

Helena Marsh

*Associate Professor of Materials
Science and Engineering*

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Research overview. I direct the Ionic Interfaces Laboratory at Meridian University, where my group studies charge transport at grain boundaries and electrode–electrolyte interfaces in solid-state battery materials. Our work combines synthesis, operando spectroscopy, and machine-learning-guided screening to design layered-oxide cathodes and ceramic electrolytes with improved cycling stability. I teach undergraduate and graduate courses in materials thermodynamics and electrochemical energy storage, and I have advised eleven graduate students to degree completion.

Education

- 2007–2011 **Ph.D., Materials Science and Engineering**, *Vertex Institute of Technology*, Ashford, ME
Dissertation: *Ionic Transport Mechanisms in Layered Oxide Cathodes for Solid-State Batteries*. Advisor: Prof. Daniel Okafor.
- 2005–2007 **M.S., Materials Science and Engineering**, *Vertex Institute of Technology*, Ashford, ME
Thesis: *Sol-Gel Synthesis of Nickel-Rich Cathode Precursors*.
- 2001–2005 **B.S., Chemistry, *magna cum laude***, *Apex University*, Rowanfield, NJ
Minor in Physics. Departmental Honors Thesis on lithium intercalation kinetics.

Academic Appointments

- 2021–present **Associate Professor (tenured)**, *Department of Materials Science and Engineering, Meridian University*, Ashford, ME
- 2015–2021 **Assistant Professor**, *Department of Materials Science and Engineering, Meridian University*, Ashford, ME
- 2012–2015 **Postdoctoral Research Associate**, *Nimbus College, Solid-State Chemistry Group*, Redgate, MA
Advisor: Prof. Sarah Lindqvist. Developed operando X-ray diffraction protocols for tracking phase transitions in cathode materials during cycling.
- 2011–2012 **Visiting Research Fellow**, *Synapse Foundation Materials Institute*, Corwin City, IL
Collaborative appointment supporting transition from doctoral to postdoctoral research.

Honors and Awards

- 2024 Distinguished Teaching Award, Meridian University
- 2022 Early-Career Faculty Fellowship, Synapse Foundation
- 2019 Young Investigator Award, Nexa Research Council
- 2017 CAREER Award, Nexa Research Council (Directorate for Materials Research)
- 2016 Rising Star in Materials Chemistry, Materials Research Society
- 2013 Postdoctoral Excellence Prize, Nimbus College
- 2011 Outstanding Doctoral Dissertation Award, Vertex Institute of Technology
- 2005 Chemistry Department Medal, Apex University

Research Funding

2023–2026	Interfacial Engineering of Solid Electrolytes for Next-Generation Batteries , Nexa Research Council, Role: Principal Investigator, \$685,000
2022–2025	Collaborative Research on Battery Degradation Diagnostics , Apex University / Vertex Institute of Technology Consortium, Role: Senior Personnel (Meridian share), \$275,000
2021–2024	Scalable Synthesis of Layered Oxide Cathode Materials , Synapse Foundation, Role: Principal Investigator, \$420,000
2020–2023	Machine-Learning-Guided Discovery of Ionic Conductors , Nimbus Industries, Industry Partnership Program, Role: Co-Principal Investigator, \$310,000
2017–2022	CAREER: Grain Boundary Transport in Solid-State Electrolytes , Nexa Research Council, Role: Principal Investigator, \$550,000
2016–2017	Seed Grant: Novel Cathode Surface Coatings , Meridian University Office of Research, Role: Principal Investigator, \$45,000
Total	Extramural funding as PI/Co-PI since 2016: \$2,285,000

Publications

Peer-Reviewed Journal Articles

(† denotes graduate student mentee; * denotes corresponding author)

