

Zhexi Lin

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Education

Columbia University

Doctor of Philosophy in Chemical Engineering

February 2017 – June 2021

Master of Philosophy in Chemical Engineering

February 2017 – February 2019

Master of Science in Chemical Engineering

September 2015 – February 2017

University of Delaware

Bachelor of Chemical Engineering, Cum Laude, Dean's List

September 2011 – May 2015

Research Experience

Columbia University

June 2021 – Present

Postdoctoral Research, Advisor: Prof. Jingguang G. Chen

- **457 total citations, 14 published papers, 3 papers in preparation or under review**
- **Participated in invited peer review with the Royal Society of Chemistry, MDPI, etc.**
- **Google Scholar:** <https://scholar.google.com/citations?user=ewS8rDIAAAAJ&hl=en&oi=ao>
- **Publons Reviewer Profile:** <https://publons.com/researcher/4255452/zhexi-lin/>
- Investigate reaction mechanisms of catalytic conversion of biomass-derived molecules over well-defined single crystal surfaces and powder catalysts
- Present experimental results at the monthly meetings with collaborators
- Oversee and maintain the normal operation of the ultrahigh vacuum laboratory
- Mentor Ph.D. students in experimentation, data analysis, and presentation

Columbia University

Fall 2015 – Spring 2021

Doctoral Thesis Research, Advisor: Prof. Jingguang G. Chen

Thesis Committee Members: Prof. Robert J. Farrauto, Prof. Daniel V. Esposito, Prof. Alissa A. H. Park, Prof. Alan C. West

Dissertation: "Catalytic Transformation of Biomass-Derived Oxygenates Using Transition Metal Carbide, Nitride, and Oxide Surfaces"

- Investigated carbide, nitride, and oxide catalytic materials for converting biomass-derived molecules (furfural, glycerol, and isopropyl alcohol) into value-added fuels and chemicals
- Developed correlations among density-functional theory calculations, model surface experiments, and powder catalyst evaluations to guide the rational design of catalysts
- Presented results at recurring meetings with collaborators at the University of Delaware and the University of South Carolina
- Led the efforts in upgrading the instruments in the lab for streamlined data acquisition and processing and building a mobile mass spectrometer for gas-phase product detection
- Developed extensive skills in operating equipment, managing time, and logging experimental details carefully while paying close attention to lab safety

Brookhaven National Laboratory

In-situ Experiments

Summer 2016, Fall 2019

- Performed ambient-pressure X-ray photoelectron spectroscopy experiments to investigate the Ni-Fe model catalysts for CO₂ mitigation
- Conducted reflection absorption infrared spectroscopy to probe the active sites of a WO_x/Pt(111) model catalyst for the dehydrogenation and dehydration reactions of isopropyl alcohol

Catalysis Center for Energy Innovation, University of Delaware

Senior Thesis Research, Advisor: Prof. Dionisios G. Vlachos

Fall 2014 – Spring 2015

- Constructed a high-throughput plug flow reactor for the kinetics studies of fructose conversion
- Elucidated the growth rate and molecular structure of humins during the catalytic conversion of biomass

Undergraduate Research, Advisor: Prof. Dionisios G. Vlachos

Winter 2013 – Spring 2013

- Biomass upgrading on metal and metal oxide catalysts

Pacific Northwest National Laboratory

Summer 2013

Research Education for Undergraduate program, Advisor: Prof. Ayman M. Karim

- Synthesized and characterized well-dispersed Pd-Fe nanoparticles for the catalytic upgrading of biomass

Institute of Energy Conversion, University of Delaware

Summer 2012

- Developed textured zinc oxide surfaces by oxalic acid for photovoltaic applications
- Analyzed and optimized the light diffusion ratio for the light trapping property of solar cells

Publications

1. W. N. Porter, **Z. Lin**, J. G. Chen, “Elucidating interactions of the epoxide ring on Pt(111) by comparing reaction pathways of propylene oxide and 1-epoxy-3-butene”, *J. Vac. Sci. Technol. A*. 2021, 39, 063214.
2. **Z. Lin**, S. R. Denny, J.G. Chen, “Transition metal carbides and nitrides as catalysts for thermochemical reactions”, *J. Catal.* 2021, *In Press*.
3. **Z. Lin**, S. Liu, S. R. Denny, W. N. Porter, S. Caratzoulas, J. A. Boscoboinik, D. G. Vlachos, J. G. Chen, “Experimental and theoretical insights into the active sites on WO_x/Pt(111) surfaces for dehydrogenation and dehydration reactions”, *ACS Catal.* 2021, 11, 8023–8032.
4. W. N. Porter, **Z. Lin**, J. G. Chen, “Experimental and theoretical studies of reaction pathways of direct propylene epoxidation on model catalyst surfaces”, *Surf. Sci. Rep.* **2021**, 76 (2), 100524.
5. N. Artrith, **Z. Lin**, J.G. Chen, “Predicting the activity and selectivity of bimetallic metal catalysts for ethanol reforming using machine learning”, *ACS Catal.* 2020, 17, 9438–9444.
6. Q. He, J. H. Lee, D. Liu, Y. Liu, **Z. Lin**, Z. Xie, S. Hwang, S. Kattel, L. Song, J. G. Chen, “Accelerating CO₂ Electroreduction to CO Over Pd Single-Atom Catalyst”, *Adv. Funct. Mater.* 2020, 30, 2000407.

