Negative Emissions Science

The Fourth Annual Scialog Conference
November 15–18, 2023

scialog 2023®

ALFRED P. SLOAN FOUNDATION

RESEARCH CORPORATION *for* SCIENCE ADVANCEMENT

climateworks FOUNDATION

Objectives

Engage in dialogue with the goal of accelerating high-risk/high-reward research.

Identify and analyze bottlenecks to advance fundamental understanding of negative emissions science and develop approaches for breakthroughs.

Build a creative, better-networked community that is more likely to produce breakthroughs.

Form teams to write proposals to seed novel projects based on highly innovative ideas that emerge at the conference.

Process

Brainstorming is welcome; don't be afraid to say what comes to mind.

Consider the possibility of unorthodox or unusual ideas without immediately dismissing them.

Discuss, build upon and constructively criticize each other's ideas — in a spirit of cooperative give and take.

Make comments concise to avoid monopolizing the dialogue.

Diversity, Inclusion and No Harassment

Research Corporation for Science Advancement fosters an inclusive and respectful environment for listening in which the different identities, backgrounds, and perspectives of all participants are valued, and in which everyone is empowered to share ideas as fellow scientists.

RCSA does not tolerate any form of harassment, which could include verbal or physical conduct that has the purpose or effect of substantially interfering with anyone else's participation or performance at this conference, or of creating an intimidating, hostile, or offensive environment; any such harassment may result in dismissal from the conference.

Read RCSA's Code of Conduct

From the President

Welcome to the *2023 Scialog: Negative Emissions Science* meeting, cosponsored by Research Corporation and the Alfred P. Sloan Foundation, with additional support provided by ClimateWorks Foundation. This is the fourth annual Scialog meeting on this theme and the second in person. We hope the face-to-face exchanges, including informal times, will offer an even richer experience than last year's virtual meeting. We hope you find the experience of writing team proposals "on the spot" exciting and rewarding.

The goal of this Scialog is to catalyze theorists, computational scientists, and experimentalists across multiple disciplines to collaborate on developing new and innovative projects to accelerate fundamental science to drive advances in understanding the underlying science that will allow negative emissions technologies to become efficient, affordable, and scalable.

Scialog's overarching purpose is to advance cutting-edge science of great significance to humanity by catalyzing innovative, basic research leading to fundamental discoveries. Our focus is on scientists in the early years of their independent careers. Through the unique Scialog process, we seek to lay the foundation for an ongoing, highly creative, cross-disciplinary community of scientists that will prove adept at identifying exciting areas for research advances for decades to come.

To that end, under the guidance of Program Directors **Richard Wiener**, **Andrew Feig**, **Silvia Ronco,** and **Eileen Spain** of RCSA, and **Evan Michelson** and **Isabella Gee** of the Sloan Foundation, we hope you will be engaged in passionate discussions with colleagues, many of whom you will have met for the first time at Scialog. The process may even push you out of your comfort zone with the goal of stimulating new and better ideas. The result, we expect, will be a meeting unlike others that you attend. We are confident that you will find the next few days to be extremely worthwhile.

This is your opportunity to air that wild idea you have been reluctant to share with others, or to discuss a nagging hunch that does not yet have sufficient supporting data, or to take a leap on a high-impact/high-risk project instead of concentrating all your effort on somewhat more "incremental" studies. This is the time to come up with, and be open to, completely new ideas that may truly change the world.

We hope this third meeting on this topic yields a crop of outstanding team proposals, which will make our job of determining who receives funding very challenging. I wish you every success in exploring new and compelling ideas over the next few days.

Have a terrific meeting!

Daniel Linzer
President
Research Corporation for Science Advancement

From the Program Director

Research Corporation's highly interactive Scialog meetings aim to catalyze new collaborations, based on blue-sky ideas, among a highly select group of exemplary early career U.S. and Canadian scientists. For Scialog Fellows, the emphasis is on dialogue, networking, and building new teams to pursue novel, high-risk discovery research.

Cosponsors Research Corporation and the Alfred P. Sloan Foundation, with additional support from Climate Pathfinders Foundation and ClimateWorks Foundation, chose to focus on Negative Emissions Science because we believe this critical area of science requires major breakthroughs in fundamental understanding of capturing and utilizing or sequestering carbon and other greenhouse gases in the atmosphere and oceans that will lead to a sustainable future. Just as firmly, we believe these breakthroughs can be accelerated by chemists and engineers and those in related fields working collaboratively on novel, high-risk projects, particularly combining multiple research approaches, such as modeling, data science, and experiments.

We have an outstanding keynote speaker to set the stage for breakout discussions: **Chris Jones**, Georgia Institute of Technology.

We have a team of terrific discussion facilitators: **Roger Aines**, Lawrence Livermore National Laboratory; **Sarbajit Banerjee**, Texas A&M University; **Jordi Cabana**, University of Illinois at Chicago; **Luis Campos**, Columbia University; **Nancy Haegel**, National Renewable Energy Laboratory; **Chris Jones**, Georgia Tech; **Amy Landis**, Colorado School of Mines, **Aleksandra Vojvodic,** University of Pennsylvania; and **George Shields**, Furman University.

