

# YAYUAN LIU

Department of Chemical Engineering  
Massachusetts Institute of Technology  
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## Education and Training

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- Massachusetts Institute of Technology**, Cambridge, MA 03/2019-present  
Postdoctoral Associate, Chemical Engineering  
Advisor: Prof. T. Alan Hatton  
Research: Electrochemically-mediated carbon capture and stimuli-responsive gas gating membranes
- Stanford University**, Stanford, CA 2014-2019  
**Ph.D.** Materials Science and Engineering GPA 4.20/4.00  
Advisor: Prof. Yi Cui  
Thesis: Materials designs and fundamental understandings of lithium metal anode for next-generation batteries  
Thesis Committee: Prof. Steven Chu, Prof. Zhenan Bao, Prof. William Chueh, Prof. Jian Qin
- Nanyang Technological University**, Singapore 2010-2014  
**B.Eng.** Materials Science and Engineering GPA 4.88/5.00 (ranking 1/250)  
Advisor: Prof. Fengwei Huo  
Thesis: Designable yolk/shell nanoparticle/metal-organic framework heterostructures
- University of Illinois at Urban-Champaign**, Champaign, IL Fall 2012  
Exchange Program, Materials Science and Engineering, Chemical Engineering  
Advisor: Prof. Hong Yang  
Research: Synthesis and mechanistic study of shape-controlled nanocrystals for electrocatalytic oxygen reduction

## Awards and Honors

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- Distinguished Young Scholars Seminar Winner, University of Washington 2020  
Rising Stars in Chemical Engineering 2019  
MIT Chemical Engineering Postdoc Grant-Writing Contest Winner 2019  
Division of Inorganic Chemistry Young Investigator Award, American Chemical Society 2019  
Graduate Student Gold Award, Materials Research Society 2018 Fall Meeting  
Stanford Graduate Fellowship 2017-2019  
Chinese Government Award for Outstanding Self-Financed Students Abroad 2018  
O. Cutler Shepard Award, Stanford University 2017  
Best Poster Award, Department of Energy Battery500 Consortium 2017  
Lee Kuan Yew Gold Medal, Nanyang Technological University 2014  
Chen-Ning Yang Scholars Research Gold Award, Nanyang Technological University 2013  
Dean's List, Nanyang Technological University 2010-2014  
Chen-Ning Yang Scholarship, Nanyang Technological University 2010-2014  
PRC Undergraduate Scholarship, Singapore Ministry of Education 2009-2014

## Research Interests

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My research aims to tackle pressing challenges at the energy-environment nexus by *developing and understanding electrochemically mediated processes* that leverage fundamental principles of electrochemistry, chemical engineering, materials science, and advanced characterization techniques.

## First-Author Publications

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‡ Denotes equal contribution \* Denotes corresponding author

(68 peer-reviewed journal publications in total; h-index: 48; 11,000+ citations / [Google Scholar](#))

