Materials Engineering Program
Texas Center for Superconductivity at Univ. of Houston
Center for Integrated Bio and Nano Systems
10:00 am, Friday, Sept. 15, 2023

This seminar will be held in hybrid mode: in person at HSC 102
Online: zoom link: https://uh-edu-cougarnet.zoom.us/j/97136580701
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In situ methods for understanding battery cathodes and magnetic materials

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Abstract: Rechargeable batteries will play a central role in the future energy economy. While current lithium-ion batteries have performed admirably for many applications, high cost and limited lifetime remain a key challenge. To design the next generation of high-performance, inexpensive batteries, a detailed understanding of the electrode materials is needed. In particular, the changes in crystal structure and electronic structure experienced by the electrodes during charge and discharge directly control the voltage, capacity, and reversibility of the cell. In this talk, I will introduce a new *in situ* SQUID magnetometry probe for electrochemical cells. This probe can be used to continuously measure the room-temperature magnetic moment of a charging and discharging battery cell, or can alternately be used to obtain full variable-temperature magnetic data down to 2K at discrete points of charge. This technique provides quantitative measurements of transition metal reduction/oxidation while also revealing electronic structure transitions including charge ordering and insulator-metal transitions. We employ *in situ* SQUID magnetometry alongside *in situ* high-resolution synchrotron diffraction (beamline I11, Diamond Light Source) to understand the simultaneous evolution of crystal and electronic structure in several families of battery electrodes. I will also discuss how these same techniques can be of great use in characterizing and controlling magnetic & quantum materials. Lastly, I will introduce our efforts in improving open-source materials data management through the *datalab* project.

Bio: Dr. Joshua Bocarsly is an Assistant Professor in Chemistry at the University of Houston and a Robert A. Welch Foundation Professor at the Texas Center for Superconductivity (TcSUH). His research focuses on discovering, characterizing, and controlling advanced inorganic materials for applications in batteries, computing, and energy conversion. He is also engaged in advancing digital laboratory data management to enable greater reproducibility and sharing of scientific data.

After completing his undergraduate in Chemistry from Princeton University in 2015, Dr. Bocarsly received his Ph.D. in Materials in 2020 from UC Santa Barbara. In Santa Barbara, he studied magnetocaloric materials and skyrmion host materials under the joint mentorship of Profs. Ram Seshadri and Stephen Wilson. He then moved to the University of Cambridge to complete a postdoctoral fellowship studying next-generation battery cathodes in the group of Prof. Clare Grey. He joined the UH faculty in Fall 2023.