, 2025, 125, 5228–5281
- B. Qiu, **M. Zhang***, Y. S. Meng et al, "Negative thermal expansion and oxygen-redox electrochemistry", *Nature*, 2025, 640, 941–946
- G. Raghavendran, **M. Zhang***, Y. S. Meng et al, "Deep learning assisted high-resolution microscopy image processing for phase segmentation in functional composite materials", *Journal of Microscopy*, 2025, 1–16
- M. Zhang**, K. Tantratian, L. Chen, Y.S. Meng et al, "Grain selection growth of soft metal in electrochemical processes", *Joule*, 2025, 9, 101847
- N.R. Park, **M. Zhang***, Y.S. Meng et al, "Understanding boron chemistry as the surface modification and electrolyte additive for Co-free lithium-rich layered oxide", *Advanced Energy Materials*, 2024, 2401968
- M. Chouchane, **M. Zhang***, Y. S. Meng, et al, "Improved rate capability for dry thick electrodes through finite elements method and machine learning coupling", *ACS Energy Letters*, 2024, 9, 1480

11. R. Shimizu, D. Cheng, **M. Zhang***, Y. S. Meng, et al, “Elucidating dynamic conductive state changes in amorphous lithium lanthanum titanate for resistive switching devices”, **Next Materials**, 2024, 2, 100102
12. B. Sayahpour, W. Li, **M. Zhang***, Y. S. Meng, et al, “Quantitative analysis of sodium metal deposition and interphase in Na metal batteries”, **Energy & Environmental Science**, 2024, 17, 1216
13. D. Cheng, T. Wynn, B. Lu, **M. Zhang***, Y. S. Meng, et al, “A free-standing lithium phosphorus oxynitride thin film electrolyte promotes uniformly dense lithium metal deposition with no external pressure”, **Nature Nanotechnology**, 2023, 8, 3230
14. **M. Zhang**, M. Chouchane, Y. S. Meng, et al, “Coupling of multiscale imaging analysis and computational modeling for understanding thick cathode degradation mechanisms”, **Joule**, 2023, 7(1), 201
15. W. Yao, M. Chouchane, **M. Zhang***, Y. S. Meng, et al, “A 5 V-class cobalt-free battery cathode with high loading enabled by dry coating”, **Energy & Environmental Science**, 2023, 16(4), 1620
16. X. Li, Q. Gu, **M. Zhang***, Y. S. Meng, Z. Liu, et al, “Rational design of thermally stable polymorphic layered cathode materials for next generation lithium rechargeable batteries”, **Materials Today**, 2022, 61, 91
17. H. Chung, Y. Li, **M. Zhang***, Y. S. Meng, et al, “Mitigating anisotropic changes in classical layered oxide materials by controlled twin boundary defects for long cycle life Li-ion batteries”, **Chemistry of Materials**, 2022, 34, 16, 7302
18. R. Shimizu, D. Cheng, **M. Zhang***, Y. S. Meng, et al, “Unraveling the stable cathode electrolyte interface in all solid-state thin-film battery operating at 5 V”, **Advanced Energy Materials**, 2022, 2201119
19. B. Sayahpour, S. Parab, **M. Zhang***, Y. S. Meng, et al, “Perspective: design of cathode materials for sustainable sodium - ion batteries”, **MRS Energy & Sustainability**, 2022, 9, 183
20. W. Li, D. Cheng, **M. Zhang***, Y. S. Meng, et al, “Artificial cathode electrolyte interphase for improving high voltage cycling stability of thick electrode with Co-Free 5 V spinel oxides”, **Energy Storage Materials**, 2022, 49, 77
21. **M. Zhang**, D. A. Kitchaev, Y. S. Meng, et al, “Pushing the limit of 3d transition metal-based layered oxides that use both cation and anion redox for energy storage”, **Nature Reviews Materials**, 2022, 7, 522
22. Y. Li, W. Li, **M. Zhang***, Y. S. Meng, et al, “Elucidating the effect of borate additive in high-voltage electrolyte for Li-Rich layered oxide materials”, **Advanced Energy Materials**, 2022, 2103033
23. D. Cheng, B. Lu, **M. Zhang***, Y. S. Meng, et al, “Leveraging cryogenic electron microscopy for advancing battery design”, **Matter**, 2022, 5, 26
24. C. Yin[†], Z. Wei[†], **M. Zhang[†]**, et al, “Structural insights into composition design of Li-rich layered cathode materials for high-energy rechargeable battery”, **Materials Today**, 2021, 51, 12
25. C. Fang, B. Lu, G. Pawar, **M. Zhang**, B. Liaw and Y. S. Meng et al, “Pressure-tailored lithium deposition and dissolution in lithium metal batteries”, **Nature Energy**, 2021, 6, 987
26. H. S. Hirsh, B. Sayahpour, **M. Zhang***, Y. S. Meng, et al, “Role of electrolyte in stabilizing hard carbon as an anode for rechargeable sodium-ion batteries with long cycle life”, **Energy Storage Materials**, 2021, 42, 78
27. **M. Zhang[†]**, B. Qiu[†], et al, “High pressure effect on structural and electrochemical properties of anionic redox-based lithium transition metal oxides”, **Matter**, 2021, 4, 164
28. Y. Li, M. J. Zuba, **M. Zhang***, Y. S. Meng*, et al, “Regeneration of degraded Li-rich layered oxide materials through heat treatment-induced transition metal reordering”, **Energy Storage Materials**, 2021, 35, 99
29. B. Qiu[†], **M. Zhang[†]**, et al, “Metastability and reversibility of anionic redox-based cathode for high-energy rechargeable batteries”, **Cell Reports Physical Science**, 2020, 1, 100028
30. W. Li, Y. Cho, **M. Zhang***, Y. S. Meng*, et al, “Enabling high areal capacity for Co-free high voltage spinel materials in next-generation Li-ion batteries”, **Journal of Power Sources**, 2020, 473, 228579
31. E. Zhao[†], **M. Zhang[†]**, J. Liu, X. Yu, Y. S. Meng, et al, “Local structure adaptability through multi cations for oxygen redox accommodation in Li-rich layered oxides”, **Energy Storage Materials**, 2020, 24, 384
32. H. Chung, A. Grenier, **M. Zhang***, Y. S. Meng, et al, “Comprehensive study of a versatile polyol synthesis approach for cathode materials for Li-ion batteries”, **Nano Research**, 2019, 12, 2238