- [J1] Marsh, H.*, Whitfield, R.†, Cho, J.† (2025). Grain-boundary segregation and its effect on ionic conductivity in garnet-type solid electrolytes. *Journal of Applied Materials Chemistry*, 41(3), 1122–1136.
- [J2] Okonkwo, L.†, Marsh, H.*, Reyes, P. (2024). Operando neutron diffraction study of nickel-rich layered cathodes under fast charge. *Energy Storage Science*, 12(2), 245–259.
- [J3] Marsh, H.*, Torbin, A.† (2024). Machine-learning screening of halide solid electrolytes for interfacial stability. *Ionics and Interfaces*, 8(1), 33–48.
- [J4] Whitfield, R.†, Marsh, H.*, Lindqvist, S. (2023). Coating chemistry effects on cycling stability of NMC811 cathodes. *Journal of Applied Materials Chemistry*, 39(11), 4410–4423.
- [J5] Marsh, H.*, Cho, J.†, Dumont, F. (2023). Sodium-substituted layered oxides as low-cost cathode candidates. *Materials Horizons Quarterly*, 10(4), 891–904.
- [J6] Torbin, A.†, Marsh, H.* (2022). Deep-learning prediction of activation energies in ceramic ion conductors. *Ionics and Interfaces*, 6(3), 210–226.
- [J7] Marsh, H.*, Okafor, D., Reyes, P. (2022). Interfacial resistance evolution at cathode/garnet interfaces: a five-year retrospective. *Energy Storage Science*, 10(1), 55–71.
- [J8] Cho, J.†, Whitfield, R.†, Marsh, H.* (2021). Atomic layer deposition of alumina buffer layers for solid-state cathodes. *Journal of Applied Materials Chemistry*, 37(6), 2201–2214.
- [J9] Marsh, H.*, Lindqvist, S. (2021). Revisiting the role of oxygen vacancies in high-voltage spinel cathodes. *Materials Horizons Quarterly*, 8(2), 402–417.
- [J10] Dumont, F.†, Marsh, H.* (2020). Solvent-free mechanochemical synthesis of sulfide solid electrolytes. *Ionics and Interfaces*, 4(4), 301–315.
- [J11] Marsh, H.*, Reyes, P., Torbin, A.† (2019). CAREER perspective: bridging grain boundary chemistry and macroscopic conductivity. *Energy Storage Science*, 7(3), 188–201.
- [J12] Marsh, H.*, Whitfield, R.† (2018). Thermal stability of nickel-rich cathodes under abuse conditions. *Journal of Applied Materials Chemistry*, 34(9), 3390–3402.
- [J13] Reyes, P., Marsh, H.* (2017). A comparative study of wet-chemical routes to lithium garnet electrolytes. *Ionics and Interfaces*, 2(1), 44–58.

- [J14] Marsh, H.^{*}, Okonkwo, L.[†] (2016). Surface reconstruction of layered oxides upon air exposure. *Materials Horizons Quarterly*, 3(2), 155–167.
- [J15] Marsh, H., Lindqvist, S.^{*} (2014). Operando X-ray diffraction cell design for cathode phase-transition studies. *Journal of Applied Materials Chemistry*, 30(7), 2650–2661.
- [J16] Marsh, H., Okafor, D.^{*} (2013). Lithium diffusion pathways in doped layered oxides: a combined experimental and computational study. *Ionics and Interfaces*, 1(1), 12–27.
- [J17] Marsh, H., Okafor, D.^{*} (2011). Sol-gel derived nickel-rich cathode precursors: particle morphology control. *Energy Storage Science*, 1(1), 3–14.

Book Chapters

- [B1] Marsh, H. (2023). Interfacial degradation in solid-state batteries. In *Advances in Ceramic Electrolyte Design*, eds. Reyes, P. & Lindqvist, S. Meridian Academic Press, pp. 118–147.
- [B2] Marsh, H., Okafor, D. (2016). Characterization techniques for layered oxide cathodes. In *Handbook of Electrode Materials*, 2nd ed., ed. Dumont, F. Vertex University Press, pp. 63–90.

Selected Conference Proceedings

- [C1] Marsh, H., Whitfield, R.[†] (2024). Grain boundary engineering in garnet electrolytes. *Proceedings of the Materials Research Society Fall Meeting*, Corwin City, IL.
- [C2] Torbin, A.[†], Marsh, H. (2022). ML-guided ionic conductor discovery. *Proceedings of the Electrochemical Society Spring Meeting*, Redgate, MA.
- [C3] Marsh, H., Cho, J.[†] (2019). Cathode coating strategies for fast-charge applications. *Proceedings of the International Battery Materials Symposium*, Ashford, ME.
- [C4] Marsh, H. (2014). Operando diffraction of layered oxide cathodes. *Proceedings of the Materials Research Society Spring Meeting*, Rowanfield, NJ.