Program representatives **Evan Michelson** and **Isabella Gee** of the Alfred P. Sloan Foundation, **Sam Abernethy** of Spark Climate Solutions, and **Rose Cox-Galhotra** and **Adria Wilson** of Breakthrough Energy are looking forward to interacting with Fellows and Facilitators.

Scialog meetings focus on dialogue and team building with the goal of creating novel strategies and collaborative approaches. An important feature is the opportunity for Scialog Fellows to form teams and write proposals to pursue particularly creative ideas that emerge through the dialogue. We hope this competition is exciting, but regardless of which proposals are funded, the primary purpose is to catalyze a deeper and more meaningful exchange of ideas than ordinarily occurs at scientific conferences. Our intent is for this process to help participants gain new insights and connections that significantly advance fundamental science.

We hope each participant finds the Scialog experience of great value. Please do not hesitate to provide feedback on how to make the conference better. My fellow RCSA Program Directors, Andrew Feig and Silvia Ronco, the RCSA staff, and I are here to help make the meeting a great experience!

Richard Wiener
Senior Program Director
Research Corporation for Science Advancement

Scialog: Negative Emissions Science

Conference Agenda
November 15 - 18, 2023

Wednesday, November 15

2:00 pm	**Registration Opens**	Sonoran Foyer
2:00 – 5:00 pm	**Snacks & Informal Discussions**	Sonoran Foyer
5:00 – 6:30 pm	**Poster Session and Reception**	Murphey/Murphey Patio
6:00 – 6:30 pm	**Meeting for Discussion Facilitators**	Sonoran
6:30 – 7:30 pm	**Dinner**	Murphey Patio
7:30 – 8:30 pm	**Welcome** Dan Linzer, President, RCSA Evan Michelson, Program Director, Sloan Foundation **Conference Overview, Outcomes and Proposal Guidelines** Richard Wiener, Senior Program Director, RCSA **Introductions/Ice Breakers**	Sonoran
8:30 – 11:00 pm	**Starlight Cafe**	Murphey/Murphey Patio

Thursday, November 16

7:00 – 8:00 am	**Breakfast**	Murphey/Murphey Patio
8:00 – 8:45 am	**Keynote Presentation** *Direct Air Capture (DAC) of CO_2 with Porous Sorbent Materials Coupled with Scalable Processes* **Chris Jones, Georgia Tech**	Sonoran
8:45 – 9:00 am	**Breakout Session Overview and Instructions**	Sonoran
9:00 – 10:15 am	**Breakout Session I**	Sonoran, Sunsations, Finger Rock I, II and III
10:15 – 10:35 am	**Report Out**	Sonoran
10:35 – 10:45 am	**Conference Photo**	Stairs – Murphey Patio
10:45 – 11:15 am	**Morning Break**	Sonoran Foyer
11:15 – 11:45 am	**Mini Breakout Session I (Fellows)** **Facilitator Meeting (Facilitators)**	All spaces Sunsations
11:45 – 1:00 pm	**Lunch**	Murphey/Murphey Patio
1:00 – 2:15 pm	**Breakout Session II**	Sonoran, Sunsations, Finger Rock I, II and III
2:15 – 2:35 pm	**Report Out**	Sonoran
2:35 – 3:05 pm	**Mini Breakout Session II (Fellows)**	All spaces
3:05 – 5:15 pm	**Afternoon Break**	Sonoran Foyer
5:15 – 6:30 pm	**Poster Session and Reception**	Murphey/Murphey Patio
6:30 – 7:30 pm	**Dinner**	Murphey/Murphey Patio
7:30 – 8:15 pm	**2022 Team Award Presentations**	Sonoran
8:15 – 11:00 pm	**Starlight Cafe**	Murphey/Murphey Patio

Friday, November 17

7:00 – 8:00 am	**Breakfast**	Murphey/Murphey Patio
8:00 – 8:45 am	**2022 Team Award Presentations**	Sonoran
8:45 – 9:15 am	**Mini Breakout Session III (Fellows)**	All spaces
9:15 – 9:45 am	**Morning Break**	Sonoran Foyer
9:45 – 11:00 am	**Breakout Session III**	Sonoran, Sunsations, Finger Rock I, II and III
11:00 – 11:20 am	**Report Out**	Sonoran
11:20 – 11:50 am	**Mini Breakout Session IV (Fellows)** **Facilitator and Funding Partners Discussion**	All spaces Sunsations
11:50 – 1:00 pm	**Lunch**	Murphey/Murphey Patio
1:00 – 5:45 pm	**Team Formation, Informal Discussions and Proposal Writing**	All spaces
5:45 – 6:30 pm	**Reception**	Murphey/Murphey Patio
6:30 – 7:30 pm	**Dinner**	Murphey/Murphey Patio
7:30 – 11:00 pm	**Starlight Cafe**	Murphey/Murphey Patio

Saturday, November 18

6:30 – 7:30 am	**Breakfast**	Murphey/Murphey Patio
7:30 – 11:00 am	**Presentation of Proposals** **Assessment Survey and Wrap-up**	Sonoran
11:00 – 12:00 pm	**Lunch (available to go)**	Sonoran Foyer

Keynote Speaker

Direct Air Capture (DAC) of CO_2 with Porous Sorbent Materials Coupled with Scalable Processes

Christopher W. Jones
Georgia Institute of Technology

Abstract: Worldwide energy demand is projected to grow strongly in the coming decades. Even with unprecedented growth rates in the development of renewable energy technologies such as solar, wind and bioenergy, the world will continue to rely on fossil fuels as the predominant energy source for at least the next decade. Simultaneously, due to decades of inaction, current climate models as well as the recent IPCC AR6 Climate Change Report state that limiting warming to <2°C will require large scale deployment of negative emissions technologies (NETs). NETs, which remove CO_2 from the atmosphere, are projected to be needed at a scale of 10 Gt/y by 2060, yet today, virtually none have been deployed. NETs may be natural or technological, with one of the most scalable technological approaches being the direct capture of CO_2 from the air, or "direct air capture" (DAC). Because of the ultra-dilute nature of CO_2 in air, the separation of CO_2 from this mixture presents a significant engineering challenge.

