

# C. Michael McGuirk

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Assistant Professor  
Colorado School of Mines, Department of Chemistry and Materials Science Program  
160 Coolbaugh Hall, Golden, CO, 80401  
cmmcguirk@mines.edu  
Cell: 920-740-4215  
www.mcguirk-supra-mat-chem.com

## EDUCATION

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<b>University of California–Berkeley</b> Philomathia Postdoctoral Fellow with <i>Prof. Jeffrey R. Long</i>	5.1.2016–5.25.2019
<b>Northwestern University</b> Ph.D. in Chemistry with <i>Prof. Chad A. Mirkin</i>	8.1.2011–3.30.2016
<b>University of Minnesota–Twin Cities</b> B.A. in Chemistry with minor in Biochemistry <i>Summa Cum Laude</i> with High Honors	9.1.2006–5.15.2010

## APPOINTMENTS

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<b>Colorado School of Mines</b> Assistant Professor, Department of Chemistry	6.1.2019–Present
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## RESEARCH TIMELINE

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<b>2019 – Present</b>	“Supramolecular Materials Chemistry” <i>Primary Investigator</i> , Colorado School of Mines
<b>2016 – 2019</b>	“Elucidating the Molecular Origins of Step-Shaped Adsorption in Metal–Organic Frameworks” <i>Advisor: Prof. Jeff Long</i> , University of California, Berkeley
<b>2011 – 2016</b>	“Coordination Chemistry-Based Strategies for the Regulation and Enhancement of Hydrogen Bond-Donating Catalyst Activity” <i>Advisor: Prof. Chad Mirkin</i> , Northwestern University
<b>2010 – 2011</b>	“Development of Anti-Misting Formulations using Non-Newtonian Fluids” Ecolab Inc.
<b>2009 – 2010</b>	“Characterization of Clathrin-Dependent Uptake Mechanisms of Natriuretic Peptide Receptors” <i>Advisor: Prof. Lincoln Potter</i> , University of Minnesota, Twin Cities
<b>2008 – 2009</b>	“N-Heterocyclic Carbene-Based Ligands for the Isolation of Transient Cu(I)-Oxo Species” <i>Advisor: Prof. William Tolman</i> , University of Minnesota, Twin Cities

## PREVIOUS RESEARCH EXPERIENCE

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- **Post-Doctoral Research – University of California, Berkeley – Long Lab**
  - Discovery of, and molecular-level investigation into, the chemically specific cooperative adsorption mechanism of the commodity chemical carbon disulfide in diamine-appended metal–organic frameworks.

- Structural investigation of the origins of non-classic step-shaped adsorption in stimuli-responsive zeolitic imidazolate frameworks for storage and delivery of natural gas in the transportation sector.
- **Dissertation Research – Northwestern University – Mirkin Lab**
  - Established a platform for the *in situ* control of hydrogen bond-donating catalysis, based on a novel synthetic strategy that employed structurally addressable supramolecular coordination structures. These architectures have potential applications in controlled polymerization, chemical sensors, and amplification devices.
  - Harnessed the three-dimensional structural order of metal–organic frameworks for dramatically enhancing the activity of hydrogen bond-donating catalysis through the deliberate obviation of deleterious inter-catalyst association.

### PRIMARY INVESTIGATOR EXTERNAL GRANTS

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1. Title: High Capacity Step-Shaped Hydrogen Adsorption in Robust, Pore-Gating Zeolitic Imidazolate Frameworks  
Agency: Department of Energy, Office of Energy Efficiency and Renewable Energy  
Award Number: DE-EE0008823  
Awarded: August 2019, Start: January 2020.  
Time/Amount: 3 years, \$380,000
2. Title: CAREER: Studies of Chalcogen Bonding-Mediated Assembly towards Porous Crystalline Frameworks, Hierarchical Assemblies and Multicomponent Materials  
Agency: National Science Foundation, Division of Materials Research, Solid State and Materials Chemistry  
Award Number: 2142623  
Awarded: November 2021, Start: January 2022.  
Time/Amount: 5 years, \$760,394
3. Title: Building a Scientific Foundation for a New Generation of Low Energy Adsorptive Separations: Probing the Role of Responsive Structural Flexibility Using Synthetic Porous Frameworks  
Agency: Department of Energy, Basic Energy Sciences, Separation Science, Early Career Research Program (ECRP) Award  
Award Number: DE-SC0024164  
Awarded: May 2023, Start: July 2023.  
Time/Amount: 5 years, \$875,000
4. Title: Plastic Waste to DAC: A Study of the Chemical and Lifecycle Feasibility Converting Polyolefin Waste to Aminopolymers for Direct Air Capture  
Agency: Research Corporation for Science Advancement  
Awarded: December 2023, Start: January 2024  
Time/Amount: 1 year, \$55,000 (10% overhead)
5. Title: Examining the Regeneration Stability of Aminopolymers Under Hydrogen-Rich Streams  
Agency: Fortescue Future Industries  
Awarded: May 2024, Start: June 2024

