

RACHEL N. GAINES, PH.D.

(937) 760-3045 | gainesrn@ornl.gov | ORCID: 0000-0003-1953-0194

EDUCATION AND TRAINING

Postdoctoral Research Associate, Oak Ridge National Laboratory August 2025 – present
Radioisotope Science and Technology Division, Isotope Science and Engineering Directorate
Note: some export-controlled research not publicly available

Ph.D., University of Illinois Urbana-Champaign August 2025
Department of Chemical and Biomolecular Engineering
Advisor: Paul J.A. Kenis | Lab manager (2022 – 2025)
Thesis: Flow Electrooxidation of Glycerol for Industrial-Scale Applications

B.S., Appalachian State University August 2019
Department of Geological and Environmental Sciences, *summa cum laude*

RESEARCH INTERESTS

Electrochemical reaction engineering for electrocatalytic upgrading of complex feedstocks
Mechanistic analysis of multi-reactant interfaces
High-throughput assessment of composition-performance relationships
Reaction system design, integration, and technology transfer

SELECTED HONORS AND AWARDS

Distinguished Young Scholars Seminar, University of Washington	2026
WiscProf Future Faculty Program, University of Wisconsin–Madison	2026
Your Science in a Nutshell competition finalist, Oak Ridge National Laboratory	2026
URA Research Fellow, Sandia National Laboratories	2024
Best Practice in Communication, Society of Women Engineers	2023
TechnipFMC Research Fellow, University of Illinois Urbana-Champaign	2023
NCAA Woman of the Year nominee, Appalachian State University	2020
Provost's Fellow, Appalachian State University	2019
Hirschvogel Foundation Fellow, Appalachian State University	2019
Outstanding Leadership in Environmental Science, Appalachian State University	2019
Outstanding Junior in Environmental Science, Appalachian State University	2018
Goalkeeper, USA Field Hockey national team	2017 – 2021

PUBLICATIONS

12 total publications: 6 first-author & 2 corresponding-author

*: equal contributions | ^: corresponding

Peer-reviewed

1. Sibál, A.P.; **Gaines, R.N.**; Friel, B.E.; Kenis, P.J.A.; Stillwell, A.S. Turning waste into value: Technoeconomic analysis and life cycle assessment of biodiesel-derived crude glycerol electrooxidation. *Environmental Science & Technology*, 2026. DOI: 10.1021/acs.est.5c16857

2. Zhao, Y.; **Gaines, R.N.**; Rojas, J.; Romo, A.I.B.; Kenis, P.J.A.; Rodriguez-Lopez, J. Valorization of glycerol through 2,2,6,6-tetramethyl-1-piperidine-N-oxyl (TEMPO)-catalyzed electrochemical oxidation with high C3 product selectivity: Impact of stirred bulk versus flow electrolysis. *ChemElectroChem*, 2025. DOI: 10.1002/celec.202500337
3. **Gaines, R.N.**; Sibál, A.P.; Bradley, A.M.; Griebler, J.J.; Shah, V.M.; Friel, B.E.; Rogers, S.A.; Stillwell, A.S.; Kenis, P.J.A. Electrolysis for valorization of industrially-sourced crude glycerol. *ACS Sustainable Chemistry & Engineering*, 2025. DOI: 10.1021/acssuschemeng.5c03028
4. Harris, L.C.; **Gaines, R.N.**; Hua, Q.; Lindsay, G.S.; Griebler, J.J.; Kenis, P.J.A.; Gewirth, A.A. Effect of glycerol concentration on rate and product speciation for Ni and Au-based catalysts. *Physical Chemistry Chemical Physics*, 2025. DOI: 10.1039/D4CP04013A
5. **Gaines, R.N.**[^]; LaFond, J.A.; Krawchuck, J.A.; Bays, N.R.; Kruse, S.M.; Kruichak, J.N. Statistical design of experiments enables rapid exploration of perfluorobutane sulfonate degradation. *ECS Advances*, 2025. DOI: 10.1149/2754-2734/ad865
6. **Gaines, R.N.**[^] Flow electrolyzers for reaction scaling. *Nature Reviews Clean Technology*, 2025. DOI: 10.1038/s44359-024-00003-3
7. **Gaines, R.N.**; Kleimenhagen, B.A.; Griebler, J.J.; Harris, L.C.; Gewirth, A.A.; Rogers, S.A.; Kenis, P.J.A. Optimization of the glycerol electrooxidation reaction using statistical design of experiments. *Journal of the Electrochemical Society*, 2024. DOI: 10.1149/1945-7111/ad537c

In revision/review

8. Kim, J.; Yen, P.Y.; Bradley, A.M.; **Gaines, R.N.**; Kenis, P.J.A.; Zavala, V. Harnessing flexibility from inflexible systems: A case study in electrolysis. In revision, *Industrial & Engineering Chemistry Research*. Preprint: 10.26434/chemrxiv.15001860/v1
9. Woo, H.K.; Lee, B.; **Gaines, R.N.**; Tang, S.; Kenis, P.J.A.; Cai, L. Unbiased tandem system for simultaneous methane and glycerol upgrading to formic acid under ambient conditions. In revision, *Advanced Science*.
10. **Gaines, R.N.**^{*}; Sit, C.Y.^{*}; Shah, V.M.^{*}; Moy, K.K.^{*}; Kenis, P.J.A. Electrocatalytic Valorization of Complex Waste Streams in an Integrated Capture, Scrubbing, and Conversion System. In revision, *Energy & Environmental Science: Catalysis*.

