

Emily M. Ryan

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Employment

- 2020-present Associate Professor, Department of Mechanical Engineering, Boston University
- 2025-present Associate Professor, Faculty of Computing and Data Science
- 2024-present Associate Director, Kilachand Honors College, Boston University
- 2023-2025 Affiliated Faculty Member of Computing and Data Science
- 2020-2024 Steering Committee Member, Hariri Institute for Computing and Computational Science and Engineering
- 2020-2023 Founding Faculty Member of Computing and Data Science
- 2019-present Associate Director, Institute for Global Sustainability, Boston University
- 2013-present Affiliated Faculty, Center for Computational Science, Boston University
- 2012-present Affiliated Faculty, Materials Science Division, College of Engineering, Boston University
- 2010-2011 Computational Scientist, Pacific Northwest National Laboratory
- 2009-2010 Post-Doctoral Research Associate, Pacific Northwest National Laboratory
- 2004-2005 Field Engineer, Select Energy Services, Natick, MA

Education

- 2009 PhD in Mechanical Engineering
Carnegie Mellon University, Pittsburgh, PA
Advisor: Cristina Amon
Dissertation: *A smoothed particle hydrodynamics model of reactive transport in the porous cathode of a solid oxide fuel cell*
- 2008 M.S. in Mechanical Engineering
Carnegie Mellon University, Pittsburgh, PA
- 2004 B.S. Magna cum Laude in Mechanical Engineering
Tufts University, Medford, MA

Awards and Honors

- 2025 Duan Family Faculty Fellow, Faculty of Computing and Data Science
- 2025 Boston University Initiative on Cities Public Impact Scholar

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| 2025 | HERS Leadership Institute |
| 2024 | Anthony Janetos Climate Action Prize, Boston University, faculty mentor of student group |
| 2020-2022 | Scialog Fellow, Negative Emission Sciences |
| 2017-2019 | Scialog Fellow, Advanced Energy Storage |
| 2016 | R&D 100 Award, CCSI Toolset co-developer |
| 2014-2017 | Hariri Junior Faculty Fellow |
| 2013 | Kern Faculty Fellow |
| 2013 | Young Faculty Travel Award, ECS |
| 2006-2009 | NSF Graduate Research Fellow |

Publications

Journal Publications

- 48 Z. Zhao*, E.M. Ryan (2025), "Guidance on Machine Learning Algorithm Selection for Materials Science and Engineering Applications", MRS Communication Special Issue: Methods Letters: Techniques to Drive Materials Science Innovation.
- 47 Z. Zhao*, J. Kubel, D. Abraham, E.M. Ryan (2025), "Benchmarking optimization methods for materials research: Gradient descent and Bayesian optimization for lithium-ion battery aging diagnostics", *Journal of Power Sources*, 656.
- 46 M. Morey*, M. Lobel+, E.M. Ryan (2025), "A systematic implementation of the solid electrolyte interphase layer and study of its impact on lithium plating morphology in lithium metal batteries", *Journal of Energy Storage*, 122.
- 45 Z. Zhao*, A. Baumann⁺, **E.M. Ryan** (2024). "Using Machine Learning Aided Computational Fluid Dynamics to Facilitate Design of Experiments", *Industrial & Engineering Chemistry Review*.
- 44 I. Bar-Lev, K. Shwartsman, V. Singh, N. Bruchiel-Spanier, **E.M. Ryan**, N. Shpigel, D. Sharon (2024), "Enhancing Efficiency, Stability, and Cycle Life of Lithium Metal Electrodeposition in Dry Solid-State Polymer Electrolytes", *ACS Applied Materials & Interfaces*, 16, 66159-66169.
- 43 M. Morey*, G. Nagara, A. Halder, S. Sharifzadeh, **E.M. Ryan** (2024). "A framework for nucleation in electrochemical systems and the effect of surface energy on dendrite growth", *Journal of Energy Storage*, 92, 112144.
- 42 **E.M. Ryan**, A. Roshandelpoor, Z. Pollard, J. Goldfarb, P. Vakili (2023). "Prospective on Methods of Design of Experiments for Limited Data Scenarios in Materials Design and Engineering", *MRS Communications*, 13 (6), 1087-1101.
- 41 Z. Pollard, A. Roshandelpoor, P. Vakili, **E.M. Ryan**, J. Goldfarb (2023). "Towards tunable polymer foam fabrication: A case study to advance green materials development in limited data scenarios", *AIChE Journal*, 69, 17984.
- 40 A. Cannon*, J. McDaniel, **E.M. Ryan** (2023). "Smoothed particle hydrodynamics modeling of electrodeposition and dendritic growth under migration- and diffusion-controlled mass transport", *Journal of Electrochemical Energy Conversion and Storage*, 20,041006.
- 39 X. Shan, M. Morey*, S. Zhao, Z. Li, Z. Xiao, H. Feng, S. Gao, A. Sokolov, **E.M. Ryan**, K. Xu, H. Yang, P. Cao (2022). "A Polymer Electrolyte with High Cationic Transport Number for Safe and Stable Solid Li-Metal Batteries", *ACS Energy Letters*, 7, 4342-4351.