7. K. E. You, S. C. Ammal, **Z. Lin**, W. Wan, J.G. Chen, A. Heyden, “Understanding the effect of Mo₂C support on the activity of Cu for the hydrodeoxygenation of glycerol”, *J. Catal.* 2020, 388, 141–153.
8. W. Wan, **Z. Lin**, J.G. Chen, “Vibrational spectroscopic characterization of glycerol reaction pathways over metal-modified molybdenum carbide surfaces”, *ChemCatChem*, 2019, 11, 1-7.
9. **Z. Lin**, W. Wan, J.G. Chen, “1,2-propanediol as a surrogate molecule for the mechanistic study of glycerol on Cu-modified Mo₂C surfaces” *ACS Sustainable Chem. Eng.* 2019, 7, 9, 8077-8082.
10. W. Wan, S. C. Ammal, **Z. Lin**, K.-E. You, A. Heyden and J. G. Chen, “Controlling reaction pathways of selective C–O bond cleavage of glycerol”, *Nat. Commun.*, 2018, 9, 4612.
11. **Z. Lin**, W. Wan, S. Yao, J.G. Chen, “Cobalt-modified molybdenum carbide as a selective catalyst for hydrodeoxygenation of furfural”, *Applied Cat B. Environmental*, 2018, 223, 160-166.
12. **Z. Lin**, R. Chen, Z. Qu, J. G. Chen, “Hydrodeoxygenation of biomass-derived oxygenates over metal carbides: from model surfaces to powder catalysts” (*Critical Review*), *Green Chem.*, 2018, 20, 2679–2696.
13. Z. Jiang, W. Wan, **Z. Lin**, J. Xie, J.G. Chen, “Understanding the role of M/Pt(111) (M = Fe, Co, Ni, Cu) bimetallic surfaces for selective hydrodeoxygenation of furfural”, *ACS Catal*, 2017, 7, 5758-5765.
14. G. Tsilomelekis, M. J. Orella, **Z. Lin**, Z. Cheng, W. Zheng, V. Nikolakis, D. G. Vlachos, “Molecular structure, morphology and growth mechanisms and rates of 5-hydroxymethyl furfural (HMF) derived humins”, *Green Chem*, 2016, 18, 1983-1993. (Cited 210 times)

Selected Presentations

- “Upgrading Glycerol Via Selective Hydrodeoxygenation Reaction on Copper-Modified Molybdenum Carbide and Nitride Surfaces.” AIChE National Conference, Orlando, FL. 2019. (Oral Presentation)
- “Selective Hydrodeoxygenation of Glycerol on Copper-Modified Molybdenum Carbide and Nitride Surfaces.” North American Catalysis Society Meeting, Chicago, IL. 2019 (Oral Presentation)
- “Transforming Biomass-Derived Oxygenates Using Carbide Catalysts.” AIChE Spring Meeting and 15th Global Congress on Process Safety, New Orleans, LA. 2019 (Poster Presentation)
- “Selective Tuning of the Glycerol C-O Bond Cleavage Sequence on Copper-Modified Molybdenum Carbide Surfaces.” AIChE National Conference, Pittsburgh, PA. 2018. (Oral Presentation)
- “Transforming biomass using metal-modified molybdenum carbides.” Third-Year Chemical Engineering Graduate Student Symposium. Columbia University, New York, NY. 2018. (Oral Presentation)

- “Comparison of the C-O bond scission between glycerol and diols on Cu-modified Mo₂C surfaces.” Catalysis Society of Metropolitan New York Annual Symposium, Lehigh University, Bethlehem, PA. 2018. (Poster Presentation)
- “Cobalt-modified molybdenum carbide as a selective catalyst for the upgrade of furfural via hydrodeoxygenation reaction.” Catalysis Society of Metropolitan New York Annual Symposium, Exxon Mobil, Clinton, NJ. 2018. (Poster Presentation)
- “Synthesis and Characterization of Palladium-Iron Nanoparticle Catalyst for the Conversion of Biomass”, AIChE Annual Student Conference, Atlanta, GA, 2014. (Poster Presentation)

Teaching Experience

Graduate Teaching Assistant

Surface Reactions and Kinetics

Fall 2019, Spring 2021

Prof. Jinguang G. Chen

- Gave guest lecture on vibrational spectroscopy
- Held review sessions for midterm exams
- Held weekly office hours and answered students' emails
- Graded and provided feedback on homework for 20-50 graduate students (on paper in Fall 2019 and with the Gradescope platform in Spring 2021)
- Provided tailored instructions to students from all academic backgrounds

