

Leo W. Gordon

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Key Skills & Expertise

Nuclear Magnetic Resonance (NMR) Spectroscopy

Highly skilled in both solid-state and liquid-state NMR spectroscopies. Experience with pulse programming, method development, and implementation of state-of-the-art pulse sequences.

Electrochemistry

Electrochemical expertise ranging from electrochemical sensors to batteries. Proven track record in both experimental application of techniques and advanced analysis.

Coding

Proficient in using python and Matlab for data handling, analysis, and visualization. Developed code to automate data analysis in the form of functions and graphical user interfaces.

Education

The City College of New York

New York, NY

PHD - CHEMICAL ENGINEERING

2018-2023

MPhil - CHEMICAL ENGINEERING

University of Edinburgh

Edinburgh, U.K.

MCHEM - CHEMISTRY

2012-2017

Experience

Danish Technical University - Department of Chemistry

Kongens Lyngby, Denmark

2025 - Present

ASSISTANT PROFESSOR - MAGNETIC RESONANCE AND ELECTROCHEMISTRY LAB

- Principle investigator of the Magnetic Resonance and Electrochemistry Lab
- Applying *operando* NMR methodologies for studying ion transport in battery and membrane systems
- NMR and electrochemical method development to understand charge storage and transport mechanisms across different lengthscales

University of California, Santa Barbara - Materials Department

Santa Barbara, CA

2023 - 2025

POSTDOCTORAL SCHOLAR - ADVISOR: PROF. RAPHAËLE J. CLÉMENT

- Determination of ionic diffusion through polymeric materials by applications of pulsed-field gradient and electrophoretic NMR measurements
- Studying both partitioning behaviours and transport processes in multi-phasic systems using spatially-resolved NMR techniques
- Designing apparatus for *operando* NMR transport measurements in membranes
- Probing ion-ion and ion-solvent interactions via their coupled diffusion, as compared to equilibrium models of ion dissociation
- Mentoring and teaching graduate students and facilitating NMR and electrochemistry training

The City College of New York - Department of Chemical Engineering

PHD CANDIDATE - ADVISOR: PROF. ROBERT J. MESSINGER

New York, NY

2018-2023

- Applying advanced solid-state NMR methodologies to establish ionic and electronic charge storage mechanisms in quinone electrodes for aluminum batteries
- NMR characterization of molten-salt electrolytes in liquid and heterogeneous samples to develop understanding of reaction processes following electrochemical cycling
- Quantum chemical calculations to determine thermochemical viability of ion generation pathways and quadrupolar NMR parameters of electroactive ions
- Evaluating reaction schemes via NMR to characterize the modification of LiPF₆ by P₂O₅ for long-life and low hysteresis lithium-metal batteries
- Investigating chalcogen electrodes for rechargeable aluminum batteries, studying the impacts of structure at different length-scales to the resultant reactions
- Understanding a novel non-intensive recycling process for lithium-ion battery cathodes by NMR analysis, in combination with complimentary techniques
- Mentoring undergraduate and graduate students, training in NMR, electrochemistry and other instrumentation

Teaching Experience

Spring 2022	Chemical Engineering Thermodynamics I , Teaching Assistant
Spring 2021	Chemical Engineering Thermodynamics I , Teaching Assistant
Fall 2020	Chemical Engineering Thermodynamics II , Teaching Assistant
Spring 2020	Chemical Engineering Thermodynamics I , Teaching Assistant

Awards & Fellowships

2024	Heeger Travel Award , Materials Research Laboratory, UCSB Rising Stars of Materials Science & Engineering , Stanford University
2022	Travel Award , The Electrochemical Society Twitter Conference Poster Award , Global NMR Discussions Travel Award , Rocky Mountain Conference (RMC) on Magnetic Resonance Travel Award , Experimental Nuclear Magnetic Resonance Conference (ENC)
2020	Grove School of Engineering Fellowship , The City College of New York
2019	Acrivos Fellowship , The City College of New York

Outreach & Professional Development

SERVICE AND OUTREACH

2023-2025	Organizer , UCSB NMR Seminar Series
2024	Volunteer , MRL Outreach
Summer 2024	Entrepreneurial Lead , NSF I-CORPS
2021-2023	Treasurer , Electrochemical Society Student Chapter
2019-2020	Treasurer , Graduate Student Council, CCNY