- 38 T. Melsheimer⁺, M. Morey*, A. Cannon*, **E.M. Ryan** (2022). “Modeling the Effects of Pulse Plating on Dendrite Growth in Lithium Metal Batteries”, *Electrochimica Acta* 433, 141227.
- 37 A. Gupta, G.K. McDonough, J. Moreira, J. Lau, V.W. Doheny, **E.M. Ryan**, S. Grace, R. Holt (2022). “Passive cavitation imaging in fuel injector nozzles”, *The Journal of the Acoustical Society of America*, 152, 4, A246-A246.
- 36 Z. Pollard, A. Cannon. **E.M. Ryan**, J. Goldfarb (2022). “Capturing the effects of particle heterogeneity on adsorption in a fixed bed” *AIChE Journal* 68, 4.
- 35 M. Morey*, J. Loftus, A. Cannon*, **E.M. Ryan** (2022), “Interfacial Studies on the Effects of Patterned Anodes for Guided Lithium Deposition in Lithium Metal Batteries”, *Journal of Chemical Physics*, 156, 014703.
- 34 A. Hubbard, **E.M. Ryan**, J. Goldfarb. (2022), “Enhancing pyrolysis gas and bio-oil formation through transition metals as in situ catalysts”, *Fuel* 308, 121900.
- 33 A. Yan⁺, T. Sololinski, W. Lane*, J. Tan*, K. Ferris, **E.M. Ryan**. (2021), “Applying transfer learning with convolutional neural networks to identify novel electrolytes for metal air batteries”, *Computational and Theoretical Chemistry*, 1205, 113443.
- 32 S. Rajendran, A. Cannon*, **E.M. Ryan**, L. Arava. (2021). “Inhibition of Lithium Dendrite Formation in Lithium Metal Batteries via Regulated Cation Transport through Ultrathin Sub-Nanometer Porous Carbon Nanomembranes”, *Advanced Energy Materials*, 11 (29).
- 31 A. Cannon*, **E.M. Ryan** (2021). “Characterizing the Microstructure of Separators in Lithium Batteries and Their Effects on Dendritic Growth”, *ACS Applied Energy Materials* 4 (8), 7848-7861.
- 30 K. Dong, Y. Xu, J. Tan*, M. Osenberg, C. Yang F. Sun, Z. Kochovski, D. T. Pham, S. Mei, A. Hilger, E.M. Ryan, Y. Lu, J. Banhart, I. Manke (2021). “Unravelling the Mechanism of Lithium Nucleation and Growth and the Interaction with the Solid Electrolyte Interface”, *ACS Energy Letters*, 6, 1719-1728. <https://doi.org/10.1021/acsenerylett.1c00551>