Time/Amount: 1 year, \$149,818

6. Title: Getting on the Grid: Parallel Nano-Crystallography for Large-Scale Data Generation  
Agency: Research Corporation for Science Advancement  
Awarded: July 2024  
Time/Amount: 1 year, \$66,000 (10% overhead)
7. Title: Understanding the Fundamental Origins of Flexibility in Porous Frameworks to Enable Low-Energy, On-Demand Delivery of Large Payloads of Gaseous Fuels, Oxidants, Propellants, and Therapeutics  
Agency: Army Research Office (ARO), Reactive Chemical Systems  
Award Number: W911NF2410286  
Awarded/Start Date: August 2024/September 2024  
Time/Amount: 3 year, \$597,815.00

### CO-PRIMARY INVESTIGATOR EXTERNAL GRANTS

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1. Title: Solid State Based Hydrogen Loss Recovery During LH<sub>2</sub> Transfer  
Agency: Department of Energy, Office of Energy Efficiency and Renewable Energy, Hydrogen and Fuel Cells Technologies Office (Hydrogen Shot)  
Awarded: September 2023, Start: January 2024  
Time/Amount: 3 years, \$6,000,000
2. Title: PFAS@Mines – A Multi-Scale and Interdisciplinary Center to Address the Environmental Fate, Transport, and Remediation of Per- and Polyfluoro-alkyl Substances (PFASs)  
Agency: ERDC, US Army Corp of Engineers  
Awarded: January 2024, Start: February 2024  
Time/Amount: 4 years, \$498, 849 (5% of \$9,976,998 total)

### CORRESPONDING AUTHOR PUBLICATIONS

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1. Eckstein, B. J.; Martin, H. R.; Moghadasnia, M. P.; Halder, A.; Le Magueres, P.; **McGuirk, C. M.** A Permanently Porous Chalcogen-Bonded Organic Framework, *In Preparation*.
2. Cleary, S. R.; Starace, A. K.; Curran-Velasco, C. C.; Ruddy, D. A.; **McGuirk, C. M.** The Overlooked Potential of Sulfated Zirconia: Reexamining Solid Superacidity Toward the Controlled Depolymerization of Polyolefins, *Langmuir* **2024**, *40*, 6612. **Invited as Part of “Highlights in Interface Science and Engineering: Heterogeneous Catalysis for Polymer Upcycling” Special Issue.**
3. Moghadasnia, M. P.; Eckstein, B. J.; Martin, H. B.; Paredes, J. U.; **McGuirk, C. M.** Towardds the Next Generation of Permanently Porous Materials: Halogen-Bonded Organic Frameworks, *Cryst. Growth Des.* **2024**, *24*, 2304. **Invited Perspective.**
4. Eckstein, B. J.; Martin, H. R.; Moghadasnia, M. P.; Halder, A.; Melville, M. J.; Buzinski, T. N.; Balaich, G. J.; **McGuirk, C. M.** Influence of Donor Point Modifications on the Assembly of Chalcogen-Bonded Organic Frameworks, *Chem. Commun.* **2024**, *60*, 758. **Invited as Part of “2023 Emerging Investigators” Special Issue.**
5. Halder, A.; **McGuirk, C. M.** Exploring the Influence of Linker Substitution and Ratios on Cooperative Framework Flexibility Through the Mixed-Linker Approach, *Cryst. Growth*

*Des.* **2024**, *24*, 1200. Invited as Part of “Lattice Dynamics” Special Issue.

