

A New Generation of Battery Technologies Enabled by Solid-State Electrolytes

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MAE Seminar Series



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There is tremendous interest in making the next super battery; however, lithium-ion (Li-ion) technology continues to improve and has inertia in several commercial markets. Recent material breakthroughs in solid electrolytes (SE) could enable a new class of non-combustible solid-state batteries delivering twice the energy density (>1,300 Wh/L) compared to Li-ion. However, technological and manufacturing challenges remain, creating the impetus for fundamental, applied, and multi-disciplinary research in materials science, mechanical engineering, and chemical engineering.

The recent discovery of several solid electrolytes with Li-ion conductivities approaching or exceeding that of state-of-the-art (SOA) liquid electrolytes has inspired a resurgence in research of solid-state batteries and other advanced electrochemical technologies. While these material discoveries have the disruptive potential to enable dramatic improvements in performance and safety, fundamental research is understanding emergent mechano-electrochemical and physical phenomena that occur during operation, especially at interfaces. This discussion will focus on 1) mechano-electrochemical phenomena at solid interfaces; 2) manufacturing challenges related to Li metal integration; and 3) provide a brief overview of the new U.S. Department of Energy, Energy Frontier Research Center, MUSIC – Mechano-Chemical Understanding of Solid Ion Conductors.

Dr. Jeff Sakamoto is the Mehrabian Endowed Chancellor's Chair and a Professor of Materials and Mechanical Engineering at the University of California, Santa Barbara (UCSB). He is also the Director of the U.S. Department of Energy, Energy Frontier Research Center, MUSIC – Mechano-Chemical Understanding of Solid Ion Conductors. He investigates ceramic ion conductors, focusing on mechano-chemical phenomena in applications such as lithium and sodium metal solid-state batteries and flow cells for grid storage. Professor Sakamoto has 25 years of experience conducting fundamental, applied, and translational research on materials for terrestrial and space energy technologies. Before joining UCSB in November 2023, he was a Professor at the University of Michigan, Ann Arbor (UM) (2014-2023), where he was involved in the UM EV Center and second-generation UM Battery Lab, and the founder and CTO of the UM solid-state battery startup Zakuro, Inc. Earlier in his career, he was an Assistant Professor at Michigan State University (2007-2014), and a senior engineer at the Caltech Jet Propulsion Laboratory (2000-2007). At the Jet Propulsion Laboratory, he helped develop Li-ion batteries for the 2003 Mars rovers. Professor Sakamoto is a Kavli Fellow and the primary contributor on 18 granted and 21 pending patents. His work has been recognized with two Major Space Act Awards from the NASA Inventions and Contributions Board, and he received the Teacher-Scholar (2013) and Withrow Excellence in Teaching (2009) Awards while on the faculty of Michigan State University.