

FUDONG HAN

Assistant Professor
Priti and Mukesh Chatter '82 Career Development Chair

Department of Mechanical, Aerospace, and
Nuclear Engineering
Rensselaer Polytechnic Institute
Troy, New York, 12180

Office: JEC 2022
Email: hanf2@rpi.edu
Phone: 518-276-2573
Web: <https://www.fhan-group.com>

Education

Ph.D. Chemical Engineering, University of Maryland College Park, 2018

MS Materials Science and Engineering, Shandong University, 2012

BS Materials Science and Engineering, Shandong University, 2009

Research and Professional Experience

08/2019 – present Assistant professor, Department of Mechanical, Aerospace, and Nuclear Engineering, Rensselaer Polytechnic Institute

08/2019 – present Priti and Mukesh Chatter '82 Career Development Chair, Rensselaer Polytechnic Institute

03/2019 – 08/2019 Guest Scientist, Materials for Energy and Sustainable Development Group, National Institute of Standards and Technology

05/2018 – 08/2019 Postdoctoral Associate, Department of Chemical and Biomolecular Engineering, University of Maryland College Park

Research Interests

Solid State Batteries, Solid Electrolytes, Battery Electrodes, Neutron-Based Characterizations

Awards and Honors

- 1) NSF CAREER Award, 2023
- 2) Highly Cited Researcher in Cross-Field by Clarivate, 2022
- 3) Electrochemical Society Electrodeposition Division Early Career Investigator Award, 2022
- 4) International Society for Solid State Ionics Young Scientist Award Finalist, 2022

- 5) Electrochemical Society Battery Division Student Research Award, 2018
- 6) Dean's Doctoral Research Award, A. James Clark School of Engineering, 2018
- 7) Materials Research Society Graduate Student Gold Award, 2017
- 8) NASA Tech Brief Certificate, 2016
- 9) All-S.T.A.R. Fellowship, University of Maryland College Park, 2016
- 10) Harry K. Wells Fellowship, A. James Clark School of Engineering, 2016
- 11) Future Faculty Fellow, A. James Clark School of Engineering, 2016
- 12) TA of the Year, Department of Chemical and Biomolecular Engineering, 2014

Book Chapters:

- 2, Y. Huang, B. Shao, F. Han, Solid State Batteries – An Introduction, in “Solid State Batteries: Emerging Materials and Applications”, Chapter 1, pp 1-20, 2022, American Chemical Society Symposium Series Vol. 1413.
- 1, B. Shao, Y. Huang, F. Han, Lithium-Sulfur Solid-State Batteries, in “Solid State Batteries: Emerging Materials and Applications”, Chapter 12, pp 267-288, 2022, American Chemical Society Symposium Series Vol. 1414.

Publications (Citations: 14035, H-index = 53, data from Google Scholar:
<https://scholar.google.com/citations?user=TSWDzy4AAAAJ&hl=en>)

78. B. Shao, S. Tan, Y. Huang, L. Zhang, J. Shi, X.-Q. Yang, E. Hu, F. Han, Enabling Conversion-Type Iron Fluoride Cathode by Halide-Based Solid Electrolyte, *Advanced Functional Materials*, (2022), 2206845.
77. Y. Huang, B. Shao, F. Han, Li Alloy Anodes for High-Rate and High-Areal-Capacity Solid-State Batteries, *Journal of Materials Chemistry A*, (2022), 10, 12350.
76. R. Jain, A. Lakhnot, K. Bhimani, S. Sharma, V. Mahajani, R. Panchal, M. Kamble, F. Han, C. Wang, N. Koratkar, Battery Electrodes: Nano vs Micro-Structuring, *Nature Review Materials*, (2022), 7, 736.
75. Y. Huang, B. Shao, F. Han, Interfacial Challenges in All-Solid-State Lithium Batteries, *Current Opinion in Electrochemistry*, (2022), 33, 100933. Invited Review.
74. X. Liu, R. Garcia-Mendez, A. R. Lupini, Y. Cheng, Z. D. Hood, F. Han, A. Sharafi, J. C. Idrobo, N. J. Dudney, C. Wang, C. Ma, J. Sakamoto, M. Chi, Local Electronic Structure Variation Resulting in Li "Filament" Formation within Solid Electrolytes, *Nature Materials*, (2021), 20, 1485.

