Dr. Daniel A. Moreno

Assistant Professor, Mechanical Engineering
Cooperative Engineering Program at Missouri State University
PCTR 2021G · 405 N. Jefferson Ave. · Springfield, MO 65897
417-837-2329 · danielmoreno@missouristate.edu

Adjunct Assistant Professor, Mechanical & Aerospace Engineering (Courtesy Appointment)
Missouri University of Science and Technology
573-341-4002 · danielmoreno@mst.edu

I. EDUCATION/PROFESSIONAL DEVELOPMENT

Previous Positions Held:

Postdoctoral Scholar, University of Kentucky Center for Applied Energy Research *5/2019 – 7/2021*
Graduate Research Assistant, Georgia Institute of Technology *3/2016 – 5/2019*
Graduate Teaching Assistant, Georgia Institute of Technology *1/ 2015 – 12/2016*
Undergraduate Research Assistant, Olin College of Engineering *6/2013 – 8/2013*

Education:

Georgia Institute of Technology, Atlanta, GA
Ph.D., Mechanical Engineering *5/2019*
Thesis Title: Thermodynamics of Electrosorption-Based Separation Processes and Cycles
Advisor: Dr. Marta Hatzell
M.S., Mechanical Engineering *12/2015*
The Cooper Union for the Advancement of Science and Art, New York, NY
B.Eng., Mechanical Engineering *5/2014*

II. RESEARCH

Ongoing Research:

- Director of research in engineering and related sciences pertaining to electrochemical technologies.
- Current primary focus topics are on electrochemical energy storage and CO_2 conversion.

Student Advising:

Graduate:

- Niklas Landgraf (Materials Science) (Co-advised with Dr. David Cornelison) *Jun 2022 – Present*
- David Iyodo (Materials Science) *Feb 2023 - Present*

Undergraduate:

- Joshua Cox (Mechanical Engineering) *Jan 2022 – May 2023*
- Ana Torres (Mechanical Engineering) (Co-advised with Dr. Tayo Obafemi-Ajayi) *Jan 2022 – May 2023*
- Pablo Skaggs (Mechanical Engineering) *Feb 2022 – Present*
- Devon Parker (Mechanical Engineering) *May 2022 – May 2023*
- Joe Cota (Mechanical Engineering/Physics Dual Degree) *May 2023 – Present*
- Gavin Reese (Mechanical Engineering/Physics Dual Degree) *May 2023 – Present*
- Grant Cary (Mechanical Engineering) *May 2023 – Aug 2023*
- Hunter Nelson (Physics) *May 2023 – Present*
- Emily Rapp (Physics) *Aug 2023 - Present*

Publications:

13. Moreno, D., Thompson, J., Omosebi, A., Abad, K., Liu, K. "Theoretical Performance Optimization of Enzymatic Electrochemical CO2 Reduction to Formate: Voltage, Concentration, Temperature, Pressure, and Flow Rate." *Journal of CO2 Utilization.* Submitted 10 Jan. 2024.

12. Moreno, D., Thompson, J., Omosebi, A., Abad, K., Liu, K. "Optimization of Design and Operating Parameters in a Dual-Cell Flow System for Electrochemical CO_2 to Formate Conversion Using Engineered Enzymatic Catalysts." *Manuscript Completed, Undergoing Internal Review.*

11. Moreno, D., Omosebi A, Jeon BW, Abad K, Kim YH, Thompson J, Liu K. Electrochemical CO2 conversion to formic acid using engineered enzymatic catalysts in a batch reactor. *Journal of CO2 Utilization*. 2023 Apr 1;70:102441.

10. Naser, M., Thompson, J., **Moreno, D.**, Abad, K., Omosebi, A., Wook Joen, B., Kim, Y.H., Liu, K. "Electrochemical Reduction of Carbon Dioxide to Formic Acid: The Life Cycle Assessment Study." Environmental Science & Technology. *Submitted Jun. 2022*.

9. Moreno, D., Thompson J, Omosebi A, Landon J, Liu K. Electrochemical analysis of charge mediator product composition through transient model and experimental validation. *Journal of Applied Electrochemistry*. 2022 Nov;52(11):1573-84.7.

8. Thompson, J., Omosebi, A., **Moreno, D.**, Matin, N., Abad, K., Liu, K. An Intensified Electro-Catalytic Process for Production of Formic Acid from Power Plant CO2 Emissions: Final Technical Report. *University of Kentucky Research Foundation*; 2022 Apr 1.

7. Moreno, D., Hatzell, M. C. (2019). Constant chemical potential cycles for capacitive deionization. Physical Chemistry Chemical Physics, 21(44), 24512-24517.