In this lecture, I will describe the design and synthesis, characterization, and application of supported amine materials and other nanoporous materials that we have developed as cornerstones of new technologies for the removal of CO_2 from ultra-dilute (air) gas streams. The amine chemisorbents efficiently remove CO_2 from simulated flue gas streams, and the CO_2 capacities are enhanced by the presence of water, unlike the case of physisorbents such as zeolites. We will describe the development of these materials, how they integrate into scalable DAC technologies, as well as their key physicochemical structure-property relationships. DAC technologies offer an interesting case study for the parallel design of materials, unit operations, and processes in chemical engineering. Contemporary challenges in DAC will be discussed.

Biography: Professor Jones is the John F. Brock III School Chair and Professor of Chemical & Biomolecular Engineering at Georgia Tech. Dr. Jones leads a research group that works on materials, catalysis and adsorption. He is known for his work on materials that extract CO_2 from ultra-dilute mixtures such as ambient air, which are key components of direct air capture (DAC) technologies. He also has produced an extensive body of work in catalysis. Jones's work in both catalysis and CO_2 separation has been recognized with awards from numerous organizations.

Scialog: NES Team Awards 2022

BioDAC: Integrating Enzyme Engineering & Electrochemistry for Sustainable Acrylate Production
Ahmed Badran, Chemistry / Integrative Structural and Computational Biology, Scripps Research Institute *
Jimmy Jiang, Chemistry, University of Cincinnati *
Shaama Mallikarjun Sharada, Chemical Engineering and Materials Science, University of Southern California *

Electro-swing Modulation of Lipophilic Environments for Direct Air Capture of Methane
Yuanyue Liu, Mechanical Engineering, University of Texas at Austin ^
Phillip Milner, Chemistry and Chemical Biology, Cornell University ^
Marcel Schreier, Chemical and Biological Engineering, University of Wisconsin - Madison ^

Surface Charge-induced CO2 Solvent Regeneration Via Free Volume Manipulation
Chibueze Amanchukwu, Pritzker School of Molecular Engineering, University of Chicago *
Yayuan Liu, Chemical and Biomolecular Engineering, Johns Hopkins University *
Houlong Zhuang, Engineering of Matter, Transport & Energy, Arizona State University ^

Sunlight Driven CO2 Capture and Release
Kandis Leslie Abdul-Aziz, Chemical and Environmental Engineering, University of California, Riverside*
Mita Dasog, Chemistry, Dalhousie University *

Robust Scalable Multifunctional Electrode for CO2 Reduction and C-C Coupling in Seawater
Will Bowman, Materials Science and Engineering, University of California, Irvine †
Jose Mendoza, Chemical Engineering and Materials Science, Michigan State University †
Hang Ren, Chemistry, University of Texas at Austin †

Triple-intensified Process for Direct Carbon-negative Methanol Synthesis from Biogas
Anindita Das, Chemistry, Southern Methodist University *
Simona Liguori, Chemical & Biomolecular Engineering, Clarkson University *
Rafael Santos, School of Engineering, University of Guelph *

A Radical Approach to Negative Methane Emissions
Adam Holewinski, Chemical & Biological Engineering, University of Colorado Boulder ^
Anna Wuttig, Chemistry, University of Chicago ^

* Funded by Alfred P. Sloan Foundation
^ Funded by RCSA
† Funded by ClimateWorks Foundation

Scialog: NES Team Awards 2021

Electrocatalytic Activation and Cycling of Moisture-Swing Direct Air Capture Materials
Matthew Green, Chemical Engineering, Arizona State University †
Gary Moore, School of Molecular Sciences, Arizona State University †
Emily Ryan, Mechanical Engineering, Boston University †

Carbon Dioxide-Methane Coupling with Electric-Field-Polarized Microelectrodes
Zhou Lin, Chemistry, University of Massachusetts Amherst *
Yayuan Liu, Chemical and Biomolecular Engineering, Johns Hopkins University *
Sen Zhang, Chemistry, University of Virginia *

Photochemical Amine Production from N2 and CO2
Marta Hatzell, Mechanical Engineering, Georgia Institute of Technology †
Kathryn Knowles, Chemistry, University of Rochester †
Jose Mendoza, Chemical Engineering and Materials Science, Michigan State University †

Carbon Dioxide Removal from Seawater Driven by a Visible Light-Induced pH Gradient
David Kwabi, Mechanical Engineering, University of Michigan †
Michael Nippe, Chemistry, Texas A&M University, College Station †

