Miaofang Chi

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Current Position:
Distinguished Scientist, Electron Microscopy Group, Center for Nanophase Materials Sciences, Oak Ridge National Laboratory
Joint Professor, Duke University, Durham, NC

Research Focus:

- Energy, mass and charge transport in materials and at their interfaces for energy and information technologies, e.g. batteries, solid oxide fuel cells, memristors, electrolyte-gating systems, and chemical energy transformation systems.
- The developments of new electron microscopy techniques for energy and quantum materials research, emphasizing on imaging functionalities of materials under *in situ* operation and synthesis conditions (e.g. cryogenic, biasing, annealing, and/or gas environments) with desirable energy, spatial and temporal resolutions.
- The design of functional interfaces with controlled charge transfer behavior for exceptional energy transport, storage, and transformations.

Education:

University of California, Davis	Ph.D.	09/2003 – 01/2008	Materials Science and Engineering
	Quantitative Scanning Transmission Electron Microscopy and Electron Energy Loss Spectroscopy for Transition Metal Oxides Advisor: Nigel Browning		
Shanghai Institute of Ceramics	M.E.	09/2000 – 07/2003	Materials Science and Engineering
	Elucidating the Role of Grain Boundaries in Mechanical Properties of Alumina		
Jilin University	B.E.	09/1993 – 07/1997	Materials Science

Research and Professional Experience:

Distinguished Scientist	2022 - current	Oak Ridge National Laboratory, TN
Senior Staff Scientist	2017 - 2022	Oak Ridge National Laboratory, TN
R&D Staff Scientist	2008 - 2017	Oak Ridge National Laboratory, TN
R&D Scientist	2008 – 2008	Gatan Co., Pleasanton, CA
Research Fellow	2006 – 2008	Lawrence Livermore National Laboratory, Livermore, CA
Research Assistant	2004 - 2006	Lawrence Berkeley National Laboratory, CA

Selected Awards:

- 2023, RSC Fellow
- 2022, Fellow of Microscopy Society of America.
- 2021, Director's Award for Outstanding Accomplishment in Science & Technology, ORNL.
- 2021, Distinguished Scientist, ORNL.
- 2022, 2021, 2020, 2018, Global highly cited researchers, Clarivate Analytics.
- 2019, the K.F.J. Heinrich Award, Microanalysis Society (MAS).

- 2019, DOE-BES Early Career Research Award.
- 2017, 2016, 2015, Significant Event Award, Oak Ridge National Laboratory.
- 2016, Burton Medal Award, Microscopy Society of America.
- 2015, Director's Award for Outstanding Accomplishment in Science & Technology, ORNL.
- 2015, Early Career Researcher Award, ORNL.
- 2006-2008, Lawrence Graduate Student Research Fellowship at Lawrence Livermore National Lab, Livermore, CA.
- 2007, Distinguished Scholar Award (MAS), Microscopy & Microanalysis 2007 Annual Meeting, Fort Lauderdale, FL.
- 2007, Graduate Student Award, 11th Frontiers of Electron Microscopy in Materials Science Conference.

Committee activities:

- Chair, Educational Resource Committee for Microscopy Society of America (MSA), 2021-present.
- Chair, Award Committee for Microscopy Society of America (MSA), 2019-2022.
- Editorial Board, Materials Today, 2019 – present.
- Editorial Advisory Board, Nanoscale Horizons, 2023 – present.
- Organizer, "International Cryo EM (ICE) Workshop for Advanced Materials," Albuquerque, NM, Aug. 2022.
- Panelist and Plenary speaker at the BES Roundtable on Research Opportunities in the Physical Sciences Enabled by Cryogenic Electron Microscopy, May 4–6, 2021.
- The International Advisory Board of the International Conference on Electroceramics, 2019-present.
- Award Committee of Microscopy Society of America, 2016 – 2022.
- Panel committee at DOE-BES Basic Research Needs for Electrical Energy Storage: panel 5 "All Solid-State Batteries" and "Cross-cutting research for EES" 2017.
- Committee member of "Future directions for microscopy society of America" at Microscopy and Microanalysis 2017.
- Conference organizer, The 17th Frontiers of Electron Microscopy in Materials Science International Conference (FEMMS), Asheville, NC 2019.
- *Reviewer* for funding agencies such as US-NSF, US-DOE-BES, French National Research Agency, and NSERC of Canada; and for journals including Science, Nature, Nature Materials, Nano Letters, Advanced Materials, Ultramicroscopy, Energy and Environ. Sci. and more.