PEER REVIEW

Polymer
ACS Sustainable Chemistry & Engineering
Journal of Physical Chemistry

Publications & Patents

PUBLISHED

- [1] Parham Ghasemiahangarani, Donovan del Mundo, Ryan C Chow, Gabriel Farhan, **Leo W Gordon***, and Theresa Schoetz*. A tutorial for the identification and quantitative disentangling of charge storage mechanisms by variable-rate cyclic voltammetry. *Electrochimica Acta*, page 148127, 2026.
- [2] James T Bamford, **Leo W Gordon**, Raphaële J Clément, and Rachel A Segalman. Converting a metal-coordinating polymer to a polymerized ionic liquid improves li⁺ transport. *ACS Macro Letters*, 14:87–92, 2025.
- [3] Thomas R. Webber, Declan P. Shannon, **Leo W. Gordon**, Oscar A. Nordness, Joshua D. Moon, Raphaële J. Clément, Benny D. Freeman, Rachel A. Segalman, Craig J. Hawker, and Songi Han. Solution-like water transport across molecular to macroscopic length scales in crosslinked poly(ethylene glycol diacrylate) networks with tailored sidechains. *Journal of Polymer Science*, 63:3990–4002, 10 2025.
- [4] Nico Marioni, Akhila Rajesh, Rahul Sujanani, Zidan Zhang, **Leo W. Gordon**, Raphaële J. Clément, Rachel A. Segalman, Benny D. Freeman, and Venkat Ganesan. What is the Role of Relative Humidity on Conductivity in Polymer Electrolytes? *ACS Macro Letters*, 14(6):865–871, June 2025.
- [5] Evangelia Founta, Marina Caravetta, Michael Thielke, Ana Belen Jorge Sobrido, **Leo W. Gordon**, Themis Prodromakis, Carlos Ponce De León, Dimitra G. Georgiadou, and Theresa Schoetz. Understanding Charge Storage Mechanisms in Flexible Nanocellulose/Graphite Battery Electrodes. *ChemElectroChem*, page 2500096, May 2025.
- [6] Seongkoo Kang, Jihyun Kim, Youngju Choi, Suwon Lee, **Leo W. Gordon**, Euan N. Bassey, Jean-Claude Badot, Olaf J. Borkiewicz, Olivier Dubrunfaut, Raphaële J. Clément, and Yong-Mook Kang. Controlling Interlayer Disorder Toward Reversible Phase Transition in a Layered Sodium Manganese Oxide Cathode. *Journal of the American Chemical Society*, 147(8):6665–6678, February 2025.
- [7] James T. Bamford, **Leo W. Gordon**, Raphaële J. Clément, and Rachel A. Segalman. Converting a Metal-Coordinating Polymer to a Polymerized Ionic Liquid Improves Li⁺ Transport. *ACS Macro Letters*, 14(1):87–92, January 2025.
- [8] Rahul Sujanani, Phong H. Nguyen, **Leo W. Gordon**, James T. Bamford, Alexandra Zele, Benjamin J. Pedretti, Nathaniel A. Lynd, Raphaële J. Clément, and Rachel A. Segalman. Influence of Water Sorption on Ionic Conductivity in Polyether Electrolytes at Low Hydration. *ACS Macro Letters*, 14(1):64–71, January 2025.
- [9] Harrison Y. Asare, Surabh S. KT, **Leo W. Gordon**, George John, and Robert J. Messinger. Effects of ion mass transport on electrochemical reaction pathways in aluminum-anthraquinone batteries. *Electrochimica Acta*, 507:145031, December 2024.
- [10] Jonah Wang, Theresa Schoetz, **Leo W. Gordon**, Elizabeth J. Biddinger, and Robert J. Messinger. Ternary Ionic Liquid Analogues as Electrolytes for Ambient and Low-Temperature Rechargeable Aluminum Batteries. *ACS Applied Energy Materials*, 7(13):5438–5446, July 2024. Publisher: American Chemical Society.
- [11] **Leo W. Gordon**, Rahul Jay, Ankur L. Jadhav, Snehal S. Bhalekar, and Robert J. Messinger. Elucidating Consequences of Selenium Crystallinity on Its Electrochemical Reduction in Aluminum–Selenium Batteries. *ACS Materials Letters*, 6(7):2577–2581, July 2024.
- [12] James T. Bamford, Seamus D. Jones, Nicole S. Schauser, Benjamin J. Pedretti, **Leo W. Gordon**, Nathaniel A. Lynd, Raphaële J. Clément, and Rachel A. Segalman. Improved Mechanical Strength without Sacrificing Li-Ion Transport in Polymer Electrolytes. *ACS Macro Letters*, 13(5):638–643, May 2024.
- [13] Theresa Schoetz, Loleth E. Robinson, **Leo W. Gordon**, Sarah A. Stariha, Celia E. Harris, Hui Li Seong, John-Paul Jones, Erik J. Brandon, and Robert J. Messinger. Elucidating the Role of Electrochemically Formed LiF in Discharge and Aging of Li-CF_x Batteries. *ACS Applied Materials & Interfaces*, 16(15):18722–18733, April 2024. Publisher: American Chemical Society.
- [14] Oi Man Leung, **Leo W. Gordon**, Robert J. Messinger, Themis Prodromakis, Julian A. Wharton, Carlos Ponce de León, and Theresa Schoetz. Solid Polymer Electrolytes with Enhanced Electrochemical Stability for High-Capacity Aluminum Batteries. *Advanced Energy Materials*, 2303285(14), January 2024. Publisher: John Wiley and Sons Inc.
- [15] Brendan E. Hawkins, Theresa Schoetz, **Leo W. Gordon**, Surabh Kt, Jonah Wang, and Robert J. Messinger. Reversible Zinc Electrodeposition at -60 °C Using a Deep Eutectic Electrolyte for Low-Temperature Zinc Metal Batteries. *Journal of Physical Chemistry Letters*, 14(9):2378–2386, March 2023. Publisher: American Chemical Society.
- [16] **Leo W. Gordon**, Jonah Wang, and Robert J. Messinger. Revealing impacts of electrolyte speciation on ionic charge storage in aluminum-quinone batteries by NMR spectroscopy. *Journal of Magnetic Resonance*, 348:107374, March 2023. Publisher: Elsevier Inc.

