Seminars

Special
4 p.m. Wednesday, March 17, 2021
Zoom

Thermodynamic and mechanistic studies of CO\textsubscript{2} reduction catalysts

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The increase in global energy demands, coupled with growing environmental concerns, necessitates the development of viable technologies to store solar energy. Towards this end, my group is focused on developing efficient catalysts that convert CO\textsubscript{2} to CO, methanol or formic acid. My talk will first describe our mechanistic studies on known CO\textsubscript{2} hydrogenation catalysts, whereby mechanistic insight is gleaned through thermochemical studies, and allows for tuning the product selectivity. We also have uncovered a unique mechanism for CO\textsubscript{2} hydrogenation, whereby CO\textsubscript{2} must first bind to the ligand before subsequent reduction occurs. I will then discuss how we have used the same thermochemical approach to study the mechanism of electrocatalytic CO\textsubscript{2} reduction in a combined carbon capture & reduction system. Finally, I will present a novel ligand scaffold that, when put on Co, allows for both the hydrogenation of CO\textsubscript{2} to formate and the electrochemical reduction of CO\textsubscript{2} to formate; this is unique in that no H\textsubscript{2} is produced electrocatalytically. The collective work underscores the importance of the effective hydricity as a parameter of interest and in using thermochemical parameters to rationalize and uncover alternative mechanisms. The studies presented are contextualized in developing an understanding of how to rationally design energy-efficient CO\textsubscript{2} reduction catalysts.

Caroline Saouma was born in Pittsburgh, PA, and grew up between Boulder, CO, and Lausanne, Switzerland. After visiting National Institute of Standards and Technology as a second grader, she was hooked on science. She went to the Massachusetts Institute of Technology to complete her bachelor’s degree (chemistry, 2005), where she did research with Steve Lippard on developing cisplatin analogues that target specific malignancies. She then went to Caltech to complete her doctorate under the supervision of Jonas Peters, where she investigated iron-mediated reductions of CO\textsubscript{2} and N\textsubscript{2}. Her postdoctoral work with Jim Mayer focused on Proton-Coupled Electron Transfer (PCET) reactions of synthetic FeS clusters and MOFs. She joined the faculty at the University of Utah as an assistant professor in 2014, where her research is focused on mechanistic studies and catalyst design for CO\textsubscript{2} reduction. She is the recipient of the National Science Foundation CAREER (2020) and is a Chemical Communications Emerging Investigator (2020). Outside of chemistry, she is an avid athlete; as a graduate student she was training to row with the US national team, and she now enjoys cross country skiing and road biking.