- 29 S. Gao, A. Cannon*, F. Sun, Y. Pan, D. Yang, S. Ge, N. Liu, A. P. Sokolov, **E.M. Ryan**, H.n Yang, and P. Cao (2021). “Glass-Fiber Reinforced Polymeric Protective Layers for Stable Li-Metal Electrode: Unraveling the Key Attributes of Artificial Solid-Electrolyte Interface (SEI)”, *Cell Reports Physical Science*, 2 (8).
- 28 D. Gopalakrishnan, S. Alkatie, A. Cannon*, N. Bhagirath, **E.M. Ryan**, L.M. Reddy Arava (2021). “Anisotropic mass transport using Ionic Liquid Crystalline Electrolyte to suppress dendrite growth”. *Sustainable Energy and Fuels*, 5: 1488-1497.
- 27 J. Tan, A. Cannon*, **E.M. Ryan** (2020). “Dendrite growth in Lithium Batteries under Cycling Conditions”, *Journal of Power Sources*, 463: 228187.
- 26 E. Arai*, A. Tartakovsky, R.G. Holt, S. Grace, **E.M. Ryan** (2020). “Comparison of Surface Tension Generation Methods in Smoothed Particle Hydrodynamics for Dynamic Systems”, *Computer and Fluids*, 203, 5.
- 25 E. Arai*, D. Villafranco, S. Grace, **E.M. Ryan** (2020). “Simulating Bubble Dynamics in a Buoyant System”, *International Journal for Numerical Methods in Fluids*, 93, 3, 169-188.
- 24 D. Villafranco, A. Gupta, **E.M. Ryan**, R.G. Holt, S. Grace (2020) “An Assessment of Homogeneous Mixture Method Cavitation Models in Predicting Cavitation in Nozzle Flow”, *Journal of Fluids Engineering*, 143, 1.
- 23 **E.M. Ryan**, J. Goldfarb (2019). “Manipulating Dendritic Growth: An Undergraduate Laboratory Experience in the Interplay between Mass Transport, Supersaturated Solutions, and Dendrite Structure”. *Journal of Chemical Education*. <https://doi.org/10.1021/acs.jchemed.8b00962>
- 22 **E.M. Ryan**, Z. Pollard, Q. Ha*, A. Roshandelpoor, Z. Pollard, P. Vakili, J. Goldfarb (2019). “Designing Heterogeneous Hierarchical Material Systems: A Holistic Approach to Structural and Materials Design”. *MRS Communications*, 9, 2, 628-636 (invited).

