

# Leo W. Gordon

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## Education

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### The City College of New York

PHD - CHEMICAL ENGINEERING

MPHIL - CHEMICAL ENGINEERING

New York, NY

2018-2023

### University of Edinburgh

MCHEM - CHEMISTRY

Edinburgh, U.K.

2012-2017

## Research Experience

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### University of California, Santa Barbara - Materials Department

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

Santa Barbara, CA

2023 - Present

### The City College of New York - Department of Chemical Engineering

ADVISOR: PROF. ROBERT J. MESSINGER

- 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  $\text{LiPF}_6$  by  $\text{P}_2\text{O}_5$  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

New York, NY

2018-2023

### The City College of New York - Department of Chemical Engineering

ADVISOR: PROF. ELIZABETH BIDDINGER

- Performed preliminary work for surface-enhanced FTIR studies of reaction pathways in the electrochemical upgrading of bio-oils derived from otherwise wasted feedstocks to bio-fuels

New York, NY

Summer 2018

### University of Edinburgh - Department of Chemistry

ADVISOR: DR. DIMITRIOS KAMPOURIS

- Investigated the design of microelectrode arrays, in particular the impact of reference electrode positioning producing stacked, one-dimensional microelectrode arrays of working electrodes and coupled reference electrodes. This work was performed in the clean-room environment of the Scottish Microelectronics Centre

Edinburgh, U.K.

2016-2017

## Teaching Experience \_\_\_\_\_

Spring 2022	<b>Chemical Engineering Thermodynamics I</b> , Teaching Assistant
Spring 2021	<b>Chemical Engineering Thermodynamics I</b> , Teaching Assistant
Fall 2020	<b>Chemical Engineering Thermodynamics II</b> , Teaching Assistant
Spring 2020	<b>Chemical Engineering Thermodynamics I</b> , Teaching Assistant

## Awards & Fellowships \_\_\_\_\_

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

## Outreach & Professional Development \_\_\_\_\_

### SERVICE AND OUTREACH

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

### PEER REVIEW

Polymer  
ACS Sustainable Chemistry & Engineering  
Journal of Physical Chemistry

## Publications & Patents \_\_\_\_\_

### PUBLISHED

- [1] 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, Dec 2024.
- [2] 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*, Jun 2024.
- [3] **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*, pages 2577–2581, May 2024.
- [4] James T. Bamford, Seamus D. Jones, Nicole S. Schausser, 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*, pages 638–643, May 2024.

- [5] Theresa Schoetz, Loeth 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<sub>x</sub> Batteries. *ACS Applied Materials & Interfaces*, 16:18722–18733, Apr 2024.
- [6] 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, Jan 2024.
- [7] 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. *The Journal of Physical Chemistry Letters*, 14(9):2378–2386, Mar 2023.
- [8] **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, Mar 2023.
- [9] 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*, e202201418, Aug 2022.
- [10] **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*, 126:14082–14093, Aug 2022.
- [11] 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 LiPF<sub>6</sub> Carbonate Electrolyte by a Phosphorus Pentoxide Acid Scavenger. *ACS Applied Materials & Interfaces*, 14:36679–36687, Aug 2022.
- [12] 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*, 34:4486–4495, May 2022.
- [13] 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, Feb 2022.

## IN REVIEW

- [1] 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.
- [2] T.R. Webber, D.P. Shannon, **L.W. Gordon**, O.A. Nordness, J.D. Moon, R.J. Clément, B.D. Freeman, R.A. Segalman, C.J. Hawker, S. Han. Solution-like Water Transport Across Molecular to Macroscopic Length Scales in Crosslinked Poly(ethylene glycol diacrylate) Networks with Tailored Sidechains.
- [3] S Kang, J. Kim, Y. Choi, S. Lee, J.-C. Badot, **L.W. Gordon**, E.N. Bassey, R.J. Clément, O.J. Borkiewicz, O. Dubrunfaut, Y.-M. Kang. Modulated interlayer structure of a sodium manganese oxide cathode exploiting the metastable phase transition route toward reversible cycling.
- [4] J.T. Bamford, **L.W. Gordon**, R.J. Clément, R.A. Segalman. Converting a Metal-Coordinating Polymer to a Polymerized Ionic Liquid Improves Li<sup>+</sup> Transport.
- [5] R. Sujanani, P.H. Nguyen, **L.W. Gordon**, A. Zele, J.T. Bamford, B.J. Pedretti, N.A. Lynd, N. Marioni, V. Ganesan, R.J. Clément, and R.A. Segalman. The Influence of Water Sorption on Ionic Conductivity in Polyether Electrolytes at Low Hydration.
- [6] 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, *Disclosure Filed*.]

## Presentations

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### CONFERENCE PRESENTATIONS

#### American Institute of 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  $\text{LiPF}_6$  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  $\text{LiPF}_6$  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*.