In preparation/submitted

11. [Invited] Stoltz, L.^{*}; **Gaines, R.N.**^{*^} Engineering principles for scaling flow electrolysis. In preparation, *ACS Sustainable Chemistry & Engineering*.
12. Bradley, A.M.; **Gaines, R.N.**; Elayan, H.; Lu, B.; Rios, Y.; Chavez, O.; Kenis, P.J.A. Process-informed assessment of crude glycerol electrooxidation. In preparation.

PROPOSALS & FUNDING

Funded

Sandia National Laboratories URA fellowship proposal	2024
<i>Independently authored before receiving staff scientist support; award rate ~15%</i>	
TechnipFMC fellowship proposal	2023
<i>1-2 awardees per year across STEM disciplines at UIUC</i>	
Appalachian State internal research grant	2019

Submitted & competitive

DOE Pu-238 Supply Program research proposals (2 total)	<i>Submitted</i>
Postdoctoral research proposal, Los Alamos National Laboratory	2025
<i>Awarded; not funded due to FY2025 sponsor constraints</i>	
Pauling Fellowship proposal, Pacific Northwest National Laboratory	2025
<i>Advanced to second round (~10% of submitted proposals)</i>	
<i>Independently authored before receiving staff scientist support</i>	

MENTORING

Directly mentored 3 graduate students and 6 undergraduate students in chemical & nuclear engineering
Managed hiring, onboarding, and mediation for 27 students over 3 years as laboratory manager

Graduate students

Alec Hillier	Fall 2026 – present
<i>Ph.D. student, Nuclear Engineering, University of Tennessee-Knoxville</i>	
Abi Bradley	Fall 2023 – Summer 2025
<i>Ph.D. candidate, Chemical & Biomolecular Engineering, University of Illinois Urbana-Champaign</i>	
<i>Mentored to receive NSF-GRF Honorable Mention, 2024</i>	
Vijay Shah	Spring 2023 – Summer 2025
<i>Ph.D. candidate, Chemical & Biomolecular Engineering, University of Illinois Urbana-Champaign</i>	
<i>Mentored to receive Illinois DFI Fellowship, 2024</i>	

Undergraduate & post-baccalaureate students

Blaine Lu	Spring 2025 – Summer 2025
<i>Ph.D. student, Chemical & Biological Engineering, Northwestern University</i>	
Yasmine Rios	Fall 2024 – Summer 2025
<i>Ph.D. student, Chemical & Biomolecular Engineering, University of Delaware</i>	
<i>Mentored to receive NSF-GRF, 2026</i>	
Hamza Elayan	Fall 2024 – Spring 2025
<i>Chemical engineer, Oxy</i>	
Katharine Moy	Spring 2023 – Spring 2025
<i>Chemical engineer, Kansas City National Security Campus</i>	
Beth Kleimenhagen	Fall 2022 – Summer 2024
<i>Ph.D. candidate, Chemical & Biological Engineering, University of Colorado-Boulder</i>	
Ashrith Keshireddy	Fall 2022 – Spring 2023
<i>Chemical engineer, stealth startup</i>	

PRESENTATIONS

1. **[Invited talk]** Trash CAN do that: Electrocatalytic reaction engineering for upgrading of complex industrial wastes. *Chemical and Fuel Cycle Division, Argonne National Laboratory, September 2026.*
2. **Gaines, R.N.** Let's talk trash: Electrochemistry turns waste into products. Finalist, *Your Science in a Nutshell competition, Oak Ridge National Laboratory, July 2026.*
3. **[Invited talk]** Trash CAN do that: Electrocatalytic reaction engineering for upgrading of complex industrial wastes. **First-place presentation**, *Distinguished Young Scholars Seminar series, Department of Chemical and Biomolecular Engineering, University of Washington, July 2026.*