Novel Membrane Design for Hybrid Ocean Capture and Desalination
Matthew Green, Chemical Engineering, Arizona State University *
Katherine Hornbostel, Mechanical Engineering & Materials Science, University of Pittsburgh *
Jenny Yang, Chemistry, University of California Irvine *

Electrified Low-Temperature Process for CO2 Capture and Conversion (e-LT-C3)
Charles McCrory, Chemistry, University of Michigan †
Carlos Morales-Guio, Chemical and Biomolecular Engineering, University of California, Los Angeles †

CO2 Conversion to Bioplastics via Electrochemical-Bio Synthesis
Andrea Hicks, Civil and Environmental Engineering, University of Wisconsin - Madison *
Chong Liu, Chemistry and Biochemistry, University of California, Los Angeles *
Haotian Wang, Chemical and Biomolecular Engineering, Rice University *

Electric-Swing Solid State Sorbents for Direct Air Capture of CO2
Adam Holewinski, Chemical & Biological Engineering, University of Colorado Boulder *
Katherine Hornbostel, Mechanical Engineering & Materials Science, University of Pittsburgh †
Yuanyue Liu, Mechanical Engineering, University of Texas at Austin *

** Funded by RCSA*
† Funded by Alfred P. Sloan Foundation

Scialog: NES Team Awards 2020

Electrifying Humidity-Swing Adsorption for DAC by Modulation of Redox-Polymer Hydration
Shaama Mallikarjun Sharada, Chemical Engineering and Materials Science, University of Southern California †
Burcu Gurkan, Chemical and Biomolecular Engineering, Case Western Reserve University †
Xiao Su, Chemical and Biomolecular Engineering, University of Illinois at Urbana-Champaign †

Using Electrochemistry to Improve Selectivity of Plasma-Assisted CO2 Reduction
William Bowman, Materials Science and Engineering, University of California, Irvine †
Eva Nichols, Chemistry, University of British Columbia †
Robert Coridan, Chemistry and Biochemistry, University of Arkansas †

Integrated Low-Temperature Electrified Process for CO2 Direct Air Capture and Transformation to Solid Carbon
Kathryn Knowles, Chemistry, University of Rochester *
Carlos Morales-Guio, Chemical and Biomolecular Engineering, University of California, Los Angeles *
Robert Coridan, Chemistry and Biochemistry, University of Arkansas *

Investigation of the Carbonation Dynamics of Synthetic Silicates: Guiding the Development of Net-Negative Production Process and Deployment in Enhanced Rock Weathering
Rafael Santos, School of Engineering, University of Guelph ††
Pratik Dholabhai, Physics and Astronomy, Rochester Institute of Technology *
Andrea Hicks, Civil and Environmental Engineering, University of Wisconsin - Madison *

Bricks from The Ocean: Hybrid Microbial-Electrochemical Mineralization of CO2
Nanette Boyle, Chemical & Biological Engineering, Colorado School of Mines *
Shu Hu, Chemical and Environmental Engineering, Yale University ††

Solar-Augmented Direct Air Capture of Methane Using Methanotrophic Bacteria
Nanette Boyle, Chemical & Biological Engineering, Colorado School of Mines *
Chong Liu, Chemistry and Biochemistry, University of California, Los Angeles *

Envisioning a Low Carbon Built Environment through Innovative Electrochemical and Chemical Processing of Construction Materials and Enhanced Circular Reuse
Greeshma Gadikota, Civil and Environmental Engineering, Cornell University ††
Venkat Viswanathan, Mechanical Engineering, Carnegie Mellon University ††

Electrochemically Driven Reactive Capture of CO2 from Air Using Azolium-Carboxylates
Wilson Smith, Chemical and Biological Engineering, University of Colorado Boulder *
David Kwabi, Mechanical Engineering, University of Michigan *
Robert Gilliard, Department of Chemistry, University of Virginia *

* *Funded by the Alfred P. Sloan Foundation*
† *Funded by RCSA*
†† *Funded by the Thistledown Foundation*

2023 Proposal Guidelines

Scialog: Negative Emissions Science

1. Awards are intended to provide seed funding for teams of two to three Scialog Fellows formed at this conference for high-risk, high-impact projects.

2. The application package should be submitted as a single PDF file. Pages one and two should describe the project and role of each team member. A third page may be used for references. No budget is necessary.

3. Awards will be in the amount of $50K direct funding per team member, plus a small percentage for overhead. Grant duration will be one year.

4. No Scialog Fellow can be a member of more than two teams. If a Scialog Fellow is a member of two teams, other members of the teams must be different. No team can submit more than one proposal.

5. No Scialog Fellow who previously has won a Scialog NES Collaborative Award can be a member of more than one team. The other team members must be different from the members of the previously awarded team.

6. Teams cannot include members who have previously collaborated with one another. If you are unsure of your status (e.g., prospective team members were part of a large collaboration but did not significantly interact), please check for clarification with an RCSA program director.

7. Teams are encouraged (but not required) to:
    a. Include members with different research approaches and methods.
    b. Include members from different disciplines.

8. Proposals must be submitted electronically by **6:30 a.m. PST Saturday, November 18, 2023.** Instructions for submission will be provided at the meeting.

9. Awards are anticipated to start on **February 1, 2024**.

Scialog Fellows

Ahmed Badran ahbadran@scripps.edu
Chemistry / Integrative Structural and Computational Biology, Scripps Research Institute
The development of bioengineering strategies to capture greenhouse gases (e.g. carbon dioxide, methane) and convert them into useful materials.