- Bingel, L. W.; Klein, R. A.; Halder, A.; Carter, M.; Trump, B. A.; Bloch, E. D.; Zhou, W.; Walton, K. S.; Brown, C. M.; **McGuirk, C. M.** A Dynamic and Inversely Selective Metal–Organic Framework for Record Propane/Propylene Separations, *J. Am. Chem. Soc.* **2023**, *145*, 21955.
- Moghadasnia, M. P.; Eckstein, B. J.; Balaich, G. J.; **McGuirk, C. M.** Assembly of Multi-Dimensional Molecular Networks through Self Complementary Halogen-Bonded Tectons, *Cryst. Growth Des.* **2023**, *23*, 5066.
- Halder, A.; Klein, R.A.; Shulda, S.; McCarver, G. A.; Parilla, P. A.; Furukawa, H.; Brown, C. M.; **McGuirk, C. M.** A Multivariate Flexible Framework with High Usable Hydrogen Capacity in a Reduced Pressure Swing Process, *J. Am. Chem. Soc.* **2023**, *145*, 8033.
- Halder, A.; Klein, R.A.; Lively, R.; **McGuirk, C. M.** A Family of Multivariate Frameworks with an Inverting Trend in Flexibility and Adsorption Pressure Threshold, *Chem. Commun.* **2022**, *58*, 11394.
- Eckstein, B. J.; Brown, L. C.; Noll, B.; Moghadasnia, M.; Balaich, G. J.; **McGuirk, C. M.** A Porous Chalcogen- Bonded Organic Framework, **2021**, *J. Am. Chem. Soc.* **2021**, *143*, 20207.
- Klein, R. A.; Shulda, S.; Parilla, P. A.; Le Magueres, P.; Richardson, R. K.; Morris, W.; Brown, C. M.; **McGuirk, C. M.** Structural and Mechanistic Insight into Hydrogen Adsorption in Flexible Framework ZIF-7. *Chem. Sci.* **2021**, *12*, 15620.
- McGuirk, C. M.**; Bazilian, M. D.; Kammen, D. Mining Plastic: Harvesting Stored Energy in a Re-use Revolution. *One Earth.* **2019**, *1*, 392.

#### PRIMARY AUTHOR PUBLICATIONS

- McGuirk, C. M.**; Runčevski, T.; Oktawiec, J.; Turkiewicz, A.; Taylor, M.; **Long, J. R.** Influence of Metal Substitution on the Pressure-Induced Phase Change in Flexible Zeolitic Imidazolate Frameworks. *J. Am. Chem. Soc.* **2018**, *140*, 15924.
- McGuirk, C. M.**; Siegelman, R. L.; Drisdell, W. S.; Runčevski, T.; Milner, P. J.; Oktawiec, J.; Wan, L. F.; Su, G. M.; Jiang, H. Z. H.; Reed, D. A.; Gonzalez, M. I.; Prendergast, D.; **Long, J. R.** Cooperative Adsorption of Carbon Disulfide in Diamine-Appended Metal–Organic Frameworks. *Nat. Commun.* **2018**, *9*, 5133.
- McGuirk, C. M.**; Mendez-Arroyo, J.; d’Aquino, A. I.; Stern, C. L.; **Mirkin, C. A.** A Concerted Two-Prong Approach to the *in Situ* Allosteric Regulation of Bifunctional Catalysis. *Chem. Sci.* **2016**, *7*, 6674.
- McGuirk, C. M.**; Katz, M. J.; Stern, C. L.; Sarjeant, A. A.; Hupp, J. T.; Farha, O. K.; **Mirkin C. A.** Turning on Catalysis: Incorporation of a Hydrogen Bond Donating Squaramide Moiety into a Zr-Metal-Organic Framework. *J. Am. Chem. Soc.* **2015**, *137*, 919.
- McGuirk, C. M.**; Mendez-Arroyo, J.; Lifschitz, A. M.; **Mirkin, C. A.** Allosteric Regulation of Supramolecular Oligomerization and Catalytic Activity via Coordination-Based Control of Competitive Hydrogen Bonding Events. *J. Am. Chem. Soc.* **2014**, *136*, 16594.
- McGuirk, C. M.**; Stern, C. L.; **Mirkin, C. A.** Small Molecule Regulation of Self-Association and Catalytic Activity in a Supramolecular Coordination Complex. *J. Am. Chem. Soc.* **2014**, *136*, 4689.

