

LEA R. WINTER

PhD Candidate and NSF-GRFP Fellow
Chemical Engineering, Columbia University
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EDUCATION

Columbia University, New York, NY

M.S. Chemical Engineering (February 2017)

Ph.D. Chemical Engineering (Expected May 2020)

National Science Foundation Graduate Research Fellow

GPA: 3.95

Selected Coursework:

- Materials Thermodynamics and Phase Diagrams
- Surface Reactions and Kinetics
- Chem. Eng. Applications of Electrochemistry
- Catalysis for Emissions Control
- Protein Engineering
- Plasma Physics
- Environmental Economics

Yale University, New Haven, CT

B.S. Chemical Engineering, Distinction in the Major (May 2015)

RESEARCH EXPERIENCE

GRADUATE RESEARCH

**Columbia University Department of Chemical Engineering –
Chen Research Group**, New York, NY

Fall 2015-Present

- **Advisor:** Prof. Jingguang G. Chen
- Researched catalytic mechanisms of CO₂ reduction by hydrogen over supported non-precious metal catalysts. Elucidated oxidation state of Ni during the reaction over Ni/CeO₂ and revealed bulk oxygen exchange with CeO₂ as well as the effect of Ni on the oxygen exchange mechanism. Employed NiFe/CeO₂ bimetallic catalysts to tune reaction selectivity.
- Designed and constructed hybrid plasma-catalysis reactors, including a novel in situ FTIR reactor for elucidating plasma and catalyst contributions.
- Discovered process for one-step conversion of ethane with CO₂ to produce alcohols using non-thermal plasma activation. Improved methanol selectivity using Cu/ZnO/Al₂O₃ and provided direct in situ measurements of alcohol/alkoxy species adsorbed on the catalyst surface. Identified that the plasma-activated reaction pathway is different from thermocatalytic methanol synthesis.
- Provided the first direct evidence of catalyst modification of plasma-activated NH₃ synthesis using in situ FTIR to observe surface intermediates. Identified that different mechanisms occur on Ni and Fe/ γ -Al₂O₃.
- Investigating N₂ and CO₂ conversion using non-thermal plasma and supported metal catalysts as well as a novel plasma-electrochemical reactor.
- Mentored around a dozen visiting scholars, PhD students, undergraduates, and high school students in the laboratory.

UNDERGRADUATE RESEARCH

**Grand Technion Energy Program, Technion Israel Institute of Technology –
Nitrogen Hydrogen Alternative Fuels Lab**, Haifa, Israel

Summer 2014

- **Advisors:** Prof. Gideon Grader and Dr. Alon Grinberg-Dana
- Researched combustion mechanism and effect of pressure on combustion of novel nitrogen-based alternative fuel in a homemade batch reactor.

**École Nationale Supérieure de Chimie de Paris (National Superior School of Chemistry) –
Plasma Process Engineering and Surface Treatment Lab**, Paris, France

Summer 2013

- **Advisors:** Prof. Michael Tatoulian and Dr. Bradley Da Silva
- Researched hydrophilic/phobic surface modification of novel polymers for microfluidics applications using metal-organic plasma-enhanced chemical vapor deposition (MO-PECVD).
- Studied activity of catalysts deposited using MO-PECVD for catalytic ozonation of pyruvic acid in polymeric microfluidic device.

Yale School of Engineering and Applied Science – Elimelech Lab, New Haven, CT

Spring 2013

- **Advisors:** Prof. Menachem Elimelech and Dr. Edo Bar-Zeev
- Researched osmotic back-flushing and prokaryotic programmed cell death for biofilm removal on desalination membranes.

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Weizmann Institute of Science – Immuno-Genomics Lab, Rehovot, Israel

Summer 2012

- **Advisors:** Prof. Ido Amit and Dr. Franziska Paul
- Developed methods for murine mast and dendritic cell vesicle isolation, verified using qPCR.
- Isolated vesicle RNA and prepared libraries for sequencing using ChIP-Seq.

FELLOWSHIPS AND AWARDS

- National Science Foundation Graduate Research Fellowship 2015-Present
- AIChE Catalysis and Reaction Engineering Division Travel Award 2019
- North American Catalysis Society: NAM26 Conference Kokes Award 2019
- TA Excellence Award in Chemical Engineering, *Surface Reactions and Kinetics* 2018
- NSF Participant Award, Gordon Research Conference: Plasma Processing Science 2018
- 1st Place Poster Award, Catalysis Society of Metropolitan New York Annual Symposium 2018
- Grossman Scholar, Columbia University Fu Foundation SEAS 2018 & 2019
- Columbia University Dept. of Chemical Engineering Pesco Award 2015
- *Journal of International Affairs* Andrew Wellington Cordier Essay Winner 2015
- Yale University Dept. of Chemical Engineering Harry A. Curtis Prize 2015
- Yale Summer Environmental Fellowship (2014), Yale College Masters Richter Summer Fellowship (2013), Schusterman Israel Travel Grant (2013), Elisa Spungen Bildner '75 and Robert Bildner '72 Israel Travel Grant (2012), Ganzfried Family Travel Fellowship (2012), Yale Creative and Performing Arts Award (2013 & 2014)
- Yale Scroll and Key Society member 2014
- Yale Creative and Performing Arts Award 2013 & 2014