16. Electrochemically-mediated gating membrane with dynamically-controllable gas transport.  
Y. Liu, C.-M. Chow, K. R. Phillips, M. Wang, S. Voskian, T. A. Hatton\*, *Science Advances* 6, eabc1741 (2020).
15. Electrochemically-mediated carbon dioxide separation with quinone chemistry in salt-concentrated aqueous media.  
Y. Liu, H.-Z. Ye, K. M. Diederichsen, T. Van Voorhis, T. A. Hatton\* *Nature Communications* 11, 2278 (2020).
14. Challenges and opportunities towards fast charging battery materials.  
Y. Liu, Y. Zhu, Y. Cui\* *Nature Energy* 4, 540-550 (2019).
13. Fast galvanic lithium corrosion involving a Kirkendall-type mechanism.  
D. Lin‡, Y. Liu‡, Y. Li, Y. Li, A. Pei, J. Xie, W. Huang, Y. Cui\* *Nature Chemistry* 11, 382-389 (2019).
12. Solubility-mediated sustained release enabling nitrate additive in carbonate electrolytes for stable lithium metal anode.  
Y. Liu, D. Lin, Y. Li, G. Chen, A. Pei, O. Nix, Y. Li, Y. Cui\* *Nature Communications* 9, 3656 (2018).
11. An ultrastrong double-layer nanodiamond interface for stable lithium metal anodes.  
Y. Liu‡, Y. -K. Tzeng‡, D. Lin, A. Pei, H. Lu, N. A. Melosh, Z. -X. Shen, S. Chu\*, Y. Cui\* *Joule* 2, 1595-1609 (2018).
10. Design of complex nanomaterials for energy storage: past success and future opportunity.  
Y. Liu, G. Zhou, K. Liu, Y. Cui\* *Accounts of Chemical Research* 50, 2895-2905 (2017).
9. Transforming from planar to three-dimensional lithium with flowable interphase for solid lithium metal batteries.  
Y. Liu, D. Lin, Y. Jin, K. Liu, X. Tao, Q. Zhang, X. Zhang, Y. Cui\* *Science Advances* 3, eaao0713 (2017).
8. Reviving the lithium metal anode for high-energy batteries.  
D. Lin‡, Y. Liu‡, Y. Cui\* *Nature Nanotechnology* 12, 194-206 (2017).
7. An artificial solid electrolyte interphase with high Li-ion conductivity, mechanical strength, and flexibility for stable lithium metal anodes. Y. Liu, D. Lin, P. Y. Yuen, K. Liu, J. Xie, R. H. Dauskardt, Y. Cui\* *Advanced Materials* 29, 1605531 (2017).
6. A Prussian blue route to nitrogen-doped graphene aerogels as efficient electrocatalysts for oxygen reduction with enhanced active site accessibility. Y. Liu, H. Wang, D. Lin, J. Zhao, C. Liu, J. Xie, Y. Cui\* *Nano Research* 10, 1213-1222 (2017).
5. Layered reduced graphene oxide with nanoscale interlayer gaps as a stable host for lithium metal anodes.  
D. Lin‡, Y. Liu‡, Z. Liang, H. W. Lee, J. Sun, H. Wang, K. Yan, J. Xie, Y. Cui\* *Nature Nanotechnology* 11, 626-632 (2016).
4. Lithium-coated polymeric matrix as a minimum volume-change and dendrite-free lithium metal anode.  
Y. Liu‡, D. Lin‡, Z. Liang, J. Zhao, K. Yan, Y. Cui\* *Nature Communications* 7, 10992 (2016).
3. Electrochemical tuning of olivine-type lithium transition-metal phosphates as efficient water oxidation catalysts.  
Y. Liu, H. Wang, D. Lin, C. Liu, P. C. Hsu, W. Liu, W. Chen, Y. Cui\* *Energy & Environmental Science* 8, 1719-1724 (2015).
2. Dual-phase spinel MnCo<sub>2</sub>O<sub>4</sub> and spinel MnCo<sub>2</sub>O<sub>4</sub>/nanocarbon hybrids for electrocatalytic oxygen reduction and evolution. X. Ge‡, Y. Liu‡, F. T. Goh, T. A. Hor\*, Y. Zong, P. Xiao, Z. Zhang, S. H. Lim, B. Li, X. Wang, Z. Liu\* *ACS Applied Materials & Interfaces* 6, 12684-12691 (2014).
1. Designable yolk-shell nanoparticle@MOF petalous heterostructures.  
Y. Liu, W. Zhang, S. Li, C. Cui, J. Wu, H. Chen, F. Huo\* *Chemistry of Materials* 26, 1119-1125 (2014).

## Work in Progress

High-capacity, continuous-flow carbon capture with redox-active molecular liquid.

Y. Liu, T. A. Hatton\*, *et. al.* to be submitted

## **Patents**

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1. Y. Cui, Z. Liang, Y. Liu, D. Lin, Composite lithium metal anodes for lithium batteries with reduced volumetric fluctuation during cycling and dendrite suppression. US Patent 15/348,884 (2017).
2. Y. Liu, Y. Cui, D. Lin, Solid-state lithium metal battery based on three-dimensional electrode design. US Patent App. 16/616,910.
3. Y. Liu, T. A. Hatton, Porous medium with adjustable fluid permeability and associated systems and methods. US Provisional App. 63/002,490 (2020).