Chris Bartel cbartel@umn.edu
Chemical Engineering and Materials Science, University of Minnesota Twin Cities
My group uses first-principles calculations and machine learning to accelerate the design and discovery of inorganic solids for energy conversion and storage applications. Our main areas of expertise are ab initio thermodynamics, solid-state chemistry, and data science.

Fani Boukouvala fboukouvala6@gatech.edu
Chemical & Biomolecular Engineering, Georgia Institute of Technology
I lead the Data-Driven Process Systems Engineering Lab, which focuses on merging machine learning, mathematical programming and chemical engineering to optimize complex systems in for carbon capture, power-grids, plastics recycling and biochemical manufacturing.

Will Bowman will.bowman@uci.edu
Materials science and engineering, University of California, Irvine
Materials for carbon capture, utilization and storage, and energy conversion and storage. Advanced transmission electron microscopy and spectroscopy. Electrochemical properties and defect chemistry of ceramics, nanomaterials, interfaces, and surfaces.

Juliana Carneiro js6441@columbia.edu
Chemical Engineering, Columbia University
My research interests lie in developing active, selective, and stable electrocatalysis for electrochemical conversion and separation processes, including the electrochemical recycling/upcycling of plastics, and the capture, utilization or storage of atmospheric and oceanic CO_2.

Rebecca Ciez rciez@purdue.edu
Mechanical Engineering & Environmental and Ecological Engineering, Purdue University
I study the economic and environmental impacts of decarbonization technologies using techno-economic models, life cycle assessment, and quantitative social science techniques.

Anindita Das aninditad@smu.edu
Chemistry, Southern Methodist University
My lab's research focuses on addressing the current challenges faced by materials chemists to build heterogeneous systems with atomic precision for applications in catalysis.

Rachel Davidson rachelda@udel.edu
Chemistry and Biochemistry, University of Delaware
We are exploring electrochemical additive manufacturing as a means of directing growth of nano arrays and 3D architectures and are focused on understanding the evolution of crystal structure-electronic structure-electrochemical activity relations in CO_2 reduction electrocatalysts.

Scialog Fellows Continued

Luis De Jesus Baez ldjesus@buffalo.edu
Chemistry, University at Buffalo SUNY
We navigate the intersection between materials, physical, and inorganic chemistry to furnish a fundamental understanding of the morphology–composition–entropy relationship to property.

Pratik Dholabhai pratik.dholabhai@rit.edu
Physics And Astronomy, Rochester Institute of Technology
Computational materials scientist and condensed matter physicist with expertise in application and development of atomistic simulation methods to design novel materials and technologies.

Liang Feng liang.feng@duke.edu
Mechanical Engineering and Materials Science, Duke University
Interested in exploring supramolecular, polymeric, and porous materials to design innovative non-equilibrium adsorption mechanisms for carbon capture & utilization, and hydrogen storage. Committed to advancing climate and sustainability solutions.

Ariel Furst afurst@mit.edu
Chemical Engineering, Massachusetts Institute of Technology
The Furst Group develops platforms to support global energy equity by engineering microbes for easy-to-use, inexpensive, and portable technologies for sustainability and environmental remediation.

Prashun Gorai pgorai@mines.edu
Metallurgical and Materials Engineering, Colorado School of Mines
We use quantum-chemical calculations, high-throughtput computing, and machine learning to accelerate the discovery and design of functional materials for energy conversion and storage, and next-generation microelectronics. We are also interested in defect properties of materials.

Andrea Hicks hicks5@wisc.edu
Civil and Environmental Engineering, University of Wisconsin - Madison
Environmental impacts and sustainability implications of emerging technologies. Using tools such as life cycle assessment, techno-economic assessment, and agent based modeling in order to better understand the potential for carbon negative technologies.

Joshua Jack jdjack@umich.edu
Civil & Environmental Engineering, University of Michigan
Joshua 's lab focuses on the development of hybrid electrochemical-biological technologies for scalable CO_2 capture and conversion into value-added fuels and chemicals.

Dohyung Kim dohyungk@seas.upenn.edu
Chemical and Biomolecular Engineering, University of Pennsylvania
My group is focused on advancing the manipulation of solid-liquid interfaces at the nanoscale for energy and catalytic applications with the goal to address the current limitations in achieving comprehensive control over electrochemical reactions and enhancing their complexity.

Scialog Fellows Continued

Yuzhang Li yuzhangli@ucla.edu
Chemical and Biomolecular Engineering, University of California, Los Angeles
The Li group invents new tools and materials that can accelerate next-generation renewable energy solutions. These efforts have led to significant breakthroughs in our understanding of batteries (Science 358, 506, 2017) and electrocatalysts (Nature Energy 8, 138, 2023).

Simona Liguori sliguori@clarkson.edu
Chemical and Biomolecular Engineering, Clarkson University
My research interests are focused on development of inorganic membranes and membrane reactors, non-equilibrium reactions, gas separation and negative emission technologies.

Zhou Lin zhoulin@umass.edu
Chemistry, University of Massachusetts Amherst
Development and application of quantum mechanical models for spectroscopy, dynamics, photochemistry, and electrochemistry for a variety systems, especially molecular ions, organic semiconductors, and heterogeneous catalysis.