Invited Presentations

1. "Phase Transformations in 2D Van der Waals Trichlorides: Insights from Cryogenic Scanning Transmitting Electron Microscopy" 2023 MRS Fall, Boston, MA, Nov. 26-Dec.1, 2023
2. "Microscopic Insights into Ion Conduction at Solid-Solid Interfaces," 2023 MRS Fall, Boston, MA, Nov. 26-Dec.1, 2023.
3. "Probing phase transformations in quantum materials using cryogenic STEM," The 5th International Symposium on Advanced Microscopy and Spectroscopy (ISAMS-5), December 4-6, 2023, Irvine, CA
4. "Advanced Cryogenic Scanning Transmission Electron Microscopy for Quantum Materials Research," 69rd American Vacuum Society International Symposium & Exhibition, Portland, OR, November 15-10, 2023
5. 243rd ECS Meeting with the 18th International Symposium on Solid Oxide Fuel Cells (SOFC-XVIII), "Emerging Electron Microscopy Techniques for Studying Interfaces in Energy Materials" , Boston 2023.
6. ACS Spring 2023, "Electron microscopy research enabled by shape-controlled nanoparticles", Indianapolis.

7. ACS Spring 2023, Elucidating interfaces in energy materials using advanced scanning transmission electron microscopy (STEM), Indianapolis.
8. The DOE Office of Basic Energy Sciences is planning for a Japan-US Joint Seminar on Fundamentals of Next Generation Batteries to be held on March 16-17, 2023, "Probing ion transport of individual interfaces in all solid state batteries," Tsukuba, Japan.
9. Chemical Reactions at Surfaces Gordon Research Conference, "Elucidating interfaces in energy materials using advanced scanning transmission electron microscopy (STEM)," 02/12/2023 – 02/17/2023, Lucca, Italy
10. Layer-number Dependency of Phase Transitions in 2D Layered Materials Revealed by Cryogenic Scanning Transmission Electron Microscopy, MRS Spring 2023, April 10-14 in San Francisco
11. MRS Fall Meeting, "Cryogenic STEM Imaging and Spectroscopy for Energy and Quantum Materials," Nov. 27-Dec. 2, 2022
12. MRS Fall Meeting, "Elucidating Interfaces in Solid State Batteries Using Advanced Scanning Transmission Electron Microscopy (STEM)," Nov. 27-Dec. 2, 2022
13. International Cryo-EM (ICE) Workshop for Advanced Materials, "Atomic Scale Cryogenic Scanning Transmission electron microscopy for quantum and energy materials," Sandia National Laboratories, NM, Aug. 22-25th, 2022.
14. MRS Spring 2022, "Elucidating Redox Dynamics of High Entropy Oxide Catalysts by Using In Situ and Cryogenic STEM," May 8-13, Honolulu, HI, 2022.
15. MRS Spring 2022, "Cryogenic STEM imaging for 2D van der Waals materials and their heterogeneous structures," May 8-13, Honolulu, HI, 2022.
16. Webnair, Next Frontier - CryoEM for Quantum Materials and Energy Research, "Recognizing the hidden hands in microscopy for materials science," June 9, 2022.
17. The ACS Spring 2022 National Meeting "Probing synthesis and reaction mechanisms of core-shell metal nanoparticles via in situ environmental and liquid STEM," San Diego, March 20-25, 2022.
18. The ACS Spring 2022 National Meeting "Atom-by-atom elucidation of lattice occupancy and redox dynamics of high entropy oxide (HEO) catalysts," San Diego, March 20-25, 2022.
19. Seminar, "Emerging Cryogenic and 4D-STEM for Quantum and Energy Materials" Department of Materials Science and Engineering Seminar, UCLA, Feb 11, 2022.
20. MRS Fall 2021, "Emerging Scanning Transmission Electron Microscopy (STEM) for Batteries Research," virtual, Dec 5-10, 2021.
21. PacifiChem 2021, "In situ and 4D-STEM for Energy Materials Research," virtual, December 15-20, 2021.
22. The World Conference on Solid Electrolytes for Advanced Applications: Garnets and Competitors, "Emerging scanning transmission electron microscopy (STEM) for solid state battery research," virtual, Oct. 25-27, 2021.
23. Graduate Seminar, "Emerging Electron Microscopy for Interfacial Phenomena in Quantum and Energy Materials" Department of Materials Science and Engineering Seminar, UCLA, Oct. 11, 2021.
24. Microscopy and Microanalysis 2021, "Cryogenic Atomic Resolution and 4D-STEM Imaging for Energy and Quantum Materials," Microscopy and Microanalysis 2021, Aug. 1-5, 2021.
25. Invited seminar, Ford Motor Company, "Understanding the Role of Interfaces in All Solid-State Batteries," Microscopy and Microanalysis 2021, July 30th, 2021.
26. AAAFM-UCLA International Conference on Advances in Functional Materials, "How can Microscopy Help in Realizing Solid State Batteries?" Aug 18-20, 2021.
27. The Fourth International Symposium on Advanced Microscopy and Spectroscopy (ISAMS-4), "Probing Interfacial Stability of All Solid-State Batteries via STEM," July 26-27, 2021.
28. Plenary Lecture, "How Can Cryo-STEM Revolutionize Materials Science?", the Virtual BES Roundtable on Research Opportunities in the Physical Sciences Enabled by Cryogenic Electron Microscopy, May 4–6, 2021.