4. **[Invited talk]** Optimizing the flow electrooxidation of industrial waste glycerol. *Photovoltaics and Materials Technology Organization, Sandia National Laboratories*, July 2025.
5. **[Invited talk]** Reaction engineering for waste-to-value electroconversions. *Faraday Technology Inc.*, May 2025.
6. **Gaines, R.N.** Towards a mechanistic understanding of the electrocatalytic behavior of complex organic wastes. *Pauling Fellowship Committee, Pacific Northwest National Laboratory*, January 2025.
7. **[Invited talk]** Reaction engineering for waste-to-value electroconversions. *Materials Synthesis and Integrated Devices Group, Los Alamos National Laboratory*, January 2025.
8. **[Invited talk]** Engineering waste glycerol electrooxidation. *Radioisotope Science and Technology Division, Oak Ridge National Laboratory*, December 2024.
9. **Gaines, R.N.**; Sibal, A.P.; Friel, B.E.; Shah, V.M.; Stillwell, A.S.; Kenis, P.J.A. Investigating crude glycerol electrooxidation. *ECS Fall 2024, Honolulu, HI*, October 2024.
10. **Gaines, R.N.** Enhancing short-chain PFAS degradation. *Universities Research Association Lightning Talks, Sandia National Laboratories*, virtual, July 2024.
11. **[Invited talk]** What do I do with a degree in environmental science? *Geological and Environmental Sciences, Appalachian State University*, virtual, April 2024.
12. **Gaines, R.N.** How to make a loaf of bread: Reaction engineering for waste-to-value electroconversions. *Chemical & Biomolecular Engineering Graduate Research Seminar Series, University of Illinois Urbana-Champaign*, April 2024.
13. **Gaines, R.N.**, Kleimenhagen, B.A., Griebler, J.J., Kenis, P.J.A. Glycerol electrooxidation in flow electrolyzers. **Second-place poster**, *Chemical & Biomolecular Engineering Research Symposium, University of Illinois Urbana-Champaign*, October 2023.
14. **Gaines, R.N.**; Sibal, A.P.; Griebler, J.J.; Gaddam, R.; Harris, L.C.; Kleimenhagen, B.A.; Keshireddy, A.; Gewirth, A.A.; Rodriguez-Lopez, J.; Rogers, S.A.; Stillwell, A.S.; Kenis, P.J.A. Glycerol electrooxidation in flow electrolyzers. *ECS Fall 2023, Gothenburg, Sweden*, October 2023.
15. **Gaines, R.N.**; Zhao, Y.; Kleimenhagen, B.A.; Keshireddy, A.; Gaddam, R.; Sibal, A.P.; Gewirth, A.A.; Stillwell, A.S.; Rodriguez-Lopez, J.; Kenis, P.J.A. Electrochemical valorization of glycerol in flow electrolyzers. Poster, *ACS Spring 2023, Indianapolis, IN*, March 2023.

TEACHING EXPERIENCE

Graduate Teaching Assistant

Chemical & Biomolecular Engineering, University of Illinois Urbana-Champaign

Cross-Curricular Design – Thermodynamics

Spring 2022, Fall 2022

Cross-Curricular Design – Chemical Reaction Engineering

Spring 2022, Fall 2022

Undergraduate Teaching Assistant

Geological & Environmental Sciences, Appalachian State University

Introduction to Environmental Science

Summer 2019

Introduction to Hydrology

Spring 2019

SERVICE

Peer Reviewer ACS Sustainable Chemistry & Engineering Advanced Science (Wiley)	2025 – present
Competition Reviewer , WDTS Program, ORNL <i>Competition reviewer for abstracts submitted by junior scientists and visiting teachers</i>	2026
Session Chair & Competition Judge , ORPA Conference, ORNL <i>Chaired & served as a competition judge for sessions in chemistry & chemical ecology</i> <i>Moderated small-group networking sessions on leadership and academic career paths</i>	2026
Deputy Director & Publicity Coordinator , weSTEM Conference, UIUC <i>Coordinated programming, logistics, and outreach for a conference serving ~150 attendees</i>	2023 – 2025
Social Media Coordinator , Graduate Society of Women Engineers, UIUC <i>Managed digital communications and engagement strategy for a 200-member organization</i> <i>Won “Best Practice in Communication” award from national Society of Women Engineers</i>	2022 – 2023
Communications Chair , ChBE Graduate Student Advisory Committee, UIUC <i>Facilitated departmental communication efforts and served as a student-faculty-staff liaison</i>	2021 – 2022

PROFESSIONAL EXPERIENCE

Commercialization Analyst , Office of Technology Management, UIUC <i>Evaluated invention disclosures, market potential, and IP strategy for emerging technologies</i>	May – October 2023
Research Analyst , Million Patients Cured <i>First non-founding employee</i> <i>Conducted data analysis and market research to support early-stage product development</i>	May – August 2020
Academic Success Coach (Athletic Educational Mentor), Appalachian State <i>Provided academic mentoring and performance support for at-risk student-athletes</i>	January – May 2020
Graduate Research Assistant , NEXUS Project, Appalachian State <i>Supported research on anaerobic digestion of dairy industry waste</i>	May – December 2019