Yuanyue Liu yuanyue.liu@austin.utexas.edu
Mechanical Engineering, University of Texas at Austin
Atomistic modeling of materials

Oana R. Luca oana.luca@colorado.edu
Chemistry, University of Colorado Boulder
My team is interested in electrochemical methods for carbon capture, storage and conversion of carbon dioxide and nitrogen as well as the development of new reactions for electrified materials recycling.

Yuezhi Mao ymao2@sdsu.edu
Chemistry and Biochemistry, San Diego State University
Our research centers on the development of theoretical methods and computational protocols with applications to topics ranging from molecular and enzyme catalysis to photochemical and electron transfer processes in complex environments.

Michael McGuirk cmmcguirk@mines.edu
Chemistry, Colorado School of Mines
Organic and hybrid materials, supramolecular assembly, and environmental sustainability, leveraging expertise in non-covalent interactions, structural order, and chemical reactivity to develop synthetic tools for the construction and programmed destruction of materials.

Gary Moore gary.f.moore@asu.edu
Molecular Sciences, Arizona State University
The G. F. Moore Research Group has interests in chemistry to build nanoscale materials that are fundamentally interesting, use-inspired, and address societal challenges.

Scialog Fellows Continued

Carlos Morales-Guio moralesguio@ucla.edu
Chemical and Biomolecular Engineering, University of California, Los Angeles
Interested in reactive carbon capture, the development of reactors and their scale-up.

Ivan Moreno-Hernandez ivan.moreno-hernandez@duke.edu
Chemistry, Duke University
The Moreno-Hernandez Laboratory specializes in utilizing liquid phase transmission electron microscopy (LPTEM) techniques to understand the nanoscale structural dynamics of electrochemical materials relevant to renewable energy technologies.

Eva Nichols enichols@chem.ubc.ca
Chemistry, University of British Columbia
My research interests lie in the area of sustainable electrocatalysis, with an emphasis on the reduction of CO_2 and CO to valuable products. We study catalysts under operating conditions to better understand the relevant parameters governing catalyst efficiency and selectivity.

Michael Nippe nippe@chem.tamu.edu
Chemistry, Texas A&M University
Experimental fundamental scientific studies at the molecular level for aspects of carbon capture and conversion including molecular electrochemistry.

Oscar Nordness oan2106@columbia.edu
Earth and Environmental Engineering, Columbia University
My research group focuses on quantifying the fundamental mechanisms governing transport and thermodynamics of electrolyte systems and leveraging these insights in order to design novel materials for next generation sustainable energy production and carbon management technologies.

Bin Ouyang bouyang@fsu.edu
Chemistry and Biochemistry, Florida State University
Multi-scale computational modeling, high throughput materials discovery, machine learning

Shima Parsa shima.parsa@rit.edu
Physics and Astronomy, Rochester Institute of Technology
My research is focused on reactive transport aim porous media. I study the effects of rock dissolution, and salt precipitation in small pores on the transport properties in subsurface experimentally.

Marc Porosoff marc.porosoff@rochester.edu
Chemical Engineering, University of Rochester
My group studies heterogeneous thermal catalysis for energy applications, focusing on C1 chemistry to value-added compounds. We run a combination of reactor experiments, kinetic studies and in situ characterization. We are exploring AI to redefine catalyst representation.

Scialog Fellows Continued

Zhe Qiang zhe.qiang@usm.edu
Polymer Science and Engineering, University of Southern Mississippi
My research focuses on materials and manufacturing innovations to unlock the power of plastic wastes for developing a sustainable and emission-negative future, enabling their use for carbon capture, water remediation, and electrical heating.

Lina Quan linaquan@vt.edu
Chemistry, Virginia Polytechnic Institute and State University
Our research primarily revolves around the synthesis of solution-processable semiconductors and their applications in renewable energy, particularly in hydrogen generation and water electrolysis.

Douglas Reed dreed4@uw.edu
Chemistry, University of Washington
The Reed lab utilizes new synthetic strategies to create adsorbents using novel building blocks. These new materials have relevant properties including phase-change capabilities and self-healing characteristics for sustainable and low-energy separations.

Hang Ren hren@utexas.edu
Chemistry, University of Texas at Austin
We are interested in developing electroanalytical chemistry tools to study important electrochemical interfaces in energy conversion and storage processes, including electrocatalysis and electrosynthesis.

Michael Ross michael_ross@uml.edu
Chemistry, University of Massachusetts Lowell
CO2 reduction electrocatalysis. Hydrogen evolution reaction electrocatalysis. Nanomaterials. Alloys and intermetallics. Plasmonics. Structural and in situ spectroscopy and scattering (XAS, PDF).

Rafael Santos santosr@uoguelph.ca
Engineering, University of Guelph
I continue to be active in enhanced rock weathering (ERW) research and knowledge transfer. I have recently engaged with various monitoring, reporting and verification (MRV) companies and academic groups, and I am advising and collaborating with them to deploy ERW globally.

Caroline Saouma caroline.saouma@utah.edu
Chemistry, University of Utah
My group aims to improve catalytic processes that are pertinent to future energy schemes. This entails ligand/catalyst design, establishing how catalyst structure impacts reactivity/energetics, and determining how reaction conditions alter the energetic profile.