6. Moreno, D., Hatzell, M. C. (2019). Efficiency of Thermally Assisted Capacitive Mixing and Deionization Systems. ACS Sustainable Chemistry & Engineering, 7(13), 11334-11340.

5. Dixit, M. B., **Moreno, D.**, Xiao, X., Hatzell, M. C., Hatzell, K. B. (2019). "Mapping charge percolation in flowable electrodes used in capacitive deionization." *ACS Materials Letters*, *1*(1), 71-76.

4. Moreno, D., Bootwala, Y., Tsai, W. Y., Gao, Q., Shen, F., Balke, N., Hatzell, K. B., Hatzell, M. C. (2018). "In situ electrochemical dilatometry of phosphate anion electrosorption." Environmental Science & Technology Letters, 5(12), 745-749.

3. Gunawan, A., Simmons, R. A., Haynes, M. W., **Moreno, D.**, Menon, A. K., Hatzell, M. C., Yee, S. K. (2019). "Techno-economics of cogeneration approaches for combined power and desalination from concentrated solar power." Journal of Solar Energy Engineering, 141(2).

2. Moreno, D., Hatzell, M. C. (2018). "Efficiency of Carnot and conventional capacitive deionization cycles." The Journal of Physical Chemistry C, 122(39), 22480-22486.

1. Moreno, D., Hatzell, M. C. (2018). "Influence of feed-electrode concentration differences in flow-electrode systems for capacitive deionization." Industrial & Engineering Chemistry Research, 57(26), 8802-8809.

Grants, Contracts, and Related Sponsored Research:

8. Ghosh, K., Santra, S., Moreno, D, Besara, T. MRI: Acquisition of a Physical Properties Measurement System for Research and Education ($643,620). *Submitted Nov. 2023, Under Review.*

7. Moreno, D. Evaluating Effectiveness of Acidic Solution in Anode for Electrochemical Chemical Conversion of CO2 from Petroleum-Derived Processes ($69,928.00). American Chemical Society Petroleum Research Fund. *Submitted Sep. 2023. Under Review.*

6. Moreno, D. ERI: Towards Net-Zero Emissions: Engineering Photoelectrochemical CO2 Reduction Using Available Temperature and Pressure Variations ($199,937.57). National Science Foundation Grant aimed at initiating research programs for engineering faculty in non-R1 institutions. *Submitted Sep. 2023. Under Review.*

5. Moreno, D. Large Temperature-Range Computational Modeling to Predict Lithium Ion Battery Performance. NASA Missouri Space Grant Consortium Affiliates. *Awarded Sep. 2023.*

4. Moreno, D. ERI: Exploring the Physical and Theoretical Limits of Electrosorption-Based Electrodes for Capacitive Deionization and Capacitive Mixing ($198,886). National Science Foundation Grant aimed at initiating research programs for engineering faculty in non-R1 institutions. *Rejected Mar. 2023.*

3. Cornelison, D**., Moreno, D.** Ni/Zn Battery gas evolution under operational conditions ($10,646). Private Contract, Sponsored by Aesir Technologies. Applied May 2022, *Received Jun. 2022*.

2. MSU 2023 Summer Faculty Fellowship ($6000 stipend). Applied Oct. 2022, *Awarded Dec. 2022*.
1. MSU International Travel Grant Award ($1000). Submitted March 2022, Awarded May 2022.

Patents:

1. Thompson, J., Liu, K., Widger, L., **Moreno, D.**, Omosebi, A, Landon, J. "Method and apparatus of a dual cell electrochemical reactor." *Patent Application Filed Sep. 2021*.

Invited Talks:

3. Moreno, D. "Thermodynamic Analogies for Salt Water Mixing and Desalination Processes." *Presented to Department of Mechanical Engineering, Missouri University of Science & Technology*. Apr. 2023.
2. Moreno, D. "Exploring the Limits of Electrosorption-Based Electrodes for Capacitive Deionization Using Thermodynamic Principles." *Presented to Department of Chemical and Biomedical Engineering, University of Missouri - Columbia*. Oct. 2022. *Presented to Department of Physics, Astronomy, Materials Science, Missouri State University*. Nov. 2022.
1. Moreno, D. "Employing Thermodynamics Principles to Optimize Electrochemical Capacitor Performance: Capacitive Mixing & Deionization". *Presented to Department of Chemistry, Missouri State University*. Sep. 2021.