73. R. Jain, Y. Yuan, Y. Singh, S. Basu, D. Wang, A. Yang, X. Wang, M. Rong, H. J. Lee, D. Frey, R. Khadka, P. Hundekar, S. O. Kim, F. Han, L.-W. Wang, D. Mitlin, R. Shahbazian-Yassar, N. Koratkar, Alloying of Alkali Metals with Tellurene, *Advanced Energy Materials*, (2020), 11, 2003248.
72. J. Wu, S. Liu, F. Han, X. Yao, C. Wang, Lithium/Sulfide All-Solid-State Batteries Using Sulfide Electrolytes, *Advanced Materials*, (2020) 2000751.
71. J. Yang, G. Liu, M. Avdeev, H. Wan, F. Han, L. Shen, Z. Zou, S. Shi, Y.-S. Hu, C. Wang, X. Yao, Ultrastable All-Solid-State Sodium Rechargeable Batteries, *ACS Energy Letters*, 5, (2020), 2835.
70. J. Yue, Y. Huang, S. Liu, J. Chen, F. Han*, C. Wang, Rational Designed Mixed-Conductive Sulfur Cathodes for All-Solid-State Lithium Batteries, *ACS Applied Materials & Interfaces*, 12, (2020), 36066.
69. J. Zhang, C. Cui, P.-F. Wang, Q. Li, L. Chen, F. Han, T. Jin, S. Liu, H. Choudhary, S. R. Raghavan, N. Eidson, A. von Cresce, L. Ma, J. Uddin, D. Addison, C. Yang, C. Wang, “Water-in-Salt” Polymer Electrolyte for Li-Ion Batteries, *Energy Environmental Science*, 13, (2020), 2878.
68. H. Wan, W. Weng, F. Han, L. Cai, C. Wang, X. Yao, Bio-Inspired Nanoscaled Electronic/Ionic Conduction Networks for Room-Temperature All-Solid-State Sodium-Sulfur Battery, *Nano Today*, 33 (2020) 100860.
67. J. P. Mwizerwa, Q. Zhang, F. Han, H. Wan, L. Cai, C. Wang, X. Yao, Sulfur-Embedded FeS₂ as a High-Performance Cathode for Room Temperature All-Solid-State Lithium-Sulfur Batteries, *ACS Applied Materials & Interfaces*, 12 (2020) 18519.
66. C. Cui, C. Yang, N. Eidson, J. Chen, F. Han, L. Chen, C. Luo, P.-F. Wang, X. Fan, C. Wang, A Highly Reversible, Dendrite-Free Lithium Metal Anode Enabled by a Lithium-Fluoride-Enriched Interphase, *Advanced Materials*, 32 (2020) 1906427.
65. S. Liu, X. Ji, J. Yue, S. Hou, P. F. Wang, C. Cui, J. Chen, B. Shao, J. Li, F. Han*, J. Tu*, C. Wang*, High Interfacial-Energy Interphase Promoting Safe Lithium Metal Batteries, *Journal of the American Chemical Society*, 142 (2020) 2438.
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63. H. Wan, L. Cai, F. Han, J. P. Mwizerwa, C. Wang, X. Yao, Construction of 3D Electronic/Ionic Conduction Networks for All-Solid-State Lithium Batteries, *Small*, 15 (2019) 1905849.
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59. R. Xu, J. Yue, S. Liu, J. Tu, F. Han*, P. Liu*, C. Wang*, Cathode-Supported All-Solid-State Lithium-Sulfur Batteries with High Cell-Level Energy Density, *ACS Energy Letters*, 4 (2019) 1073.
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57. F. Lu, Y. Pang, M. Zhu, F. Han, J. Yang, F. Fang, D. Sun, S. Zheng, C. Wang, A High-Performance Li–B–H Electrolyte for All-Solid-State Li Batteries, *Advanced Functional Materials*, 29 (2019) 1809219.
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54. J. Yue, X. Zhu, F. Han, X. Fan, L. Wang, J. Yang, C. Wang, Long-Cycle Life All-Solid-State Sodium Ion Battery, *ACS Applied Materials & Interfaces*, 10 (2018) 39645.
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52. F. Hao, F. Han, X. Liang, C. Wang, Y. Yao, Architectural Design and Fabrication Approaches for Solid-State Batteries, *MRS Bulletin*, 43 (2018) 775. Invited Review
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50. F. Wang, O. Borodin, T. Gao, X. Fan, W. Sun, F. Han, A. Faraone, J. A. Dura, K. Xu, C. Wang, Highly Reversible Zinc Metal Anode for Aqueous Batteries, *Nature Materials*, 17 (2018) 543.