- 21 K.R. Dupre*, A. Vyas, J.L. Goldfarb, E.M. Ryan (2019). “Investigation of Computational Upscaling of Adsorption of SO₂ and CO₂ in Fixed Bed Columns”, *Adsorption*, 25, 4, 773-782. <https://doi.org/10.1007/s10450-019-00050-4>.
- 20 **E.M. Ryan** and P. Mukherjee (2019). “Mesoscale Modeling in Electrochemical Devices – A Critical Perspective”, *Progress in Energy and Combustion Science*, 71, 118-142. (invited)
- 19 K.R. Dupre*, **E.M. Ryan**, A. Suleimenov, J. Goldfarb (2018). “Experimental and Computational Demonstration of a Low-Temperature Waste to By-Product Conversion of U.S. Oil Shale Semi-Coke to a Flue Gas Sorbent”, *Energies*, 11, 3195.
- 18 K. Xie, W. Wei, N. Li, J. Tan, L. Zhang, X. Luo, K. Yuan, Q. Song, H. Li, C. Shen, **E. M. Ryan**, L. Liu and B. Wei (2018). “Suppressing Dendritic Lithium Formation Using Porous Media in Lithium Metal Based Batteries”, *Nano Letters*, 18, 3: 2067-2073.
- 17 W.A. Lane*, **E.M. Ryan** (2018). “Verification, validation, and uncertainty quantification of a sub-grid model for heat transfer in gas-particle flows with immersed horizontal cylinders”, *Chemical Engineering Science*, 176:409-420.
- 16 J. Tan*, **E.M. Ryan** (2016). “Structured Electrolytes to Suppress Dendrite Growth in High Energy Density Batteries”, *International Journal of Energy Research*, 40, 13: 1800-1810.
- 15 J Tan*, **E.M. Ryan** (2016). “Computational study of electro-convection effects on dendrite growth in batteries”, *Journal of Power Sources*, 323: 67-77.
- 14 W. A. Lane*, S. Sundaresan, **E.M. Ryan** (2016). “Sub-grid models for heat transfer in gas-solid flows with immersed cylinders”, *Chemical Engineering Science*, 151: 7-15.
- 13 J.Tan*, K. Ferris, A.M. Tartakovsky, **E.M. Ryan** (2016). “Investigating the effects of anisotropic mixing on dendrite growth in high energy density lithium batteries”, *The Journal of the Electrochemical Society*, 163, 2: A318-A327.
- 12 C. Storlie, W.A. Lane*, **E.M. Ryan**, J.R. Gattiker, D.M. Higdon. (2015) “Calibration of Computational Models with Categorical Parameters and Correlated Outputs via Bayesian Smoothing Spline ANOVA”. *Journal of the American Statistical Society*, 110: 68-82.
- 11 D.C. Miller, M. Syamlal, D. Mebane, C. Storlie, D. Bhattacharyya, N. V. Sahinidis, D. Agarwal, C. Tong, S. E. Zitney, A. Sarkar, X. Sun, S. Sundaresan, **E.M. Ryan**, D. Engel, C. Dale. (2014). “Carbon Capture Simulation Initiative: A Case Study in Multi-Scale Modeling and New Challenges”. *Annual Review of Chemical and Biomolecular Engineering* 5.
- 10 W.A. Lane*, C. Storlie, C. Montgomery, **E.M. Ryan**. (2014). “Numerical modeling and Bayesian calibration of a bubbling fluidized bed with immersed horizontal tubes”. *Powder Technology*, 253: 733-743.
- 9 **E.M. Ryan**, D. DeCroix, R. Breault, W. Xu, E.D. Huckaby, K. Saha, X. Sun, S. Sundaresan, S. Dartevelle. (2013). “Multi-phase CFD modeling of solid sorbent carbon capture system”, *Powder Technology*, 242: 117-134.
- 8 **E.M. Ryan**, W. Xu, X. Sun, and M.A. Khaleel (2012) “A damage model for degradation in the electrodes of solid oxide fuel cells: Modeling the effects of sulfur and antimony in the anode”. *Journal of Power Sources*, 210: 233-242.
- 7 **E.M. Ryan**, K.P. Recknagle, W. Liu, M.A. Khaleel. (2012). “The Need for Nano-scale Modeling and Experimentation in Solid Oxide Fuel Cells”, *Journal of Nanoscience and Nanotechnology*, 12: 6758-6768.
- 6 **E.M. Ryan**, T. Sanquist. (2012). “Validation of Building Energy Modeling Tools Under Idealized and Realistic Conditions”, *Energy and Buildings*, 47: 375-382.
- 5 **E.M. Ryan**, A.M. Tartakovsky. (2011). “A Hybrid Micro-Scale Model for Transport in Connected Macro-Pores in Porous Media”, *Journal of Contaminant Hydrology*, 126: 61-71.
- 4 **E.M. Ryan**, A.M. Tartakovsky, C. Amon. (2011).” Pore-Scale Modeling of Competitive Adsorption of a Plume in a Porous Medium”, *Journal of Contaminant Hydrology*, 120-121: 56-78.