Marcel Schreier mschreier2@wisc.edu
Chemical and Biological Engineering, University of Wisconsin - Madison
I pursue a strong fundamental interest in understanding how electrified interfaces make and break chemical bonds. My group takes a molecular perspective to improve electrochemical technologies and to expand electrocatalysis into uncharted territories of sustainable chemistry.

Scialog Fellows Continued

Ben Snyder bsnyder@illinois.edu
Chemistry, University of Illinois at Urbana-Champaign
Our group uses inorganic spectroscopy and electronic structure calculations to guide the synthesis of next-generation porous materials - particularly, heterogeneous catalysts and solid adsorbents based on zeolites and metal–organic frameworks.

Wen Song wensong@utexas.edu
Center for Subsurface Energy and the Environment, University of Texas at Austin
Overview: My overall research goals are to help enable the transition toward a low-carbon energy future by understanding and controlling the fundamental multiphase reactive transport mechanisms in porous geologic materials relevant to decarbonization.

Kyriakos Stylianou kyriakos.stylianou@oregonstate.edu
Chemistry, Oregon State University
carbon capture and utilization; porous materials

Meng Wang meng.wang@pitt.edu
Civil and Environmental Engineering, University of Pittsburgh
My group is interested in developing biocatalytic methods for carbon sequestration and storage in seawater and other saline waters. Specifically, we are focusing on designing protein cage-based bionanoreactors to accelerate carbon mineralization in seawater.

Shuya Wei swei@unm.edu
Chemical and Biological Engineering, University of New Mexico
I focus on understanding the fundamental aspects of electrochemical processes occurring in electrodes and at electrode/electrolyte interfaces. Our lab aims to develop advanced metal-based batteries with high energy density for applications in energy and the environment.

Anna Wuttig awuttig@uchicago.edu
Chemistry, University of Chicago
We develop electricity-driven reactions that span the chemical value chain by drawing on physical and synthetic inorganic and organic tools to advance the underlying science gating chemical reactivity at electrified interfaces.

Xin Xu xxu@asu.edu
The Polytechnic School, Arizona State University - Polytechnic Campus
Dr. Xu’s research interests focus on charge transport, solid-state batteries and next-generation clean energy technology. The primary focus lies in the fundamental understanding of charge transport and failure mechanisms in electrochemical systems.

Yuan Yao y.yao@yale.edu
Yale School of the Environment, Yale University
My research investigates the environmental and economic implications of emerging technologies and industrial decarbonization. I use interdisciplinary approaches in industrial ecology, sustainable engineering, and machine learning.

Scialog Fellows Continued

Sen Zhang sz3t@virginia.edu
Chemistry, University of Virginia
My research interests are in nanomaterials controlled synthesis, assembly, and catalysis for reactions involved in energy and environmental applications, such as fuel cells, water splitting, CO2-to-fuel conversion, and biomass conversion.

Houlong Zhuang zhuanghl@asu.edu
School for Engineering of Matter, Transport & Energy, Arizona State University
Quantum mechanical and machine learning simulations to design and discover materials for CO2 capture.

Discussion Facilitators

Roger Aines aines1@llnl.gov
Atmospheric, Earth, and Energy Division, Lawrence Livermore National Laboratory
Carbon dioxide removal from air, geologic storage of CO_2, electrochemistry, systems studies of CDR supply chains and impacts.

Sarbajit Banerjee banerjee@chem.tamu.edu
Chemistry, Texas A&M University
My research group deciphers foundational mechanisms, develops spectroscopic tools, and designs materials of relevance to the energy transition, climate technologies, and energy security. We further have an interest in understanding global flows of critical materials.

Jordi Cabana jcabana@uic.edu
Chemistry / Materials Science Division, University of Illinois Chicago
We conduct research in inorganic solid state chemistry at Argonne National Laboratory and University of Illinois Chicago. Current emphasis in materials in electrochemical environments and for applications in energy technology and decarbonization.

Luis Campos lcampos@columbia.edu
Chemistry, Columbia University
We are interested in studying the fundamental properties of polymeric materials, from molecular building blocks and their macromolecular function, to nanostructured assemblies. Recent focus lies on CO_2-based polymers, multiexciton processes, and the chemistry of polymer networks.

Nancy Haegel nancy.haegel@nrel.gov
Materials Science, National Renewable Energy Laboratory
I am a senior research advisor at the National Renewable Energy Laboratory (NREL) and former Center Director for Materials Science. Her research interests are in the semiconductor physics, novel materials, device and materials characterization and renewable energy.

Christopher Jones cjones@chbe.gatech.edu
School of Chemical & Biomolecular Engineering, Georgia Institute of Technology
DAC, CO_2 conversion

Amy Landis amylandis@mines.edu
Civil & Environmetal Engineering, Colorado School of Mines
Sustainable energy systems, energy justice, life cycle assessment, material flow analysis, biofuels, bioenergy, Bioplastics

George Shields george.shields@furman.edu
Chemistry, Furman University
I am a computational chemist who uses various methodologies to investigate a wide range of scientific problems. I am interested in the development of catalysts that will convert CO_2 to useful molecules.