49. F. Han[†], J. Yue[†], X. Zhu, C. Wang, Suppressing Li Dendrite Formation in Li₂S-P₂S₅ Solid Electrolyte by LiI Incorporation. *Advanced Energy Materials*, 8 (2018) 1703644.
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47. F. Han[†], J. Yue[†], C. Chen, N. Zhao, X. Fan, Z. Ma, T. Gao, F. Wang, X. Guo, C. Wang, Interphase Engineering Enabled-All-Ceramic Lithium Battery. *Joule*, 2 (2018) 497. Feature Article.
46. X. Fan[†], J. Yue[†], F. Han, J. Chen, T. Deng, X. Zhou, S. Hou, C. Wang, High Performance All-Solid-State Na-S Battery Enabled by Casting-Annealing Technology, *ACS Nano*, 12 (2018) 3360.
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43. T. Gao, X. Ji, S. Hou, X. Fan, X. Li, C. Yang, F. Han, F. Wang, J. Jiang, K. Xu, C. Wang, Thermodynamics and Kinetics of Sulfur Cathode during Discharge in MgTFSI₂-DME Electrolyte, *Advanced Materials*, (2018) 1704313.
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29. F. Han[†], Y. Zhu[†], X. He, Y. Mo, C. Wang, Electrochemical Stability of Li₁₀GeP₂S₁₂ and Li₇La₃Zr₂O₁₂ Solid Electrolytes, *Advanced Energy Materials*, 6 (2016) 1501590.
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25. F. Han, T. Gao, Y. Zhu, K. J. Gaskell, C. Wang, A Battery Made from a Single Material, *Advanced Materials*, 27 (2015) 3473. VIP Paper

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22. L. Suo, Y. Zhu, F. Han, T. Gao, C. Luo, X. Fan, Y. Hu, C. Wang, Carbon Cage Encapsulating Nano-cluster Li₂S by Ionic Liquid Polymerization and Pyrolysis for High Performance Li-S Batteries, *Nano Energy*, 13 (2015) 467.
21. Y. Zhu, Y. Wen, X. Fan, T. Gao, F. Han, C. Luo, S. Liou, C. Wang, Red Phosphorus-Single-Walled Carbon Nanotube Composite as a Superior Anode for Sodium Ion Batteries. *ACS Nano*, 9 (2015) 3254.
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5. H. Zhu, N. Lun, Z. Zhang, R. Liu, X. Meng, B. Zhang, F. Han, Y. Bai, J. Bi, R. Fan, A Catalyst-Free Method to Silicon Nanowires at Relative Low Temperature, *Journal of Crystal Growth*, 312 (2010) 3579.
4. H. Zhu, F. Han, N. Lun, Y. Qi, Y. Bai, J. Bi, X. Meng, B. Zhang, Y. Wang, J. Liu, R. Fan, Rapid, Low-Temperature Synthesis of β -SiC Nanowires from Si and Graphite, *Journal of the American Ceramic Society*, 93 (2010), 2415.
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2. H. Zhu, F. Han, J. Bi, Y. Bai, Y. Qi, L. Pang, C. Wang, S. Li, C. Lu, Facile Synthesis of Si₃N₄ Nanocrystals via an Organic-Inorganic Reaction Route, *Journal of the American Ceramic Society*, 92 (2009) 535.
1. L. Pang, J. Bi, Y. Bai, H. Zhu, Y. Qi, C. Wang, F. Han, S. Li, Synthesis of Carbon Spheres via a Low-Temperature Metathesis Reaction, *The Journal of Physical Chemistry C*, 112 (2008) 12134.

Presentations

19. F. Han, Solidifying Batteries for Safe Energy Storage, *3M Tech Forum of Automotive Electrification*, 3M, 11/08/2022.

18. F. Han, Electronic Transport in Lithium Solid Electrolytes, *23rd International Conference on Solid State Ionics*, Boston, US, 07/20/2022.
17. F. Han, Electronic Conduction Induced Dendrite Formation in Solid Electrolytes, *23rd International Conference on Solid State Ionics*, Boston, US, 07/19/2022.
16. F. Han, Solidifying Batteries for Safe Energy Storage, *Department of Physics & Atmospheric Science, Dalhousie University*, Halifax, Canada, 01/13/2022.
15. F. Han, Mechanistic Understanding of Dendrite Formation in Solid Electrolytes, *2021 MRS Fall Meeting*, Boston, 12/01/2021
14. F. Han, “All-Solid-State Battery”, *Department of Physics, Applied Physics & Astronomy Colloquium, Rensselaer Polytechnic Institute*, 10/28/2020
13. F. Han, Solid Electrolyte for Safe and Energy-Dense Batteries, *Department of Mechanical and Aerospace Engineering, Syracuse University*, Syracuse, NY, Oct. 23, 2020.
12. F. Han, T. Yi, R. G. Downing, R. Briber, C. Wang, H. Wang, Visualization and Quantification of Spatial Distribution of Dendrites in Polymer Electrolytes for Lithium Metal Batteries, *ACNS 2020*, Virtual, Jul. 13–Jul. 16, 2020.
11. F. Han, “Solidifying Batteries for Safe Energy Storage”, *Department of Materials Science and Engineering, Rensselaer Polytechnic Institute*, 02/05/2020
10. F. Han, “On the Route to Solid State Batteries”, *Department of Mechanical, Aerospace and Nuclear Engineering, Rensselaer Polytechnic Institute*, 11/20/2019
9. F. Han, T. Yi, R. G. Downing, R. Briber, C. Wang, H. Wang, Structure of Lithium Dendrites in Polymer Electrolytes, *2019 APS March Meeting*, Boston, MA, Mar. 4–Mar. 8, 2019.
8. F. Han, Revisiting the Electrochemical Stability of Solid Electrolytes for Safe Energy Storage, *Department of Chemical Engineering, University of California Davis, Davis, CA*, Jan. 24, 2019.
7. F. Han, All-Solid-State Batteries for Next-Generation Electrochemical Energy Storage, *2018 AIChE Annual Meeting*, Pittsburgh, PA, Oct. 28–Nov. 2, 2018.
6. F. Han, Revisiting the Electrochemical Stability Window of Solid Electrolytes, *2018 AiMES Meeting*, Cancun, Mexico, Sep. 30–Oct. 4, 2018.
5. F. Han, J. Yue, X. Zhu, C. Wang, Lithium Dendrite Suppression in Solid Electrolytes, *2017 MRS Fall Meeting & Exhibit*, Boston, MA, Nov. 26–Dec. 1, 2017.
4. F. Han, J. Yue, C. Wang, Improved Cathode/Electrolyte Interfaces in All-Solid-State Batteries, *2017 MRS Fall Meeting & Exhibit*, Boston, MA, Nov. 26–Dec. 1, 2017.

