
TCSUH Bi-Weekly Seminar

The Key Challenges for All-solid-state Lithium Metal Batteries

Prof. Yan Yao

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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: All-solid-state lithium metal batteries are regarded as one of the future energy storage technologies capable of competing with state-of-the-art Li-ion batteries. Despite tremendous progress, the performance of all-solid-state lithium metal batteries remains unsatisfactory. In this seminar, I will present the key challenges confronting all-solid-state batteries, ranging from the fundamental knowledge gap in understanding major failure mechanisms to solid-state battery manufacturing issues. The complex origins of battery failure necessitate multidimensional characterizations using a combination of tools capable of quantifying the void and dendrites, identifying the chemical and mechanical natures of the Li dendrites and electrolyte decomposition products, and monitoring the processes in situ. We developed a suite of methods for structural, chemical, and mechanical characterizations that include PFIB-SEM, ToF-SIMS, and nanoindentation-based stiffness mapping. We fabricated

solid-state micro-cells with electrochemical performance comparable to their bulk-type cells. We investigate the function of an interlayer between a lithium metal anode and solid electrolyte in preventing lithium dendrite formation and allowing reversible lithium plating and stripping over 2500 cycles. I will also talk about our recent progress on solid-state battery manufacturing and a battery prototyping facility to be established at UH.

BIO: Dr. Yan Yao is Hugh Roy and Lillie Cranz Cullen Distinguished Professor at the University of Houston. In 2008, he received his Ph.D. in Materials Science and Engineering from UCLA and went to Stanford University for postdoctoral studies after spending two years in industry. He began his career at the University of Houston as an Assistant Professor in 2012, was promoted to Associate Professor with tenure in 2017, and to Full Professor in 2020. Dr. Yao's research is focused on bridging the scientific and technical gaps in the battery landscape that today's Li-ion batteries do not address. Dr. Yao made seminal contributions to a wide range of innovative materials and chemistries created from low-cost, abundant resources with no supply chain constraints. He is also recognized for his work on developing an in-situ diagnostic platform that combines structural, chemical, and mechanical techniques to better understand the mechanisms of solid-state batteries. His research group has received over \$12 million in funding from federal agencies and industry. He has published over 120 articles in high-impact journals, with over 28,000 total citations, and has given 140 keynote and invited lectures. For his work, he received the Office of Naval Research Young Investigator Award, Clarivate Analytics' Highly Cited Researcher Award, Scialog Fellow, and Cullen College of Engineering Professorship. Yao is a senior member of the National Academy of Inventors and IEEE and a Fellow of the Royal Society of Chemistry.

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