Discussion Facilitators Continued

Aleksandra Vojvodic alevoj@seas.upenn.edu
Chemical and Biomolecular Engineering, University of Pennsylvania
Theoretical and computational-driven materials design using computational frameworks to obtain fundamental understanding of surface and interface properties of complex materials for chemical transformations, energy conversion, and sustainable chemistry, e.g., CO_2 capture+capture.

Guests

Sam Abernethy sabernet@stanford.edu
Science, Spark Climate Solutions
Sam's past research includes Earth system modeling, determining how to compare different greenhouse gasses, and evaluating different methane removal technologies. At Spark, Sam is focused on methane removal scientific roadmapping and program-building.

Rose Cox-Galhotra rosemary@breakthroughenergy.org
Fellows Program, Breakthrough Energy
Early-stage technologies that have the potential to eliminate 0.5 Gt of CO_2 emissions per year by 2050 when deployed at scale.

Isabella Gee gee@sloan.org
Energy and Environment Program, Alfred P. Sloan Foundation
Supporting academic research, training, and networking activities to inform the societal transition to low-carbon energy systems in the United States.

Evan Michelson michelson@sloan.org
Energy and Environment Program, Alfred P. Sloan Foundation
Negative Emissions Science.

Adria Wilson adria@breakthroughenergy.org
US Policy and Advocacy, Breakthrough Energy
My research interests include any that are relevant to the development and enablement of clean and affordable energy technologies that substantially reduce greenhouse gas emissions and which are necessary to achieve net-zero emissions by midcentury.

Scialog: Negative Emissions Science

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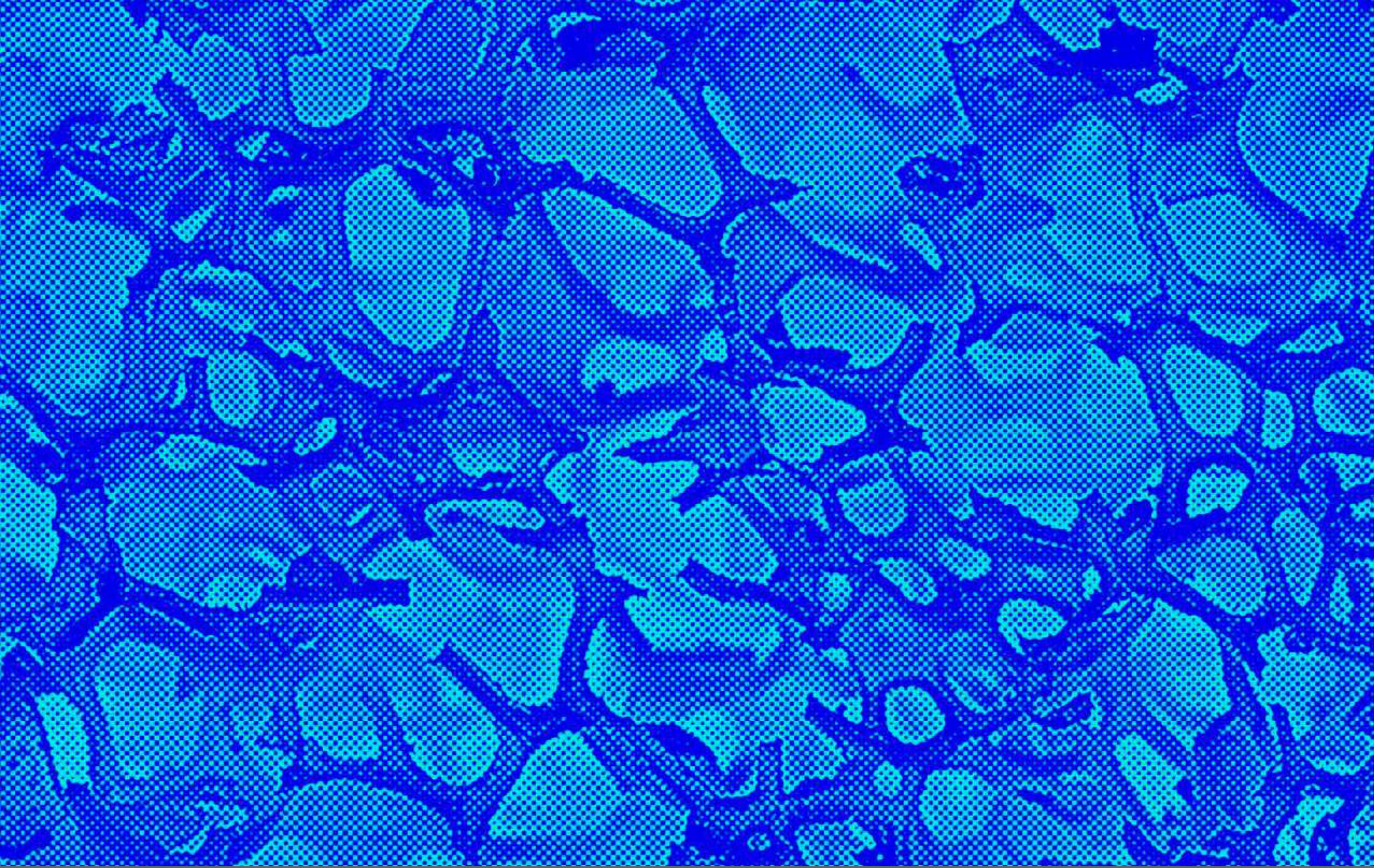

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