3. F. Han, J. Yue, X. Fan, Z. Ma, T. Gao, C. Wang, Cathode/Electrolyte Interface: Revisiting the Electrochemical Stability of Solid Electrolytes, *2017 MRS Spring Meeting & Exhibit*, Phoenix, AZ, Apr. 17-21, 2017.

2. F. Han, T. Gao, Y. Zhu, J. Yue, Y. Zhu, Y. Mo and C. Wang, Electrochemical Stability of $\text{Li}_{10}\text{GeP}_2\text{S}_{12}$ and $\text{Li}_7\text{La}_3\text{Zr}_2\text{O}_{12}$ Solid Electrolytes, *18th International Meeting on Lithium Batteries*, Chicago, IL, Jun. 19-24, 2016.

1. F. Han, T. Gao, Y. Zhu, K. J. Gaskell, and C. Wang, A Battery Made from a Single Material, *20th International Conference on Solid State Ionics*, Keystone, CO, Jun. 14-19, 2015.

Patents and Patent Applications

1. C. Wang, F. Han, Battery Made from a Single Material, US 2017/0317382 A1.

Work as Reviewer of other works

- Reviewer: Department of Energy Office of Science, 2022
- Reviewer and Panelist: NSF CBET, 2021
- Reviewer: Department of Energy Vehicle Technology Office Annual Merit Review, 2021
- Reviewer: ACS Petroleum Research Fund, 2021

I have also reviewed >100 papers in a number of journals, including *Nature Communications*, *Nature Sustainability*, *Chemical Reviews*, *Materials Today*, *Advanced Materials*, *Advanced Energy Materials*, *Nano Energy*, *Energy Storage Materials*, *Chemistry of Materials*, *Journal of Power Sources*, *ACS Applied Materials & Interfaces*, *ACS Applied Energy Materials*, *Carbon*, *Chemical Engineering Journal*, *Journal of Materials Chemistry A*, *Nanotechnology*, *Vacuum*, *Ionics*, *Journal of Nanoparticle Research*, *Journal of Physics D Applied Physics*, *Materials Research Express*, *Journal of Crystal Growth*, *Ceramics International*, *Electrochimica Acta*, and *Energy & Environmental Materials*.

Editorial Boards

Electrochem (ISSN 0008-0008)

Batteries (ISSN 2313-0105)

Professional Society Committee

1. Materials Research Society Early Career Professional Subcommittee, Member, 2/2022 to present
2. Electrochemical Society Electrodeposition Division Early Career Forum Organizing Committee, Member, 9/2022 to present

Conference Organization

1. Lead Organizer of the “Solid State Batteries: Electrodes, Electrolytes, and Interphases” Symposium of the 2021 Materials Research Society Fall Meeting at Boston, MA, 11/29/2021 to 12/02/2021.
2. Organizer of the “Energy Storage Beyond Li-ion Batteries” symposium of the 2022 American Chemical Society Fall meeting at Chicago, 08/21/2022 to 08/25/2022.

Institutional Administrative Responsibilities

1. Faculty Senate Recording Secretary, Rensselaer Polytechnic Institute, 9/2021 to 9/2022
2. Secretary of Faculty Senate, Rensselaer Polytechnic Institute, 9/2022 to present

Professional Memberships

- 1) Electrochemical Society
- 2) Materials Research Society
- 3) International Society of Electrochemistry
- 4) American Chemistry Society
- 5) American Institute of Chemical Engineers
- 6) American Society of Mechanical Engineers
- 7) American Physics Society