- [17] Atanu Roy, Theresa Schoetz, **Leo W. Gordon**, Hung-Ju Yen, Qingli Hao, and Daniel Mandler. Formation of a CoMn-Layered Double Hydroxide/Graphite Supercapacitor by a Single Electrochemical Step. *ChemSusChem*, 15(21), November 2022.
- [18] **Leo W. Gordon**, Ankur L. Jadhav, Mikhail Miroshnikov, Theresa Schoetz, George John, and Robert J. Messinger. Molecular-Scale Elucidation of Ionic Charge Storage Mechanisms in Rechargeable Aluminum–Quinone Batteries. *The Journal of Physical Chemistry C*, 126(33):14082–14093, August 2022.
- [19] Jian Zhang, Jiayan Shi, **Leo W. Gordon**, Nastaran Shojarazavi, Xiaoyu Wen, Yifan Zhao, Jianjun Chen, Chi-Cheung Su, Robert J. Messinger, and Juchen Guo. Performance Leap of Lithium Metal Batteries in LiPF₆ Carbonate Electrolyte by a Phosphorus Pentoxide Acid Scavenger. *ACS Applied Materials & Interfaces*, 14(32):36679–36687, August 2022.
- [20] Rahul Jay, Ankur L. Jadhav, **Leo W. Gordon**, and Robert J. Messinger. Soluble Electrolyte-Coordinated Sulfide Species Revealed in Al-S Batteries by Nuclear Magnetic Resonance Spectroscopy. *Chemistry of Materials*, 34(10):4486–4495, May 2022.
- [21] T. Schoetz, **L.W. Gordon**, S. Ivanov, A. Bund, D. Mandler, and R.J. Messinger. Disentangling faradaic, pseudocapacitive, and capacitive charge storage: A tutorial for the characterization of batteries, supercapacitors, and hybrid systems. *Electrochimica Acta*, 412:140072, April 2022.

IN REVIEW

- [1] O.A. Nordness, **L.W. Gordon**, Z. Zhang, V. Ganesan, R.J. Clément. Disentangling Cation Effects on Ion Mobility and Structure in Ionic Liquid Electrolytes.
- [2] N. Shojarazavi, **L.W. Gordon**, J. Zhang, Y. Fu, H. Pazooki, C. Hung, D. Jiang, J. Shi, R.J. Messinger, J. Guo. Aluminometallurgy for Lithium-Ion Battery Recycling.
- [3] O.A. Wander, A. Khan, E.N. Bassey, T.N. Pennebaker, H. Szeto, **L.W. Gordon**, Y. Zhu, R.J. Clément. Impact of diglyme co-solvent on low temperature microstructural lithium growth.
- [4] N. Shojarazavi, **L.W. Gordon**, H. Pazooki, R.J. Messinger, J. Guo. Aqueous methods to recover and purify metals from lithium-ion batteries treated with chloroaluminum reagents. [Patent Filed.]

Presentations

INVITED TALKS

CRMN Seminar, ENS Lyon

“Partitioning and Diffusion Measurements using in-situ NMR Spectroscopy,” 11 September 2025, Lyon, France.

Chemistry Departmental Seminar, Danish Technical University

“NMR Methods to Elucidate Electronic, Ionic, and Transport Mechanisms in Battery and Membrane Systems,” 22 May 2025, Kongens Lyngby, Denmark.