29. International Bunsen Discussion Meeting on Solid-state Batteries (SSB 4.0), "Microscopic Insights into Interfaces Involving Solid Electrolytes," virtual, June 16- 17, 2021.
30. The 2021MRS Spring meeting, "Understanding the Role of Grain Boundaries in Solid Electrolytes for Batteries," virtual, April 17-23 (2021).
31. The 2020 MRS Fall meeting, "*In Situ* Electron Microscopy for Heterogenous Catalysts", virtual, Nov 27- Dec 4 (2020).
32. The 2020 MRS Fall meeting, "Scanning Transmission Electron Microscopy for Research of Interfaces in All-Solid-State Batteries", virtual, Nov 27- Dec 4 (2020).
33. Invited seminar, Miaofang Chi, "Understanding interfaces via the probing of ions and electrons in a STEM," Dept. of Physics and Astronomy, University of Nevada, Las Vegas, Feb 7, 2020.
34. Invited seminar: "Deciphering material properties at the atomic scale," Research center for element strategy, Tokyo Institute of Technology, Tokyo, Oct. 25th, 2019.
35. The 13th Pacific Rim Conference of Ceramic Societies, "Elucidating Interfacial Conductivity and Stability of Solid Electrolytes via in situ and analytical STEM," Okinawa Convention Center, Japan, October 27-31, 2019.
36. Beyond Lithium Ion XII, "Probing conductivity and cyclability of solid electrolyte-electrode interfaces," Golden, Colorado, June 25-27, 2019.
37. Korea Advanced Institute of Science & Technology, "Stability and Ion conductivity of Garnet Electrolytes for Li-metal Batteries" KAIST, June 14th, 2019.
38. The 22nd International Conference on Solid State Ionics (SSI-22), "Emerging Electron Microscopy for Interfacial Research in battery materials," PyeongChang, Alpensia, Korea, Jun 15-21, 2019.
39. The ACS Spring 2019 National Meeting "Probing synthesis and reaction mechanisms of core-shell metal nanoparticles via in situ environmental and liquid STEM," Orlando, FL, March 31 – April 4, 2019.
40. The ACS Spring 2019 National Meeting, "Probing interfaces in heterogeneous catalysts at atomic scale: Current and emerging STEM techniques," Orlando, FL, March 31 – April 4, 2019.
41. The 2019 MRS Spring, "Electron Microscopy for All-Solid-State Batteries—Addressing Challenges at Atomic Scale," April 22-26, 2019, Phoenix, Arizona.
42. International Battery Meeting, San Diego, CA, March 3-8th, 2019.
43. The 2018 MRS Fall meeting, "Elucidating Ion Transport and Charge Transfer Behavior at Solid-Solid Interfaces *via* STEM", CM03, Boston, MA, Nov. 25-30, 2018.
44. Probing Interfaces Involving Solid Electrolytes *via* STEM: From Atomic Resolution to *In Situ* and Functional Imaging," MIT, Dec3rd. 2018.
45. The 14th Annual Lithium Battery Materials & Chemistries, "Ion Conductivity and Stability of Interfaces Involving Solid Electrolytes," Arlington, VA. Nov. 1-2, 2018.
46. AVS 65th International symposium & Exhibition, "Towards Atomic-scale Functional Imaging of Interfaces in STEM via In Situ 4-D Imaging and Spectroscopy" Long beach, CA. Oct. 21-26, 2018.
47. The 256th ACS National Meeting, "Emerging Microscopy Techniques for Probing Interfacial Ion Transport," Boston, MA, August 19-23, 2018.
48. The 256th ACS National Meeting, Boston, MA, August 19-23, 2018, "Probing Synthesis Mechanisms of Core-Shell Metal Nanoparticle Catalysts at the Atomic Scale Using *In Situ* STEM."
49. Gordon Research Conference – Solid State Studies in Ceramics, "Probing Interfaces in Solid Electrolytes via STEM," Mount Holyoke College, South Hadley, MA, August 12 - 17, 2018.
50. Microscopy and Microanalysis 2018, "Elucidating Ion Transport in Lithium-Ion Conductors by Combining Vibrational Spectroscopy in STEM and Neutron Scattering," Baltimore, MD, August 5-9, 2018.
51. Telluride Science Research Center Workshop: Interfacial Chemistry and Charge Transfer for Energy Conversion and Storage, Telluride, CO, July 22-27, 2018, "Insights into Local Structure and Ion Conduction at the Interfaces of Solid Electrolytes via STEM."
52. Departmental Seminar, University of Texas, Arlington, TX, April 12, 2018, "Future Electron Microscopy for Energy Storage Research."

