UC RIVERSIDE Chemical and Environmental Engineering

CEE Seminar Speaker

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EXPLORING HOW IONIC CORRELATIONS INFLUENCE ION TRANSPORT AND ELECTRON TRANSFER IN ELECTROCHEMICAL SYSTEMS

Electrochemistry promises to play a key role in mitigation of emissions associated with energy and chemical production. In electrochemical devices, high ion concentrations and large electrode potentials often induce strong ion-ion correlations, driving ions to assemble into nanostructured networks. While ion interactions are known to govern properties in concentrated electrolytes, questions persist surrounding how ion assembly influences ion transport and electron transfer. Ionic liquids are excellent models for investigating how ion assembly can promote selective redox ion transport and alter electrocatalytic activity. I will discuss three examples of how we are studying ionic liquids to explore the link between ion correlations, transport, and electron transfer in electrochemical systems. I will present our work aimed at linking electric double layer formation to rates and selectivity of CO_2 reduction to illuminate how ion assembly influences electrocatalysis. I will then highlight a microscopy approach to quantifying lithium mobility in ionic liquids, opening the door to high throughput determination of redox ion mobility in electrolytes. I will conclude by explaining how we are using entropic driving forces to design electrolytes that bridge the gap between existing solids and liquids for next-generation batteries. I will highlight how an increased understanding of nanoscale ion assembly provides opportunities for designing electrolytes and electrochemical devices.

BIOGRAPHY

Professor Matthew Gebbie joined the Department of Chemical and Biological Engineering at the University of Wisconsin-Madison in fall 2019, where he is a Michael F. and Virginia H. Conway Assistant Professor. He received his B.S. in Chemical Engineering from NC State University in 2010 and Ph.D. in Materials from the UC Santa Barbara in 2016, where he was a 2011–2015 Science and Engineering Fellow in the NSF Center for Nanotechnology in Society. He was then a 2016–2018 GLAM Postdoctoral Fellow at Stanford University before joining UW–Madison. Prof. Gebbie's research addresses fundamental roadblocks at the intersection of soft matter, interface science, and electrochemistry to achieve sustainable interconversion of chemical and electrical energy. His current projects are centered around exploring new electrolyte design paradigms to enable safe, high-performance batteries and facilitate electrochemical energy conversion. Matthew's independent research has been recognized by a CAREER Award from the National Science Foundation, an Early Career Award from the Army Research Office, and a Doctoral New Investigator Grant from the American Chemical Society Petroleum Research Fund.