- 3 **E.M. Ryan**, A.M. Tartakovsky, M.A. Khaleel, C. Amon. (2011). “Pore-Scale Modeling of the Reactive Transport of Chromium in the Cathode of a Solid Oxide Fuel Cell”, *Journal of Power Sources*, 196: 287-300.
- 2 K.P. Recknagle, **E.M. Ryan**, B.J. Koeppel, M.A. Khaleel. (2010). “Modeling of Electrochemistry and Steam-Methane Reforming Performance for Simulating Pressurized Solid Oxide Fuel Cell Stacks”, *Journal of Power Sources*, 195:6637-6644.
- 1 **E.M. Ryan**, A.M. Tartakovsky, C. Amon. (2010).” A Novel Method for Modeling Neumann and Robin Boundary Conditions in Smoothed Particle Hydrodynamics”, *Computer Physics Communications*, 181: 2008-2023.

* Denotes graduate student supported by Prof. Ryan; + Denotes undergraduate student supported by Prof. Ryan

Book Chapters

1. E.M. Ryan, M.A. Khaleel, Modeling Solid Oxide Fuel Cells from the Macro-Scale to the Nano-Scale, in: D. Stolten, B. Emonts (Eds.) Fuel Cell Science and Engineering - Materials, Processes and Systems, Wiley, 2012.

Invited Presentations

- 35 *Computational and data science approaches to energy and material systems*, Mechanical Engineering, Boston University, May 5, 2025.
- 34 *Multi-phase, Multi-physics Modeling of Interfacial Phenomena in Energy Systems*, Materials Institute, Princeton University, April 16, 2025.
- 33 *Multi-phase, Multi-physics Modeling of Interfacial Phenomena in Energy Systems*, Energy Systems Institute, Cornell University, October 17, 2024.
- 32 *Interfacial Phenomena in Energy Systems*, Energy Science and Engineering, Technical University Darmstadt, Germany, March 15, 2024.
- 31 *Interfacial Phenomena in Energy Systems*, Energy Science and Engineering, University College Dublin, Ireland, March 13, 2024.
- 30 *Multi-phase, Multi-physics Modeling of Interfacial Phenomena in Energy Systems*, Energy Science and Engineering, Penn State, February 8, 2024.
- 29 *Multi-phase, Multi-physics Modeling of Interfacial Phenomena in Energy Systems*, Energy Science and Engineering, Worcester Polytechnic Institute, January 31, 2024.
- 28 *Meso-Scale Interfacial Modeling of Electrodeposition*, Multi-Scale Modeling, Simulation, and Design, 243rd ECS Meeting, Boston, May 2023.
- 27 *Data Science Informed Modeling of Interfacial Defects in lithium batteries*, Data-Driven Design of Energy Materials Symposium, ACS Fall National Meeting, San Francisco, August 2023.
- 26 *Multi-phase, Multi-physics Modeling of Interfacial Phenomena in Energy System*, Energy Science and Engineering, Stanford University, October 24, 2022.
- 25 *Mesoscale Separator Design to Mitigate Dendrite formation in lithium batteries*, The Materials Society Spring Meeting, San Diego, CA, February 2020.
- 24 *Materials Science is All Around Us*, AMS Materials Science Day, Boston University, May 20, 2019.
- 23 *Modeling Multiphase, Multi-physics Phenomena in Energy Systems*, Schlumberger-Doll, Cambridge, MA, March 14, 2019.
- 22 *Mesosopic Phenomena in Electrochemical Systems*, Greater Boston Area Statistical Mechanics Society, Brandies University, October 27, 2018.
- 21 *Interfacial Mesoscopic Phenomena in Electrochemical Systems*, BU Materials Day, Boston