53. 2018 MRS Spring Meeting, “Formation and Stability of Solid Electrolyte-Electrode Interfaces Probed by Electron Microscopy”, EN06 Phoenix, AZ, April 2-6, 2018,
54. 2018 MRS Spring Meeting, Phoenix, “New Electron Microscopy Techniques for Probing Solid-Solid Ion Conducting Interfaces,” EN01. AZ, April 2-6, 2018.
55. 13th US-China Electric Vehicle and Battery Technology Information Exchange, “Integrating Novel Microscopy into Battery Research: From Atomic Resolution to In Situ and Functional Imaging,” San Diego, CA, April 8-10 (2018).
56. Next-Generation Battery Research - International Battery Seminar & Exhibit 2018, “Probing Interfaces Involving Solid Electrolytes: Atomic-Scale Insights from New Microscopy Techniques,” Fort Lauderdale, Florida, March 27, 2018.
57. Gordon Research Conference on Electrical Energy Storage, “Insights into Solid Electrolytes and Their Interfaces from Electron Microscopy.” Ventura, CA. Feb. 2018.
58. 2018 Conference on Electronic and Advanced Materials, “Advanced Electron Microscopy for Solid Electrolytes and Their Interfaces.” Orlando, Florida, January 17-19, 2018.
59. SciX 2017, “*In situ* Electron Microscopy for Catalysts,” Reno, NV, October 8-13, 2017.
60. Microscopy and Microanalysis 2017, “*In situ* Electron Microscopy for Solid Electrolytes.” Louis, Missouri, August 5, 2017.
61. 21st International Conference on Solid State Ionics, “Atomic-scale Insights into Solid Electrolytes and Their Interfaces,” Padua, Italy, June 18, 2017.
62. Advanced Electron Microscopy for Materials/Chemistry Research, “*In situ* Electron Microscopy for Energy Materials,” McMaster University, Hamilton, Canada, June 2, 2017.
63. Georgia Tech/ORNL workshop on chemical imaging, Atlanta, GA. Jan. 30 (2017).
64. The School of Chemistry and Biochemistry, Georgia Institute of Technology, Atlanta, GA. Jan. 18 (2017).
65. AVS 63rd International Symposium & Exhibition, Nashville, TN, Nov. 6-11 (2016).
66. The 251st ACS National Meeting & Exposition, San Diego, CA, March 13-17 (2016).
67. In-situ Heating in Aberration-Corrected STEM Workshop, Georgia Institute of Technology (2016)
68. ORNL outreach seminar, Feb. 11th 2016.
69. The Electrochemical Society, University of Kentucky Chapter, (2015).
70. International Conference of Pacific Rim Ceramic Societies (PacRim-11), Jeju Island, Korea. (2015).
71. The Electrochemical Society, University of Kentucky Chapter, “Probing Interfacial Charge Transfer Mechanism of Solid Electrolytes in Li-ion Batteries,” (2015).
72. International Conference of Pacific Rim Ceramic Societies (PacRim-11), Jeju Island, Korea. “Stability & Conductivity of Solid Electrolytes and Their Interfaces: A Microscopic Perspective” (2015).
73. Georgia Institute of Technology, Atlanta, GA. “Advanced Electron Microscopy for Energy Storage” (2014).
74. Battery Congress, Troy, MI. “Advanced Electron Microscopy for Li-battery Oxide Cathode Materials for Li-Batteries” (2013).
75. American Chemical Society, Indianapolis, IN. “Advanced Electron Microscopy for Energy Storage” (2013).
76. Microscopy & Microanalysis 2011 Annual Meeting, Nashville, TN. “Probing Surface Modification and Electrochemical Cycling Stability of Li[NixLi1/3-2x/3Mn2/3-x/3]O2 for Li-ion Batteries by using Advanced Analytical Electron Microscopy” (2011).
77. PV School at ORNL-CNMS User Meeting, “Design Of Radial p-n Junction on TiO2 through N-doping for Solar Applications” (2012)
78. University of California, Riverside, “Advanced Analytical Electron Microscopy for Probing Nanostructures” (2010).
79. University of California, San Diego, “Advanced Electron Microscopy for Energy Applications” (2011).
80. Center for Functional Nanomaterials, Brookhaven National Laboratory, “STEM Analysis of Perovskite Vanadates and Comet Materials" (2008).