Chemical Engineering and Applied Chemistry Lab

Spring 2016

Dr. James J. Russo, Dr. Ani Bedrossian-Omer

- Instructed and monitored groups of five senior undergraduate students performing enzyme kinetics experiments with UV/Vis spectrometer and HPLC
- Graded bi-weekly lab report
- Created exam questions according to course objectives and student experimental results

Engineering Separations Processes

Fall 2015

Prof. Christopher Durning

- Held weekly office hours
- Created solutions and instructions on separation column design using numerical methods
- Graded and provided feedback on homework and exams for 40 undergraduate students

Grader for the Surface Reactions and Kinetics course

Fall 2021 - Present

Prof. Jinguang G. Chen

- Grade homework and provide feedback and tutoring for 39 graduate students

Lead Teaching Fellow, Department of Chemical Engineering and Center for Teaching and Learning (CTL)

Fall 2019 – Spring 2020

- Held pedagogical workshops for TAs in the chemical engineering department and beyond
- Liaised between the home department and the Columbia Center for Teaching and Learning to provide teaching support for students

Teaching Development Program Graduate

Fall 2019 – Spring 2021

- Attended educational workshops and training sessions on effective teaching
- Practiced teaching in micro-teaching sessions

- Evaluated and reflected on my participation in the pedagogical training and practice

Research and Science Mentor Fall 2016 – Present

- Guide lab members in experiment design, instrument operation, and data analysis
- Coach students on literature search and presentation of research
- Train students in lab instrument maintenance and troubleshooting
- Mentored students in departmental Ph.D. students Open House events
- Mentored high school students in scientific experimentation via ELLIS Outreach

Leadership and Volunteer Activities

Columbia Electrochemical Energy Center Fall 2018 – Fall 2019

First Student President

ceec.engineering.columbia.edu

- Organized bi-weekly faculty and student seminars to promote collaboration and engagement among different research groups and departments
- Facilitated communications between faculty and students (~30 Ph.D. students)

Catalysis Society of Metropolitan New York Fall 2018 – Spring 2019

Membership Director

www.nycsweb.org (A local chapter of North American Catalysis Society (NACS) nacatsoc.org)

- Promoted the society and encouraged engagement in monthly meetings and the annual symposium
- Participated in annual business meetings to discuss the growth of the society and select the awardee of the Excellent in Catalysis Award
- Assisted in organizing the annual symposia (over 100 participants)

Catalysis Society of Metropolitan New York Fall 2017 – Spring 2018

Student Representative

- Communicated monthly meeting and the annual symposium announcements to student members via email and social media
- Promoted the society and encouraged student attendance
- Assumed the responsibility of secretary in response to an unexpected early leave of the previous secretary

AIChE University of Delaware Chapter Fall 2012 – Spring 2015

Student Representative

- Promoted the chapter and assisted in organizing outreach events
- Served as liaison between faculty and student body of the class (~60 students)

Other on-demand and short-term volunteer experiences include:

Chemical Engineering at Columbia: Ph.D. students qualification exam practice talks (Summer 2020, Summer 2021), faculty recruiting (Spring 2019), Open House (Spring 2016, Spring 2017); Columbia University International Students and Scholars Office: ISSO Ideation Workshop (Fall 2021); ELLIS Preparatory Academy Outreach: High school science mentor (Fall 2019); Tzu Chi Collegiate Association at Columbia: Soup Kitchen Community Lunch (Spring 2019)

Fellowships and Awards

- Columbia CTL Lead Teaching Fellowship Fall 2019 – Spring 2020
- Columbia EGSC Professional Development Fellowship Spring 2019
- Top 2 Design Team in Chemical Engineering Process Safety Design Project Spring 2018
- 2018 Columbia Consulting Case Competition Finalist Spring 2018
- Robert L. Pigford Scholarship Fall 2014
- AIChE - Wilmington Student Award Spring 2014
- Tau Beta Pi Engineering Honor Society 2013 – Present
- Alpha Lambda Delta Honor Society 2012 – Present

Languages and Skills

Languages:

Fluent in English and Cantonese Chinese, Native in Mandarin Chinese

Software Skills:

Microsoft Office, Python, Linux, MATLAB, OriginLab, Igor Pro, VASP, Quantum Espresso, Aspen

Experimental Techniques:

Temperature-Programmed Desorption, Mass Spectrometry, High-Resolution Electron Energy Loss Spectroscopy, Infrared Spectroscopy, X-ray Photoelectron Spectroscopy, Auger Electron Spectroscopy, UV/VIS Spectrometry, X-Ray Diffraction, High-Performance Liquid Chromatography, Dynamic Light Scattering, Chemical Kinetics Study, Nanoparticles Synthesis