#### SECONDARY AUTHOR PUBLICATIONS

- Massimi, S. E.; Metzger, K. E.; **McGuirk, C. M.**; Trewyn, B. G. Best Practices in the Characterization of MOF@MSN Composites. *Inorg. Chem.* **2022**, *61*, 4219.

- Mao, V. Y.; Milner, P. J.; Lee, J.-H.; Forse, A. C.; Kim, E. J.; Siegelman, R. L.; **McGuirk, C. M.**; Porter-Zasada, L.; Neaton, J. B.; Reimer, J. A.; Long, J. R. Cooperative Carbon Dioxide Adsorption in Alcoholamine- and Alkoxyalkylamine-Functionalized Metal–Organic Frameworks. *Angew. Chem. Int. Ed.*, **2020**, *59*, 2.
- Wang, S.; **McGuirk, C. M.**; d’Aquino, A. I.; Mason, J. A.; Mirkin, C. A. Metal–Organic Framework Nanoparticles. *Adv. Mater.* **2018**, *30*, 1800202.
- d’Aquino, A. I.; Cheng, H. F.; Barroso-Flores, J.; Kean, Z. S.; Mendez-Arroyo, J.; **McGuirk, C. M.**; Mirkin, C. A. An Allosterically Regulated, Four-State Macrocyclic. *Inorg. Chem.* **2018**, *57*, 3568.
- Wang, S.; **McGuirk, C. M.**; Ross, M. B.; Wang, S.; Chen, P.; Xing, H.; Liu, Y.; Mirkin, C. A. General and Direct Method for Preparing Oligonucleotide-Functionalized Metal–Organic Framework Nanoparticles. *J. Am. Chem. Soc.* **2017**, *139*, 9827.
- Shahjamali, M. M.; Zhou, Y.; Zeraee, N.; Xue, C.; Wu, J.; Large, N.; **McGuirk, C. M.**; Boey, F.; Dravid, V.; Schatz, G. C.; Mirkin, C. A. Ag-Ag<sub>2</sub>S Hybrid Nanoprisms: Structural vs. Plasmonic Evolution. *ACS Nano* **2016**, *10*, 5362.
- Lifschitz, A. M.; Young, R. M.; Mendez-Arroyo, J.; **McGuirk, C. M.**; Wasielewski, M. R.; Mirkin, C. A. Cooperative Electronic- and Structural-Regulation in a Bioinspired Allosteric Photoredox Catalyst. *Inorg. Chem.* **2016**, *55*, 8301.
- Wang, S.; Morris, W.; Liu, Y.; **McGuirk, C. M.**; Zhou, Y.; Hupp, J. T.; Farha, O. K.; Mirkin, C. A. Surface-Specific Functionalization of Nanoscale Metal–Organic Frameworks. *Angew. Chem. Int. Ed.* **2015**, *54*, 14738.
- Lifschitz, A. M.; Rosen, M. S.; **McGuirk, C. M.**; Mirkin, C. A. Allosteric Supramolecular Coordination Constructs. *J. Am. Chem. Soc.* **2015**, *137*, 7252.
- Lifschitz, A. M.; Young, R. M.; Mendez-Arroyo, J.; Stern, C. L.; **McGuirk, C. M.**; Wasielewski, M. R.; Mirkin, C. A. An Allosteric Photoredox Catalyst Inspired by Photosynthetic Machinery. *Nat. Comm.* **2015**, *6*, 6541.
- Lifschitz, A. M.; Young, R. M.; Mendez-Arroyo, J.; Roznyatovskiy, V. V.; **McGuirk, C. M.**; Wasielewski, M. R.; Mirkin, C. A. Chemically Regulating Rh(I)-Bodipy Photoredox Switches. *Chem. Comm.* **2014**, *50*, 6850.
- Kennedy, R. D.; Machan, C. W.; **McGuirk, C. M.**; Rosen, M. S.; Stern, C. L.; Sarjeant, A. A.; Mirkin, C. A. General Strategy for the Synthesis of Rigid Weak-Link Approach Platinum(II) Complexes: Tweezers, Triple-Layer Complexes, and Macrocycles. *Inorg. Chem.* **2013**, *52*, 5876.
- Dickey, D. M.; Barbieri, K. A.; **McGuirk, C. M.**; Potter, L. R. Arg 13 of B-Type Natriuretic Peptide Reciprocally Modulates Binding to Guanylyl Cyclase but not Clearance Receptors. *Mol. Pharmacol.* **2010**, *78*, 431.