Publications (Total publications: >200; Citations: >30500; h-index: 87 on google scholar)
https://scholar.google.com/citations?user=LLnw868AAAAJ&hl=en&oi=ao)
Selected 20 publications (followed by a complete list of publications)

1. J. Smith, Z. Huang, W, Gao, M. Chi*, "Atomic Resolution Cryogenic 4D-STEM Imaging via Robust Distortion Correction", *ACS Nano*, 2023.
2. M. J. Zachman, Z. Z. Yang, Y. G. Du, M. F. Chi*, "Robust Atomic-Resolution Imaging of Lithium in Battery Materials by Center-of-Mass Scanning Transmission Electron Microscopy," *Acs Nano* 2022, 10.1021/acsnano.1c09374.
3. X. M. Liu, R. Garcia-Mendez, A. R. Lupini, Y. Q. Cheng, Z. D. Hood, F. D. Han, A. Sharafi, J. C. Idrobo, N. J. Dudney, C. S. Wang, C. Ma, J. Sakamoto, and M. F. Chi*, Local electronic structure variation resulting in Li 'filament' formation within solid electrolytes, Nature Materials (2021).
4. Q. Zheng, T. L. Feng, J. A. Hachtel, R. Ishikawa, Y. Q. Cheng, L. Daemen, J. Xing, J. C. Idrobo, J. Q. Yan, N. Shibata, Y. Ikuhara, B. C. Sales, S. T. Pantelides, and M. F. Chi*, Direct visualization of anionic electrons in an electride reveals inhomogeneities, *Sci Adv* **7** (15) (2021).
5. M. J. Zachman, J. Madsen, X. Zhang, P. M. Ajayan, T. Susi, and M. F. Chi*, Interferometric 4D-STEM for Lattice Distortion and Interlayer Spacing Measurements of Bilayer and Trilayer 2D Materials, *Small* (2021).
6. Z. D. Hood, X. Chen, R. L. Sacci, X. M. Liu, G. M. Veith, Y. F. Mo, J. J. Niu, N. J. Dudney, and M. F. Chi*, Elucidating Interfacial Stability between Lithium Metal Anode and Li Phosphorus Oxynitride via In Situ Electron Microscopy, *Nano Lett* **21** (1), 151 (2021).
7. T. Blum, J. Graves, M. J. Zachman, F. Polo-Garzon, Z. L. Wu, R. Kannan, X. Q. Pan, and M. F. Chi, Machine Learning Method Reveals Hidden Strong Metal-Support Interaction in Microscopy Datasets, *Small Methods* **5** (5) (2021).
8. Zachman, M. J.; Hachtel, J. A.; Idrobo, J. C., and Chi, M.*,"Emerging electron microscopy techniques for probing functional interfaces in energy materials," *Angewandte Chemie* **132** 1400 (2020)