Invited Talks and Presentations

- 2025 “Interfacial Chemistry in Solid-State Batteries,” Colloquium, Vertex Institute of Technology
- 2024 “Grain Boundaries as Design Variables,” Keynote, International Battery Materials Symposium, Ashford, ME
- 2023 “Machine Learning Meets Solid Electrolytes,” Invited Seminar, Apex University
- 2022 “A Decade of Cathode Interfaces,” Distinguished Lecture, Nimbus College
- 2021 “Coatings and Cycling Stability,” Materials Research Society Fall Meeting, Corwin City, IL
- 2019 “CAREER Perspectives on Ionic Transport,” Nexa Research Council PI Meeting, Washington Analogue
- 2017 “Operando Methods for Battery Materials,” Invited Talk, Synapse Foundation Materials Institute
- 2015 “From Precursors to Performance,” Early Career Symposium, Electrochemical Society Meeting

Teaching

Courses Taught

Course Title	Level	Offered
MSE 210Materials Thermodynamics	Undergraduate	Spring, 2016–2019
MSE 301Introduction to Materials Science	Undergraduate	Fall, 2015–present
MSE 415Electrochemical Energy Storage	Undergrad./Grad.	Spring, 2017–present
MSE 610Advanced Solid-State Ionics	Graduate	Fall, 2019, 2021, 2023
MSE 690Graduate Research Seminar	Graduate	Fall, 2020–present

Doctoral Students Advised (degree completed)

- 2024 Anya Torbin, Ph.D. — *Data-Driven Discovery of Ionic Conductors*; now Research Scientist, Nimbus Industries
- 2023 Rowan Whitfield, Ph.D. — *Coating Strategies for Nickel-Rich Cathodes*; now Assistant Professor, Apex University
- 2022 Jin Cho, Ph.D. — *Atomic Layer Deposition for Solid-State Interfaces*; now Process Engineer, Synapse Foundation Labs
- 2020 Lucia Okonkwo, Ph.D. — *Neutron Diffraction Studies of Fast-Charge Cathodes*; now Postdoctoral Fellow, Vertex Institute of Technology
- 2018 Felix Dumont, Ph.D. — *Mechanochemical Routes to Sulfide Electrolytes*; now Staff Scientist, Nexa Research Council

Current Graduate Students

- Marguerite Fenn (Ph.D. candidate, 3rd year) — interfacial coatings for halide electrolytes
- Owen Petrakis (Ph.D. candidate, 2nd year) — machine-learning force fields for garnet conductors
- Ines Kowalczyk (M.S. student, 2nd year) — thermal abuse testing of layered oxides

Service

Departmental

- 2022–present Chair, Graduate Admissions Committee
- 2020, 2023 Member, Faculty Search Committee
- 2018–2021 Member, Undergraduate Curriculum Committee
- 2016–2018 Faculty Advisor, Materials Science Undergraduate Society

University

- 2021–present Member, Meridian University Research Council
- 2019–2021 Member, Faculty Senate
- 2017–2019 Reviewer, Meridian University Internal Seed Grant Program

Professional

- 2022–present Associate Editor, *Journal of Applied Materials Chemistry*
- 2019, 2021, 2023 Panelist, Nexa Research Council Merit Review Panels
- 2018–present Ad-hoc Reviewer: *Energy Storage Science, Ionics and Interfaces, Materials Horizons Quarterly*
- 2021, 2024 Session Chair, Materials Research Society Meeting

Professional Memberships

Materials Research Society (member since 2011)

American Chemical Society, Division of Inorganic Chemistry (member since 2009)

References

Prof. Daniel Okafor

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Vertex Institute of Technology
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Prof. Sarah Lindqvist

Solid-State Chemistry Group
Nimbus College

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Dr. Priya Reyes

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