## PATENTS

- Hodge, C. A.; **McGuirk, C. M.**; Blattner, A. R.; Notermann, C. L. Sprayable Aqueous Chlorine-Based Cleaning Compositions with Reduced Misting. PCT Int. Appl., WO 2015123324 A1 20150820, **2015**.
- Hodge, C. A.; **McGuirk, C. M.**; Levitt, M. D.; Larson, D.; Kiesel, E.; Blattner, A. R. Development of Extensional Viscosity for Reduced Atomization for Diluted Concentrate Sprayer Applications. PCT Int. Appl., WO 2013043699 A2 20130328, **2013**.
- Hodge, C. A.; Blattner, A. R.; Kohnke, T. J.; Levitt, M. D.; Marquardt, J. E.; **McGuirk, C. M.**; Silvernail, C. M.; Larson, D. Bio-Based Glass Cleaner and Forming Use Solution. U.S. Pat. Appl. Publ. 20130255719 A1 20131003, **2013**.

## SELECT LEADERSHIP AND OUTREACH ACTIVITIES

- 2022 – 2023 Organizer for Telluride Research Workshop**
- Initiated and organized a workshop as part of the Telluride Science and Innovation Center, bringing together 30 of the foremost scientists on porous materials to discuss the importance of studying atomic-level structure in extended lattice materials.
- 2022 – 2023 University Public Policy Fellow**
- Participated in an 8-month course on developing skills for communicating scientific ideas and concepts to the public and government officials.
- 2022 – Now Early Career Editorial Board at the *Journal of Physics and Chemistry of Solids***
- Serve as an associate editor at the journal, managing paper submissions, peer reviews, and themed issues.
- 2020 – 2021 Co-Organizer for the International Conference on the Fundamentals of Adsorption (FOA 14)**
- Served as a local liaison for planning committee for global conference taking place in Colorado.
- 2020 – 2021 Organizer for Front Range Inorganic Colloquium**
- Initiated and organized a virtual workshop for inorganic chemistry in the Colorado Front Range region, with talks from faculty, post-doctoral researchers, and graduate students.
- 2020 – 2022 Cientifico Latino Graduate Student Mentor**
- Mentor a college senior from a underrepresented minority through the application process for graduate school, including proofreading application materials.
- 2018 – 2020 Skype a Scientist Participant**
- Hold question and answer sessions about my research and general science with 10<sup>th</sup>–12<sup>th</sup> grade classes in schools in Hawaii and Alberta, Canada.

#### SELECT EXTERNAL PRESENTATIONS

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1. “Influence of donor point modifications on the Assembly of chalcogen-bonded organic frameworks” *American Chemical Society National Meeting*, August 19, 2024, Denver, CO, **invited speaker**.
2. “Exploring the influence of linker substitution and ratios on cooperative framework flexibility through the mixed-linker approach”, *American Chemical Society National Meeting*, August 18, 2024, Denver, CO, **invited speaker**.
3. “Exploring Function and Form in Synthetic Porous Frameworks”, Cornell University, March 26, 2024, **invited speaker**.
4. “Exploring Function and Form in Synthetic Porous Frameworks”, Rochester University, March 25, 2024, **invited speaker**.
5. “Studies of Sulfated Zirconia Towards Low-Energy Polyolefin Depolymerization”, *American Chemical Society National Meeting*, March 19, 2024, New Orleans, LA, **invited speaker**.
6. “Exploring Function and Form in Synthetic Porous Frameworks”, Rice University, March 13, 2024, **invited speaker**.
7. “Exploring Function and Form in Synthetic Porous Frameworks”, Northwestern University, February 29, 2024, **invited speaker**.
8. “Exploring Function and Form in Synthetic Porous Frameworks”, University of California–San Diego, February 9, 2024, **invited speaker**.