9. Hood, Z. D.; Chen, X.; Sacci, R.; Liu, X.; Veith, G. ; Mo, Y.; Niu, J.; Dudney, N.J., and Chi, M.*,"Elucidating Interfacial Stability between Lithium Metal Anode and Li Phosphorus Oxynitride via In Situ Electron Microscopy," *Nano Lett* (2020)
10. Wang, X. et al.,"Efficient electrically powered CO2-to-ethanol via suppression of deoxygenation," *Nature Energy* **5** 478 (2020)
11. Gao, W. P.; Hood, Z. D., and Chi, M. F.*,"Interfaces in Heterogeneous Catalysts: Advancing Mechanistic Understanding through Atomic-Scale Measurements," *Accounts Chem Res* **50** 787 (2017)
12. Han, F. D. et al.,"High electronic conductivity as the origin of lithium dendrite formation within solid electrolytes," *Nature Energy* **4** 187 (2019)
13. Gao, W. P.; Hou, Y. S.; Hood, Z. D.; Wang, X.; Xia, Y. N.; Pan, X. Q., and Chi, M. F.*,"Direct in situ Observation and Analysis of the Formation of Palladium Nanocrystals with High-Index Facets," *Nano Lett* **18** 7004 (2018)
14. Hood, Z. D.; Wang, H.; Pandian, A. S.; Peng, R.; Gilroy, K. D.; Chi, M. F.*; Liang, C. D., and Xia, Y. N.,"Fabrication of Sub-Micrometer-Thick Solid Electrolyte Membranes of beta-Li3PS4 via Tiled Assembly of Nanoscale, Plate-Like Building Blocks," *Advanced Energy Materials* **8** (2018)
15. Liu, X. M. and Chi, M.* et al.,"Elucidating the mobility of H+ and Li+ ions in (Li6.25-xHxAl0.25)La(3)Zr(2)O(12)via correlative neutron and electron spectroscopy," *Energ Environ Sci* **12** 945 (2019)
16. Ma, C.; Chen, K.; Liang, C. D.; Nan, C. W.; Ishikawa, R.; More, K., and Chi, M. F.*,"Atomic-scale origin of the large grain-boundary resistance in perovskite Li-ion-conducting solid electrolytes," *Energ Environ Sci* **7** 1638 (2014)
17. Ma, C.; Cheng, Y. Q.; Chen, K.; Li, J. C.; Sumpter, B. G.; Nan, C. W.; More, K. L.; Dudney, N. J., and Chi, M. F.*,"Mesoscopic Framework Enables Facile Ionic Transport in Solid Electrolytes for Li Batteries," *Advanced Energy Materials* **6** (2016)

