

TCSUH Bi-Weekly Seminar

Characterizing phase transitions in “beyond-Li-ion” battery electrode materials

Prof. Joshua Bocarsly

Department of Chemistry and Texas Center for Superconductivity

Thursday, May 1, 2025

In Person – Room 102, Houston Science Center, 12:00 p.m. – 1:00 p.m.
Sandwiches will be provided on a first-come, first-served basis.



ABSTRACT: As larger and larger quantities of energy storage capacity are needed to enable an electrifying society, there is an urgent need for sustainable rechargeable batteries. “Beyond-Li-ion” battery technologies, such as Na-ion batteries (NIBs) and conversion Lithium-ion batteries (LIBs), show potential to fill this gap. NIBs provide moderate energy densities at a low cost and environmental impact, while conversion LIBs are likely more expensive but can provide very high energy densities. Unfortunately, both classes of materials are known to suffer from poor reversibility and premature capacity fade as they are repeatedly cycled. This degradation is believed to be largely caused by poorly understood phase transitions occurring as lithium/sodium is inserted and removed from electrodes during battery charge and discharge. We are using a variety of advanced characterization techniques including *in situ* synchrotron diffraction, solid state NMR, and 3D electron diffraction to study the phase transitions in beyond-Li-ion battery cathodes. In layered transition metal NIB cathodes, we find that several phase transitions occur, often involving a combination of sodium/vacancy ordering, charge ordering, and orbital (Jahn-Teller) ordering. In conversion LIB cathodes, complex and asymmetric phase transitions occur, which can be modified by changing the electrode composition.

BIO: Josh Bocarsly is an Assistant Professor of Chemistry at the University of Houston and a Principal Investigator at the Texas Center for Superconductivity. His research focuses on the development of new inorganic materials for use in next-generation sustainable batteries and quantum information technologies. He is also interested in data management and artificial intelligence and (co)develops open source software to facilitate the capture and sharing of experimental data. He graduated with his A.B. in Chemistry from Princeton University in 2015 and his Ph.D. in Materials from UC Santa Barbara in 2020. He then moved to the University of Cambridge to conduct postdoctoral research from 2020-2023 before starting his independent career at the University of Houston in the fall of 2023.