9. “Exploring Function and Form in Synthetic Porous Frameworks”, University of California–Los Angeles, February 6, 2024, **invited speaker**.
10. “Exploring Function and Form in Synthetic Porous Frameworks”, University of Southern California, February 5, 2024, **invited speaker**.
11. “Exploring Function and Form in Synthetic Porous Frameworks”, University of Houston, January 30, 2024, **invited speaker**.
12. “Exploring Function and Form in Synthetic Porous Frameworks”, University of Oregon, January 19, 2024, **invited speaker**.
13. “Exploring Function and Form in Synthetic Porous Frameworks”, University of Wisconsin–Madison, December 7, 2023, Madison, WI, **invited speaker**.
14. “Exploring Function and Form in Synthetic Porous Frameworks”, University of Minnesota–Twin Cities, November 6, 2023, Minneapolis, MN, **invited speaker**.
15. “Exploring Function and Form in Synthetic Porous Frameworks”, University of Virginia, October 27, 2023, Charlottesville, VA, **invited speaker**.
16. “Exploring Function and Form in Synthetic Porous Frameworks”, Colorado State University, October 24, 2023, Fort Collins, CO, **invited speaker**.
17. “Exploring Function and Form in Synthetic Porous Frameworks”, University of California–Berkeley, October 20, 2023, Berkeley, CA, **invited speaker**.
18. “Exploring Function and Form in Synthetic Porous Frameworks”, University of Notre Dame, October 6, 2023, South Bend, IN, **invited speaker**.
19. “Exploring Function and Form in Synthetic Porous Frameworks”, Purdue University, October 5, 2023, West Lafayette, IN, **invited speaker**.
20. “Exploring Function and Form in Synthetic Porous Frameworks”, University of Colorado–Boulder, September 25, 2023, Boulder, CO, **invited speaker**.
21. “Exploring Function and Form in Synthetic Porous Frameworks”, Michigan State University, September 14, 2023, Lansing, MI, **invited speaker**.
22. “Exploring Function and Form in Synthetic Porous Frameworks”, Wayne State University, September 15, 2023, Detroit, MI, **invited speaker**.
23. “A Multivariate Flexible Framework with High Usable Hydrogen Capacity in a Reduced Pressure Swing Process” *American Chemical Society National Meeting*, August 13, 2023, San Francisco, CA, **invited speaker**.
24. “A Porous Chalcogen-Bonded Framework” *Harry Gray Young Investigator Award Symposium, American Chemical Society National Meeting*, March 27, 2023, Indianapolis, IN, **invited speaker**.
25. “Exploring Function and Form in Synthetic Porous Frameworks”, Texas Tech University, March 1, 2023, Lubbock, TX, **invited speaker**.
26. “A Porous Chalcogen-Bonded Framework” *North American Supramolecular Chemistry Conference 2022*, December 19, 2022, **invited speaker**.
27. “Adsorption in Flexible Frameworks” *Materials Research Society Fall Meeting*, December 1, 2022, Boston, MA, **invited speaker**.
28. “Exploring Function and Form in Synthetic Porous Frameworks” *Abraham Clearfield Student Invited Seminar in Inorganic Chemistry*, Texas A&M University, September 14, 2022, College Station, TX, **invited speaker**.
29. “A Porous Chalcogen-Bonded Framework” *American Chemical Society Southwest Regional Meeting*, November 1, 2021, Austin, TX, **invited speaker**.
30. “Synthetic Porous Frameworks: Connectivity-Dependent Discovery and Application” University of Denver, September 23, 2021, Denver, CO, **invited speaker**.

## AWARDS

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- Thieme Chemistry Journal Award (2024)
- Scialog<sup>®</sup> Fellow for Automating Chemical Laboratories (2024)
- DOE Early Career Research Program Award (2023)
- Scialog<sup>®</sup> Fellow for Negative Emissions Science (2022)
- President's Award for Excellence in Safety (2022)
- University Public Policy Fellow (2022)
- NSF CAREER (2021)
- DOE EFRC Ten at Ten Award Contributor (2019)
- Philomathia Postdoctoral Fellowship (2016)
- Representative of the Lindau Nobel Laureate Meeting (2015)