18. Ma, C. and Chi, M.* et al.,"Interfacial Stability of Li Metal-Solid Electrolyte Elucidated via in Situ Electron Microscopy," *Nano Lett* **16** 7030 (2016)
19. Chi, M. F. * et al.,"Surface faceting and elemental diffusion behaviour at atomic scale for alloy nanoparticles during in situ annealing," *Nature Communications* **6** (2015)
20. Zhang, L. et al.,"Platinum-based nanocages with subnanometer-thick walls and well-defined, controllable facets," *Science* **349** 412 (2015)

Full List of Publications

1. Yu, X. B., Moon, J., Cheng, Y. Q., Daemen, L., Liu, J., Kim, S. W., Kumar, A., Chi, M. F., Fung, V., Ramirez-Cuesta, A. J. & Wu, Z. L. In Situ Neutron Scattering Study of the Structure Dynamics of the Ru/Ca2N:e- Catalyst in Ammonia Synthesis. *Chem Mater* **35**, 2456-2462 (2023). https://doi.org:10.1021/acs.chemmater.2c03599
2. Yang, W., Polo‐Garzon, F., Zhou, H., Huang, Z., Chi, M., Meyer III, H., Yu, X., Li, Y. & Wu, Z. Boosting the Activity of Pd Single Atoms by Tuning Their Local Environment on Ceria for Methane Combustion. *Angewandte Chemie* **135**, e202217323 (2023).
3. Yang, W., Kim, M.-Y., Polo-Garzon, F., Gong, J., Jiang, X., Huang, Z., Chi, M., Yu, X., Wang, X. & Guo, Y. CH4 combustion over a commercial Pd/CeO2-ZrO2 three-way catalyst: Impact of thermal aging and sulfur exposure. *Chemical Engineering Journal* **451**, 138930 (2023).
4. Yang, M. Q., Li, B. Y., Li, S. K., Dong, Q., Huang, Z. N., Zheng, S. X., Fang, Y., Zhou, G. Y., Chen, X., Zhu, X. B., Li, T. Y., Chi, M. F., Wang, G. F., Hu, L. B. & Ren, Z. J. Highly Selective Electrochemical Nitrate to Ammonia Conversion by Dispersed Ru in a Multielement Alloy Catalyst. *Nano Lett* (2023). https://doi.org:10.1021/acs.nanolett.3c01978
5. Werghi, B., Wu, L. H., Ebrahim, A. M., Chi, M. F., Ni, H. Y., Cargnello, M. & Bare, S. R. Selective Catalytic Behavior Induced by Crystal-Phase Transformation in Well-Defined Bimetallic Pt-Sn Nanocrystals. *Small* **19** (2023). https://doi.org:10.1002/smll.202207956
6. Wei, K. C., Lin, H. H., Zhao, X. R., Zhao, Z. L., Marinkovic, N., Morales, M., Huang, Z. N., Perlmutter, L., Guan, H. Q., Harris, C., Chi, M. F., Lu, G., Sasaki, K. & Sun, S. H. Au/Pt Bimetallic Nanowires with Stepped Pt Sites for Enhanced C-C Cleavage in C2+Alcohol Electro-oxidation Reactions. *J Am Chem Soc* (2023). https://doi.org:10.1021/jacs.3c07027
7. Wang, T., Pan, R. T., Martins, M. L., Cui, J. L., Huang, Z. N., Thapaliya, B. P., Do-Thanh, C. L., Zhou, M. S., Fan, J. T., Yang, Z. Z., Chi, M. F., Kobayashi, T., Wu, J. Z., Mamontov, E. & Dai, S. Machine-learning-assisted material discovery of oxygen-rich highly porous carbon active materials for aqueous supercapacitors. *Nat Commun* **14** (2023). https://doi.org:ARTN 460710.1038/s41467-023-40282-1
8. Venkatraman, K. & Chi, M. Nanoscale Vibrational Spectroscopy in a Scanning Transmission Electron Microscope. (2023).
9. Thapaliya, B. P., Ivanov, A. S., Chao, H. Y., Lamm, M., Chi, M. F., Meyer, H. M., Sun, X. G., Aytug, T., Dai, S. & Mahurin, S. M. Molten salt electrochemical upcycling of CO2 to graphite for high performance battery anodes. *Carbon* **212** (2023). https://doi.org:ARTN 11815110.1016/j.carbon.2023.118151
10. Sodpiban, O., Kessaratikoon, T., Smith, J., Ren, G. D., Del Gobbo, S., Das, S., Chi, M. F., D'Elia, V. & Gates, B. C. Catalysts Prepared from Atomically Dispersed Ce(III) on MgO