## **Teaching Experience**

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### **Pedagogical Training**

Kaufman Teaching Certificate Program, Massachusetts Institute of Technology Spring 2020

Inclusive Classrooms Training, Massachusetts Institute of Technology 08/2019

**Teaching Assistant, Stanford University** Spring 2017 & Fall 2016

MATSCI 202 Materials Chemistry (Graduate-level core course, also served as co-instructor, class size ~50)  
Responsibility: Designed and graded problem sets, held weekly office hours, and gave several lectures.

**Guest Lecturer, Stanford University** Fall 2017

MATSCI 303 Principles, Materials and Devices of Batteries (Graduate-level elective course)

**Guest Lecturer, Stanford University** Spring 2017 & Spring 2016

CHEM 26N The What, Why, How and Wows of Nanotechnology

**Peer Tutor, Nanyang Technological University** 2012-2013

MS 4002 Quality Control

MS 3001 Metallic and Ceramic Materials

MS 3002 Advanced Materials Processing

MS 2008 Electronic and Magnetic Properties of Materials

## **Mentoring Experience**

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Massachusetts Institute of Technology, Department of Chemical Engineering

### • **Research mentor for Master's students**

Nicholas M. McDonald (exchange student from ETH Zurich)

Thesis: Modeling of transport phenomena for continuous directional electrochemically-mediated CO<sub>2</sub> pumping

Anna M. de Vries-Stuebing (exchange student from ETH Zurich)

Thesis: Large-scale fabrication of flexible stimuli-responsive gas gating membranes

### • **Research mentor for undergraduate research interns**

Arina Khotimsky 09/2019-present MIT freshman

Gabriella Aponte 01/2020-present MIT freshman

Stanford University, Department of Materials Science and Engineering

### • **Research mentor for graduate student** Hansen Wang (2016-2019)

Collaboration project: Materials design for composite lithium metal anode (co-authored 5 papers)

### • **Research mentor for high school research interns**

Angela Zheng Summer 2016 now an undergraduate at University of California, Los Angeles

Oliver Nix 09/2017-06/2018 now an undergraduate at Bowdoin College (co-authored 1 paper)

## Leadership and Professional Services

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### **Chemical Engineering Communication Lab, Massachusetts Institute of Technology**

*Communication Fellow* 2020-present

Received rigorous training on technical communication, provided individual coaching and targeted workshops on written, speaking, and visual communication to Chemical Engineering undergrads, grads and postdocs.

### **Stanford Energy Student Lectures, Stanford University**

*Seminar Manager* Summer 2018

*Co-organizer* Summer 2017

Organized two lecture series (20 lectures each) featuring energy research by Stanford graduate students and postdocs.

### **Gordon Research Seminar (GRS), Chemical Separations 2022**

*Chair*

### **Cui Research Group, Stanford University**

*Safety Manager* 2015-2019

### **Journal Reviewer**

Nano Letters, ACS Nano, Joule, Chem, ACS Applied Materials and Interfaces, ACS Energy Letters, ACS Materials Letters, Environmental Science & Technology, Nano Energy, Nano Research, Journal of Power Sources, etc.

## References

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### **Prof. Yi Cui**

Professor of Materials Science and Engineering, of Photon Science

Senior Fellow at the Precourt Institute for Energy

Professor, by Courtesy, of Chemistry

Department of Materials Science and Engineering, Stanford University

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### **Prof. T. Alan Hatton**

Ralph Landau Professor of Chemical Engineering

Director, David H. Koch School of Chemical Engineering Practice

Department of Chemical Engineering, Massachusetts Institute of Technology

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### **Prof. Steven Chu**

William R. Kenan Jr. Professor and Professor of Molecular and Cellular Physiology

Department of Physics, Stanford University

Email: [schu@stanford.edu](mailto:schu@stanford.edu)