Conference Poster/Oral Presentations:

25. Nelson, H., Cary, G., **Moreno, D.** "Experimentally Investigating the Thermodynamic Adsorption Limits of Carbon-Based Electrodes for Capacitive Deionization (CDI)". *March Meeting of the American Physical Society (APS)*. Poster Presentation. Submitted Oct. 2023.
24. Moreno, D, Skaggs, P., Parker, D. "Evaluating the Limits of Electrosorption-Based Electrodes for Capacitive Deionization Using Thermodynamic Principles." *ASME International Mechanical Engineering Congress & Exhibition (IMECE)*. Nov. 2023.
23. Moreno, D. "Employing Variable Current/Voltage Control Schemes to Develop Carnot-Analogous Mixing Engines for Salinity Gradient Energy Extraction." *Proceedings of the ASME 2023 Power Conference*. Aug. 2023.
22. Landgraf, N., Mandava, P., Cox, J., Skaggs, P., Cornelison, D., **Moreno, D**. "Gas Evolution Characterization of NiZn Batteries with Residual Gas Analysis." Poster Presentation. *Proceedings of the 241st Electrochemical Society Meeting,* May 2023.
21. Moreno, D., Omosebi, A., Landon, J., Thompson, J., Liu, K. "A Computational Model to Optimize the Electrochemical Reduction of CO_2 to Formic Acid Using an Enzymatic Catalyst". *Proceedings of the 241st Electrochemical Society Meeting,* May 2023.
20. Torres, A., **Moreno, D.**, Obafemi-Ajayi, T. "The Effect of Different Types of Charging Cycles and Composition on the Aging of Li-Ion Batteries for Electric Vehicles." *Presented at Spring 2023 MSU Undergraduate Research Symposium*. Apr. 2023.
19. Cox, J, Moreno, D.. "Electrochemical Carbon Dioxide Reduction and Formic Acid Production." *Presented at Spring 2023 MSU Undergraduate Research Symposium*. Apr. 2023.
18. Landgraf, N., Mandava, P., Moreno, D., Cornelison, D. "Characterization of Ni-Zn Cell Gassing at Various Charge Rates with an RGA". *2023 MOCAP Research Symposium*, Mar. 2023.
17. Torres, A., Cox, J., **Moreno, D.**, Obafemi-Ajayi, T. "The Effect of Different Types of Charging Cycles and Composition on the Aging of Li-Ion Batteries for Electric Vehicles". *Emerging Researchers National Conference*, Feb. 2023, *2023 MOCAP Research Symposium*, Mar. 2023.
16. Thompson, J., Matin, N., Omosebi, A., **Moreno, D.**, Abad, K., Liu, K. Electrochemical CO_2 conversion to formic acid through the Andora Process. Available at SSRN 4274371. *16th International Conference on Greenhouse Gas Control Technologies, GHGT-16* 2022 Nov 10.
15. Cox, J., Torres, A., Obafemi-Ajayi, T., and **Moreno, D.** "Design & Development of a Capacitive Deionization Unit for Evaluating Electrode Storage Limits." *Presented at Spring 2022 MSU Undergraduate Research Symposium*. May 2022.

14. Landgraf, N., Cornelison, D., Skaggs, P., Cox, J., and **Moreno, D.** "Analysis of the Gas Evolution of a Nickel-Zinc Cell with Mass Spectrometry." *2022 MOCAP Research Symposium*. Mar. 2022.
13. Moreno, D., Omosebi, A., Landon, J., Thompson, J., Liu, K. "Kinetic and Product Composition Studies of 9,10-Anthraquinone-2,7-Disulfonic Acid: Correlating Transient/Steady-State Modeling with Experimental Analysis." *241st Electrochemical Society Meeting,* Jun. 2022.
12. Moreno, D. "Using Temperature Variations to Demonstrate Analogous Carnot Heat Engines for Salinity Gradient Energy via Capacitive Mixing." *Proceedings of the ASME 2022 Power Conference*. Jul. 2022.
11. Thompson, J., **Moreno, D.**, Omosebi, A., Abad, K., Liu, K. "Electrochemical CO2 Conversion to Formic Acid: Optimization of Production & Efficiency Via Operating Voltage Tuning and pH Regulation." Proceedings of the AIChE 2021 Annual Meeting. Nov. 2021.
10. Moreno, D., "Thermodynamic Evaluation of Electrode Storage for Capacitive Deionization Via Adsorption Isotherms." 5th International Conference on Capacitive Deionization & Electrosorption (CDI&E). May 2021.
9. Moreno, D., Omosebi, A., Abad, K., Jeon, B.W., Landon, J., Liu, K., Kim, Y. H., and Thompson, J. "Electrochemical utilization of CO2 from coal power plants" 15th International Conference on Greenhouse Gas Control Technologies, GHGT-15, 15 Mar. 2021.
8. Moreno, D., Omosebi, A., Abad, K., Thompson, J., Liu, K. "Electrochemical CO_2 Utilization: Scalable System Operation for Formic Acid Production." Proceedings of the AIChE 2020 Annual Meeting. Nov. 2020.
7. Moreno, D., Omosebi, A., Abad, K., Thompson, J., Liu, K. "Carbon Utilization: Electrochemical Approach Using Novel Catalyst and System Integration." Presented at 8th Annual Oak Ridge Postdoctoral Association Research Symposium. Jul. 2020.
6. Moreno, D., Hatzell, M. "Using Thermodynamics Principles to Optimize Performance of Capacitive Mixing Cycles for Salinity Gradient Energy Generation." Proceedings of the ASME 2019 Power Conference. Jul. 2019. Snowbird, UT, USA.
5. Dixit, M., **Moreno, D.**, Hatzell K., Hatzell, M. "Evaluating Microstructure and Transport within Flow Electrodes for Capacitive Deionization." In Meeting Abstracts. Jul. 2019 (No. 27, pp. 911-911). The Electrochemical Society.
4. Moreno, D., Hatzell M. "Evaluating the Theoretical Efficiency of Capacitive Deionization (CDI) Cycles." Dow BEST (Building Engineering Science and Talent) Symposium. Sep. 2018.
3. Moreno, D., Hatzell M. "Addressing Thermodynamic and Transport Limitations in Capacitive Deionization." Georgia Tech Electrochemical Society Local Conference. May 2018.
2. Hatzell, K,, Hatzell, M,, Dixit, M., **Moreno, D**. "Toward energy-neutral and decentralized water re-use with flow-electrode capacitive deionization." In Abstracts of Papers of the American Chemical Society. Apr. 2017 (Vol. 253).
1. Stein, L., Aragon, D., **Moreno, D**., Goodman, J. "Evidence for the persistent effects of an intervention to mitigate gender-stereotypical task allocation within student engineering teams". Proceedings of the IEEE Frontiers in Education Conference, Nov. 2014.