Rival Bulk Ceria for CO Oxidation. *Acs Appl Mater Inter* **15**, 55885-55894 (2023). https://doi.org:10.1021/acsami.3c13708
11. Smith, J., Huang, Z. N., Gao, W. P., Zhang, G. N. & Chi, M. F. Atomic Resolution Cryogenic 4D-STEM Imaging via Robust Distortion Correction. *Acs Nano* **17**, 11327-11334 (2023). https://doi.org:10.1021/acsnano.2c12777
12. Robinson, A. W., Wells, J., Nicholls, D., Moshtaghpour, A., Chi, M. F., Kirkland, A. I. & Browning, N. D. Towards real-time STEM simulations through targeted subsampling strategies. *J Microsc-Oxford* **290**, 53-66 (2023). https://doi.org:10.1111/jmi.13177
13. Ren, G., Jung, G. Y., Wang, C., Chen, H., Zhao, B., Vasudevan, R. K., Lupini, A. R., Chi, M., Hachtel, J. A. & Xiao, D. (Oxford University Press US, 2023).
14. Park, J. H., Lu, A. Y., Tavakoli, M. M., Kim, N. Y., Chiu, M. H., Liu, H. W., Zhang, T. Y., Wang, Z., Wang, J. T., Martins, L. G. P., Luo, Z. T., Chi, M. F., Miao, J. W. & Kong, J. Revealing Variable Dependences in Hexagonal Boron Nitride Synthesis via Machine Learning. *Nano Lett* **23**, 4741-4748 (2023). https://doi.org:10.1021/acs.nanolett.2c04624
15. Ni, H. Y., Wu, Z. Y., Wu, X. Y., Smith, J. G., Zachman, M. J., Zuo, J. M., Ju, L. L., Zhang, G. N. & Chi, M. F. Quantifying Atomically Dispersed Catalysts Using Deep Learning Assisted Microscopy. *Nano Lett* (2023). https://doi.org:10.1021/acs.nanolett.3c01892
16. Mei, H. Y., Ren, G. D., Zhao, B. Y., Salman, J., Jung, G. Y., Chen, H. D., Singh, S., Thind, A. S., Cavin, J., Hachtel, J. A., Chi, M. F., Niu, S. Y. *et al.* Colossal Optical Anisotropy from Atomic-Scale Modulations. *Adv Mater* **35** (2023). https://doi.org:10.1002/adma.202303588
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