33. C. Fang, J. Li, **M. Zhang**, Y. S. Meng, et al, "Quantifying inactive lithium in lithium metal batteries", **Nature**, 2019, 572, 511
34. H. Hirsh, M. Olguin, H. Chung, **M. Zhang***, Y. S. Meng, et al, "Meso-structure controlled synthesis of sodium iron-manganese oxides cathode for low-cost Na-ion batteries", **Journal of The Electrochemical Society**, 2019, 166 (12), A2528
35. **M. Zhang**, H.D. Liu, Z. Liu, C. Fang, and Y. S. Meng, "Modified coprecipitation synthesis of mesostructure-controlled Li-rich layered oxides for minimizing voltage degradation", **ACS Applied Energy Materials**, 2018, 1(7), 3369
36. A. Singer, **M. Zhang**, S. Hy, et al, "Nucleation of dislocations and their dynamics in layered oxide cathode materials during battery charging", **Nature Energy**, 2018, 3, 641
37. J. Alvarado, M. A. Schroeder, **M. Zhang**, O. Borodin, et al, "A carbonate-free, sulfone-based electrolyte for high-voltage Li-ion batteries", **Materials Today**, 2018, 21(4), 341
38. **M. Zhang**[†], K. Yin[†], et al, "In situ TEM observation of the electrochemical lithiation of N-doped anatase TiO₂ nanotubes as anodes for lithium-ion batteries", **Journal of Materials Chemistry A**, 2017, 38, 20651
39. **M. Zhang**[†], B. Qiu[†], et al, "Understanding and controlling anionic electrochemical activity in high-capacity oxides for next generation Li-ion batteries", **Chemistry of Materials**, 2017, 29(3), 908
40. K. Yin[†], **M. Zhang**[†], et al, "The formation of a self-assembled framework during lithiation of SnS₂, monitored by in situ microscopy", **Accounts of Chemical Research**, 2017, 50 (7), 1513
41. X. Wang, **M. Zhang**, et al, "New insights on the structure of electrochemically deposited lithium metal and its solid electrolyte interphases via cryogenic TEM", **Nano Letters**, 2017, 17 (12), 7606
42. B. Qiu[†], **M. Zhang**[†], et al, "Gas-solid interfacial modification of oxygen activity in layered oxide cathodes for lithium-ion batteries", **Nature Communications**, 2016, 7, 12108
43. **M. Zhang**, A.C. MacRae, H.D. Liu, Y.S. Meng, "Investigation of anatase-TiO₂ as an efficient electrode material for magnesium-ion batteries", **Journal of the Electrochemical Society**, 2016, 163(10), A2368
44. **M. Zhang**, Y. Liu, Y. Xia, B. Qiu, J. Wang, Z. Liu, "Simplified co-precipitation synthesis of spinel LiNi_{0.5}Mn_{1.5}O₄ with improved physical and electrochemical performance", **Journal of Alloys and Compounds**, 2014, 598, 73
45. **M. Zhang**, J. Wang, Y. Xia, Z. Liu, "Microwave synthesis of spherical spinel LiNi_{0.5}Mn_{1.5}O₄ as cathode material for lithium-ion batteries", **Journal of Alloys and Compounds**, 2012, 518, 68