Center for Polymers and Organic Solids Seminar, University of California, Santa Barbara

“Studying Electrochemical Reactions in Organic Electrodes and Transport Mechanisms in Polymer Membranes by NMR Spectroscopy,” 30 April 2025, Santa Barbara, CA.

Quantum Foundry Seminar, University of California, Santa Barbara

“NMR Methods to Elucidate Electronic, Ionic, and Transport Mechanisms in Battery and Membrane Systems,” 14 March 2025, Santa Barbara, CA.

Chemical Engineering Departmental Seminar, University of South Carolina

“Membranes and Megawatts: Revealing Mechanisms with NMR Spectroscopy,” 30 January 2025, Columbia, SC.

CONFERENCE PRESENTATIONS

Danish Electrochemical Society Meeting

“Unveiling Mechanisms in Batteries from the Molecular to the Macroscopic Scale with NMR Methods,” 6-7 November 2025, Kongens Lyngby, Denmark.

Experimental Nuclear Magnetic Resonance Conference

“Measuring Partitioning and Diffusion Across Interfaces using Temporally and Spatially Resolved NMR Spectroscopy,” 6-10 April 2025, Asilomar, CA.

American Institute for Chemical Engineers Annual Meeting

“Application of Advanced Magnetic Resonance Methodologies to Elucidate Charge Storage Mechanisms and Ion Interactions for Energy Storage Systems and Beyond,” 27-31 October 2024, *San Diego, CA.*

Southern California Users of Magnets Conference

“Spatially-Resolved NMR Methods for Investigating Partitioning Behavior,” 26 October 2024, *Los Angeles, CA.*

Experimental Nuclear Magnetic Resonance Conference

“Spatially-Resolved NMR Methods for Determination of Solute Partitioning,” 7-11 April 2024, *Asilomar, CA.*

Experimental Nuclear Magnetic Resonance Conference

“Impacts of Electrolyte Speciation on Ion Binding Environments in Aluminum-Quinone Batteries Elucidated by Dipolar-Mediated and Multiple-Quantum Solid-State NMR Methods,” 16-20 April 2023, *Asilomar, CA.*

Battery & Energy Storage Conference

“Impacts of Electrolyte Speciation on Aluminum-Organic Battery Charge Storage,” 26-28 October 2022, *New York, NY.*

Electrochemical Society Meeting

“Understanding Improved Lifetimes of Lithium-Metal Batteries LiPF₆ Carbonate Electrolyte Modified by Phosphorus Pentoxide,” 9-13 October 2022, *Atlanta, GA.*

Global NMR Twitter Conference

“Electrochemical Complexation of Polyatomic Aluminum Ions to Heterogeneous Organic Electrode Samples Investigated Using Solid-State Dipolar-Mediated NMR Methods,” 3-5 August 2022, *Virtual.*

Rocky Mountain Conference on Magnetic Resonance

“Electrochemical Complexation of Polyatomic Aluminum Ions to Heterogeneous Organic Electrode Samples Investigated Using Solid-State Dipolar-Mediated NMR Methods,” 25-29 July 2022, *Copper Mountain, CO.*

Experimental Nuclear Magnetic Resonance Conference

“Molecular Structures of Reaction Products in LiPF₆ Carbonate Electrolyte with a Phosphorous Pentoxide Scavenger for Rechargeable Lithium Metal Batteries,” 24-29 April 2022, *Orlando, FL.*

American Institute for Chemical Engineers Annual Meeting

“Charge Storage Mechanisms of Quinone- & Flavin-Type Organic Electrodes for Rechargeable Aluminum Batteries Elucidated with Molecular-level Specificity,” 7-12 November 2021, *Boston, MA.*

Electrochemical Society Meeting

“Electrochemical Complexation of Polyatomic Aluminum Cations in Quinone-type Organic Battery Electrodes Revealed by Solid-state NMR,” 10-14 October 2021, *Virtual.*

Experimental Nuclear Magnetic Resonance Conference

“Molecular-level Insights into the Charge Storage Mechanisms of Rechargeable Aluminum-Indanthrone Quinone Batteries Revealed by Solid-state NMR Spectroscopy,” 29-31 March 2021, *Virtual.*

Battery & Energy Storage Conference

“Molecular-level Investigation into the Charge-storage Mechanisms of Rechargeable Aluminum-organic Batteries,” 21-23 October 2020, *Virtual.*

Electrochemical Society Meeting

“Molecular-Scale Understanding of Charge Storage Mechanisms in Organic Positive Electrode Materials for Rechargeable Aluminum Batteries,” 4-9 October 2020, *Virtual.*

Battery & Energy Storage Conference

“Rechargeable Aluminum Batteries Using Organic Cathode Materials with High Cycle Life and Capacity,” 21-22 October 2019, *New York, NY.*