PUBLICATIONS

1. **Lea R. Winter**, Jingguang G. Chen. “Revealing surface reaction mechanisms in plasma-catalytic ammonia synthesis.” *In preparation*.
2. Shuang Liu, **Lea R. Winter**, Jingguang G. Chen. “Review of plasma-assisted catalysis for selective generation of oxygenates from CO₂ and CH₄.” *ACS Catalysis* (2020) 10: 2855-2871.
3. **Lea R. Winter**, Rui Chen, Xin Chen, Kuan Chang, Zongyuan Liu, Sanjaya D. Senanayake, Amani Ebrahim, Jingguang G. Chen. “Elucidating the roles of metallic Ni and oxygen vacancies in CO₂ hydrogenation over Ni/CeO₂ using isotope exchange and in situ measurements.” *Appl. Catal. B Environ.* (2019) 245: 360-366.
4. **Lea R. Winter**, Elaine Gomez, Binhang Yan, Siyu Yao, Jingguang G. Chen. “Tuning Ni-catalyzed CO₂ hydrogenation selectivity via Ni-ceria support interactions and Ni-Fe bimetallic formation.” *Appl. Catal. B Environ.* (2018) 224: 442–450.
5. Bradley Da Silva, M. Zhang, Guillaume Schelcher, **Lea Winter**, Cedric Guyon, Patrick Tabeling, Daniel Bonn, Michael Tatoulian. “Study of the stability and hydrophilicity of plasma-modified microfluidic materials.” *Plasma Process. Polym.* (2017) 14: 1600034–1600034.
Contribution: Conducted PECVD surface treatments and stability tests, and water contact angle measurements, and contributed intellectually to experimental plans.
6. Dustin W. Fickel, Kaiwalya D. Sabnis, Luanyi Li, Neeta Kulkarni, **Lea R. Winter**, Binhang Yan, Jingguang G. Chen. “Chloromethane to olefins over H-SAPO-34: Probing the hydrocarbon pool mechanism.” *Appl. Catal. A Gen.* (2016) 527: 146–151.
Contribution: Planned and conducted time-resolved in situ FTIR experiments to reveal the surface reaction mechanism, and contributed writing for the related sections.
7. Alon Grinberg Dana, Gal Tvil, **Lea Winter**, Gennady E. Shter, Gideon S. Grader. “Pressure effect on combustion of aqueous urea ammonium nitrate alternative fuel.” *Fuel* (2015) 159: 500-507.
Contribution: Conducted differential thermal analysis and differential barometric analysis, prepared fuel samples, and contributed to manuscript writing.

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8. **Lea Winter**, “Fueling Oil Scarcity: Produced Scarcity and the Sociopolitical Fate of Renewable Energy.” *Journal of International Affairs* (2015) 69.1: 195-206.
9. **Lea Winter**, Mark S. Moore, Kathleen Wu, Caleb Small, Xiyu Wang. “Accommodation strategies for shallow aquifer source limitations.” *International Desalination Association World Congress on Desalination and Water Reuse* (2015): 1-13.
10. Bradley Da Silva, Guillaume Schelcher, **Lea Winter**, Cedric Guyon, Patrick Tabeling, Daniel Bonn, Michael Tatoulian. “Plasma surface modification of a new family of microfluidic chips for biological applications.” *European Cells and Materials* (2013) 26.6: 105.