Patents and Book Chapter:

1. Y. S. Meng, W. Yao, **M. Zhang**, et al. "Multifunctional fluoropolymer for enabling ultrathick electrodes by dry formation processes for next-generation Li-ion batteries", provisional US patent, in application
2. S. Kumakura, **M. Zhang**, et al. "Method for manufacturing a boron treated positive electrode active material", provisional US patent, in application
3. C. H. Jo, **M. Zhang**, et al. "Positive electrode active materials particle for sulfide-based all-solid-state batteries", (PCT/US2020/0303720)
4. Y. S. Meng, **M. Zhang**, et al. "Lithium excess cathode material and co-precipitation formation method", (PCT/US2016/062067)
5. Z. Liu, **M. Zhang**, et al. "Microwave synthesis of spinel LiNi_{0.5}Mn_{1.5}O₄ cathode materials for lithium-ion batteries", ZL201110131062.2
6. Z. Liu, **M. Zhang**, et al. "Synthesis of anion-doped transitional metal oxide as cathode materials for lithium-ion batteries", ZL201110131082.X
7. Z. Liu, **M. Zhang**, et al. "Synthesis of cathode materials for lithium-ion batteries using transitional metal carbonate as precursor", ZL201110214273.2

8. I.-H. Chu[†], **M. Zhang[†]**, S. P. Ong, and Y. S. Meng, "Handbook of materials modeling-battery electrodes, electrolytes, and their Interfaces", Edited by: W. Andreoni and S. Yip (Springer Nature Switzerland AG 2018)

Conferences / Presentations:

1. **M. Zhang**, H.D. Liu, C. Fang, Y. S. Meng, "Minimize the voltage degradation in Li-rich layered oxide cathode materials by morphology control" **Materials Research Society Meeting**, 2016, Boston, U.S., Oral presentation.
2. **M. Zhang**, A. C. MacRae, Y. S. Meng, "Investigation of anatase-TiO₂ as an efficient electrode material for magnesium-ion batteries" **Electrochemical Society Meeting**, 2016, San Diego, U.S., Poster presentation.
3. **M. Zhang**, H.D. Liu, C. Fang, Y. S. Meng, "Morphological and surface structural changes during electrochemical cycling in Li-rich layered oxides for next generation Li-ion batteries" **Materials Research Society Meeting**, 2017, Phoenix, U.S., Oral presentation.
4. **M. Zhang**, "Advanced Microscopy and Spectroscopy for Probing and Optimizing Electrode-Electrolyte", **DOE Annual Merit Review**, 2018, Washington DC, U.S., Poster presentation.
5. **M. Zhang**, H.D. Liu, Y. S. Meng, "Structure and voltage recovery driven by defects elimination in Li-rich layered oxide cathode materials" **Electrochemical Society Meeting**, 2018, Seattle, U.S., Oral presentation.
6. **M. Zhang**, M. Olguin, T. Wynn, Y. Li, Y. S. Meng, "Advanced characterization tools for probing anionic redox in layered cathode materials" **International Battery Association Meeting**, 2019, San Diego, U.S., Poster presentation.
7. **M. Zhang**, Y. S. Meng, "Toward the stable and reversible lattice oxygen redox in Li-rich layered oxides" **Electrochemical Society Meeting**, 2019, Atlanta, U.S., Postdoctoral Associate Research Award talk.
8. **M. Zhang**, Y. S. Meng, "Development of cryogenic techniques for characterizing energy storage materials in electrochemical process" **Microscopy & Microanalysis Meeting**, 2020, Virtual Meeting, U.S., Oral presentation.
9. **M. Zhang**, Y. S. Meng, "Three-dimensional imaging and interface analysis of battery materials via plasma FIB-SEM" **Electrochemical Society Meeting**, 2020, Virtual Meeting, U.S., Oral presentation.
10. **M. Zhang**, Y. S. Meng, "Advance characterization tools to study and develop stable anionic redox for high-energy rechargeable batteries" **Materials Research Society Meeting**, 2020, Virtual Meeting, U.S., Oral presentation.
11. **M. Zhang**, Y. S. Meng, "Sodium-ion batteries paving the way for grid energy storage" **Electrochemical Society Meeting**, 2021, Virtual Meeting, U.S., Oral presentation.
12. **M. Zhang**, "Development of Cryogenic Techniques for Characterizing Energy Storage Materials in Electrochemical Process", **International Cryo-EM Workshop for Advanced Materials**, 2022, Albuquerque, U.S., Oral presentation (Invited)
13. **M. Zhang**, "Development of Cryogenic Techniques for Characterizing Energy Storage Materials in Electrochemical Process", **Materials Research Society Meeting**, 2023, San Francisco, U.S., Oral presentation (Invited)
14. **M. Zhang**, "Recent Development on Co-free High Voltage Cathode Materials for Next-Generation Li-ion Batteries", **International Youth Forum Materials and Future**, 2023, Virtual Meeting, China, Oral presentation (Invited)
15. **M. Zhang**, "Three-Dimensional Imaging and Interface Analysis of Battery Materials Via Plasma FIB-SEM", and "Development of Cryogenic Techniques for Characterizing Energy Storage Materials in Electrochemical Process", **Microscopy & Microanalysis Meeting**, 2023, Minneapolis, U.S., Oral presentation (Invited)
16. **M. Zhang**, "Development of Cryogenic Techniques for Characterizing Energy Storage Materials in Electrochemical Process", **China Good EM seminar by ThermoFisher Scientific**, 2023, Virtual Meeting, China, Oral presentation (Invited)
17. **M. Zhang**, "Development of Cryogenic Techniques for Characterizing Energy Storage Materials", **Clean Energy Forum**, 2023, San Diego, U.S., Oral presentation (Invited)

18. **M. Zhang**, “*In Situ Analytical Electron Microscopy and Cryogenic Electron Microscopy for Characterizing Nanoscale Materials in Electrochemical Process*”, **Materials Research Society Meeting**, 2024, Seattle, U.S., Oral presentation (Invited)
19. **M. Zhang**, “*Three-dimensional Imaging and Interface Analysis of Battery Materials*”, **Materials Research Society Meeting**, 2025, Boston, U.S., Oral presentation (Invited)
20. **M. Zhang**, “*Metrology Development for Characterizing Energy Storage Materials*”, **Materials Research Society Meeting**, 2026, Honolulu, U.S., Oral presentation (Invited)

Selected Awards and Synergistic Activities:

- a. Battery Division Postdoctoral Associate Research Award of The Electrochemical Society (ECS), 2019, Atlanta, GA
- b. Session Chair, Battery and Energy Technology Joint General Session, Electrochemical Society Meeting, 2019, Atlanta, GA
- c. Symposium Organizer, Battery Student Slam, Electrochemical Society Meeting, 2021, Chicago, IL
- d. Organizer and poster session coordinator for International Cryo-EM Workshop for Advanced Materials, 2022, Albuquerque, NM
- e. Session Chair, Correlative and Multimodal Microscopy and Analysis, Microscopy & Microanalysis Meeting, 2023, Minneapolis, MN
- f. Organizer for Clean Energy Forum, 2023, San Diego, CA
- g. Highly Cited Researchers list from Clarivate for 2024 and 2025
- h. Symposium Organizer for MRS 2027 Spring on Advanced Electron Microscopy
- i. Proposal Reviewer for Office of Basis Energy Sciences (BES), Department of Energy (DOE)
- j. Peer Reviewer >150 papers for Nature Energy, Nature Communications, Joule, Energy & Environmental Science, Angewandte Chemie, ACS Nano, Chemistry of Materials, Journal of Materials Chemistry A, Nano Energy, Carbon, Journal of Power Sources, ACS Applied Materials & Interfaces, Electrochimica Acta, RSC Advances, etc.