- University, October 26, 2018.
- 20 *Materials Science is All Around Us*, AMS Materials Science Day, Boston University, May 21, 2018.
 - 19 *Modeling Multiphase, Multi-physics Phenomena in Energy Systems*, Northeastern University, Department of Mechanical and Industrial Engineering Seminar Series, December 8, 2017.
 - 18 *Modeling Multiphase, Multi-physics Phenomena in Energy Systems*, University of Massachusetts Amherst Department of Mechanical Engineering Seminar Series, October 27, 2017.
 - 17 *Materials Science is All Around Us*, AMS Materials Science Day, Boston University, May 22, 2017.
 - 16 *Modeling Multiphase, Multi-physics Phenomena in Energy Systems*, Tufts University Department of Mechanical Engineering Seminar Series, Medford, MA, March 31, 2017
 - 15 *Suppressing Dendrite Growth in high energy density batteries through anisotropic transport*, TMS, San Diego, CA, March 2, 2017
 - 14 *Modeling and Experimental Studies of Cavitation in Fuel Injectors*, DOE Advanced Engine Combustion Meeting, Livermore, CA, February 2017
 - 13 *Advancing High Energy Density Batteries through Controlled Mass Transport*, BU Research on Tap Materials Science and Engineering: The Science of Stuff, February 2017
 - 12 *Modeling the Physics and Performance Issues in Advanced Battery Technologies*, Hariri Institute for Computing and Computational Science and Engineering, Boston, MA, December 2015
 - 11 *Developing Energy Technologies for the Future: Micron to Device Scale*, Center for Computational Sciences, Boston, MA, May 2015
 - 10 *Filtered Model Development for Solid Sorbent Systems*, Carbon Capture Simulation Initiative Industry Advisory Board Meeting, Reston, VA, September 2015.
 - 9 *Sub-Grid Heat Transfer Models for Gas-Solid Flows*, Carbon Capture Simulation Initiative Industry Advisory Board Meeting, Webinar, July 2015.
 - 8 *Coarse Graining methods for multiphase fluidized beds*, Carbon Capture Simulation Initiative Industry Advisory Board Meeting, Reston, VA, September 2014.
 - 7 *Modeling and Calibration of a bubbling fluidized bed*, Carbon Capture Simulation Initiative Industry Advisory Board Meeting, Reston, VA, September 2013.
 - 6 *High-Fidelity Models of Solid Sorbent Carbon Capture Equipment*, 11th Annual Conference on carbon Capture and Sequestration, Pittsburgh, PA, May 1, 2012.
 - 5 *Using Numerical Methods to Engineer the Next Generation of Energy Systems*, Center for Computational Sciences, Boston University, MA, May 2015.
 - 4 *Detailed Secondary Reaction Modeling of SOFC electrodes*, SECA-NETL Program Review, Morgantown, WV, April 2010.
 - 3 *Electrode Level Modeling of Secondary Reaction in a Solid Oxide Fuel Cell*, Fuel Cell Workshop, PNNL, Richland, WA, October, 2009.
 - 2 *Smoothed Particle Hydrodynamics Modeling of Reactive Transport in a Solid Oxide Fuel Cell Cathode and Porous Media*, Mechanical Engineering Department, University of Toronto, Toronto, CA, May 2009.
 - 1 *Chromium Poisoning in the Cathode of a Solid Oxide Fuel Cell*, PNNL, Richland, WA, January, 2007.

Teaching

EK 225: Introduction to Energy Conversion and Environmental Engineering (undergraduate non-engineers course) **Fall 2021, 2022, 2023, 2024, 2025**

ME 306: Introduction to Materials Science (upper level undergraduate course) **Spring 2013, 2014, 2015, 2016, 2018**

ME 419: Heat Transfer (upper level undergraduate course) **Fall 2018, 2019**

ME 519: Theory of Heat Transfer (graduate level) **Fall 2012**

ME 533: Energy Conversion (graduate level) **Spring 2017, 2019, 2020, 2022, 2023, Fall 2013, 2015, 2022, 2024**

KHC 512: Choice and Change (Kilachand Honors College upper level undergraduate course) **Spring 2025, 2026**