SELECTED PRESENTATIONS

1. “Plasma-Catalysis” invited Discussion Leader. *Gordon Research Seminar on Plasma Processing Science*, Colby-Sawyer College, New London, NH. *Exp.* 25-26 Jul. 2020. Oral Presentation.
2. “Revealing Plasma Catalysis Mechanisms of N₂ Reduction Using an in-Situ FTIR Dielectric Barrier Discharge Reactor.” *AIChE Annual Meeting*, Hyatt Regency Orlando, Orlando, FL. 13 Nov. 2019. Oral Presentation.
3. “Revealing Plasma Catalysis Mechanisms of N₂ Reduction Using an in-Situ FTIR Dielectric Barrier Discharge Reactor.” *North American Catalysis Society Meeting*, Hyatt Regency Hotel, Chicago, IL. 26 Jun. 2019. Oral Presentation.
4. “Tuning Ni-catalyzed CO₂ hydrogenation pathways via Ni-ceria support interactions and Ni-Fe bimetallic formation.” *AIChE Annual Meeting*, David L. Lawrence Convention Center, Pittsburgh, Pennsylvania. 1 Nov. 2018. Oral presentation.
5. “Plasma-catalysis N₂ reduction mechanisms: Elucidating plasma-catalyst synergies in a novel in-situ FTIR spectroscopy DBD batch reactor GRC plasma processing science.” *Gordon Research Conference on Plasma Processing Science*, Bryant University, Smithfield, RI. 5-10 Aug. 2018. Poster presentation.
6. “Plasma-catalysis N₂ reduction mechanisms: Elucidating plasma-catalyst synergies in a novel in-situ FTIR spectroscopy DBD batch reactor GRC plasma processing science.” *Gordon Research Seminar on Plasma Processing Science*, Bryant University, Smithfield, RI. 4 Aug. 2018. Oral presentation.
7. “Elucidating metal and support contributions and synergies of Ni/CeO₂ under CO₂ hydrogenation reaction conditions.” *Catalysis Society of Metropolitan New York Annual Meeting*, Lehigh University, Bethlehem, PA. 26 Mar. 2018. Poster presentation. **First place poster award.**
8. “Tuning Ni-catalyzed CO₂ hydrogenation pathways via Ni-ceria support interactions and Ni-Fe bimetallic formation.” *Gordon Research Conference on Carbon Capture, Utilization, and Storage*, Colby-Sawyer College, New London, NH. 11-16 Jun. 2017. Poster presentation.
9. “Tuning Ni-catalyzed CO₂ hydrogenation pathways via Ni-ceria support interactions and Ni-Fe bimetallic formation.” *Catalysis Society of Metropolitan New York Annual Meeting*, ExxonMobil Research and Engineering Company, Clinton, NJ. 22 Mar. 2017. Poster presentation.

WORKSHOP PARTICIPATION

X-Ray Absorption Fine Structure (XAFS) Short Course –
Brookhaven National Laboratory, Upton, NY

Fall 2016

NextProf Nexus Workshop 2019 –
GeorgiaTech, Atlanta, GA

Oct. 2019

Participated in a workshop designed to prepare “a select cohort of diverse engineering” students for an academic faculty position.

TEACHING, OUTREACH, AND LEADERSHIP ACTIVITIES

Surface Reactions and Kinetics, Columbia University Graduate-Level Course
Teaching Assistant

Fall 2018

Received Chemical Engineering Dept. TA Excellence Award. Presented review lectures, held office hours, and graded.

Columbia Electrochemical Energy Center

Dec. 2018-Jan. 2019

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Seminar Coordinator

Organized seminar series on electrochemical energy research featuring professors, industry professionals, and Columbia Engineering PhD students. Facilitated student research discussions.

SciRISE (Scientific Research by International Students at ELLIS)

2018-Present

Founder, Club Advisor, Mentor

Led after-school science club for high school students who recently emigrated from countries in Africa, South America, Southeast Asia, and the Middle East. Developed curriculum and project ideas with students, led scientific discussions, taught laboratory and scientific analysis skills. Mentored ~30 students and organized science expo at Columbia University.

Journal Reviewer, ACS Catalysis, Journal of Physics D: Applied Physics

Aug. 2019-Present

Peer-reviewed six journal articles.

Robotics Workshop for High School Students, Columbia University

Nov. 2018

Lead Organizer

Columbia ENG Program, High School Summer Research

July 2018

Developed and delivered a workshop on science presentation skills for high school summer research interns.

In-Class Math and Science Tutor, ELLIS Preparatory Academy

2016-2018

Tutored high school students who recently arrived in the U.S. in math, physics, and chemistry.

Columbia University Ballet Class Instructor, Choreographer, and Ballet Ensemble Soloist

2015-Present

Yale University Chemical Engineering Survey of Florida Desalination Plants

2012-2013

Project Leader

Conceived idea, organized trip, and received funding to survey comparative desalination technologies in Florida water facilities. Prepared and delivered conference paper and presentation at the International Desalination Association World Congress.

Yale-New Haven Summer Science Research Institute

2014-2015

Co-Founder, Co-Coordinator

Co-founded and organized a program to place New Haven high school students in Yale research laboratories.

Yale Urban Debate League

2012-2015

President (2013-2014), Tournament Director (2012-2013), & Coach

SKILLS

- *Laboratory:* Catalyst synthesis techniques, gas handling techniques; flow reactor and high-vacuum reactor design, assembly, and repair; FTIR spectroscopy, gas chromatography, mass spectrometry, X-ray diffraction; high voltage plasma systems and circuits; cell culture, PCR, DNA/RNA extraction
- *Computer:* MATLAB, Autodesk Inventor 3D CAD, Athena XANES analysis, HSC Chemistry, ImageJ, ASPEN Hysis, Microsoft Office Suite, Wolfram Alpha
- *Language:* Hebrew (advanced), French (intermediate)