III. TEACHING

Teaching Experience:

Primary Instructor, Thermodynamics *Missouri State University*
Primary Instructor, Applied Thermodynamics *Missouri State University*
Primary Instructor, Heat Transfer *Missouri State University*

– Developed classes for MSU's Co-op Mechanical Engineering Program. Curriculum adapted and corresponding degree awarded from Missouri University of Science & Technology (MS&T).

Training in Teaching:

Annual Teaching & Learning Showcase *Missouri State University*

– Attended talks, workshops, and networked with other faculty on teaching methods at MSU's annual showcase hosted by the Faculty Center for Teaching & Learning.

Innovation in Teaching & Learning Conference *Missouri Institute of Science & Technology*

– Attended virtual talks to integrate course content developed with the student curriculum at MS&T.

IV. SERVICE

Committees:

ASME Renewable Energy System Committee *Jul. 2022 - Present*

– Planning and development of future conferences with the ASME POWER division.

PAMS Graduate Student Committee *May 2022 - Present*

– Contributing to the recruitment and review of graduate students in the Materials Science program.

CNAS Scholastic Appeals Committee *Jan. 2022 - Present*

– College-wide committee evaluating students on academic probation.

Peer Review:

– Reviewed proceedings papers for the ASME POWER Conference in 2023.
– Submitted two paper reviews for the American Chemical Society (ACS) during 2021.
– Submitted three conference paper reviews for ASEE Midwest Regional Conference in 2022 and 2023.
– Submitted paper reviews for Journal of Colloid and Interface Science and Electrochemical Society in 2023.

Community Activities:

Mechanical Engineering Industry Seminar Series *Missouri State University*

– Worked with students to organize industry-led seminars to provide students career opportunities.

Team Advisor, Ozark Mountain Racing *Missouri State University*

– Contributed to help start MSU's Formula SAE (Society for Automotive Engineers) team.

Volunteer Judge, Ozarks Science and Engineering Fair *Missouri State University*

– Scored and evaluated physics and engineering related projects for high school students.

Project Leader, Regional Science Olympiad *Missouri State University*

– Project leader for student teams at the middle school level on the fundamentals of waves.
– Developed a questionnaire along with three lab-based modules.

Leadership Positions:

President, American Society for Engineering Education (ASEE) *Georgia Tech*
Vice President, Mechanical Engineering Graduate Association (MEGA) *Georgia Tech*
Co-Head Teaching Assistant, Creative Decisions and Design *Georgia Tech*
Outreach Coordinator, Pi Tau Sigma *Cooper Union*

Professional Organizations

ECS, The Electrochemical Society *9/2017*
ASEE, American Society for Engineering Education *10/2016*
Order of the Engineer *4/2014*
Pi Tau Sigma, Mechanical Engineering Honor Society *4/2013*
ASME, American Society of Mechanical Engineers *4/2012*