UCMERCED | CHEMISTRY & BIOCHEMISTRY

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CHEMISTRY & BIOCHEMISTRY SEMINAR SERIES:

Magnetic Resonance Insights into Solids: Charge Transport and Interface Chemistry

Abstract:

Understanding charge transport mechanisms and interfacial phenomena in solid-state batteries is critical to achieving performance enhancement and is challenging. With a complement of advanced magnetic resonance techniques, including ex/in situ nuclear magnetic resonance spectroscopy (NMR), magnetic resonance imaging (MRI), and electron paramagnetic resonance (EPR), we can non-invasively track ion transport and examine interfacial processes with temporal and spatial resolution. Compositional, structural, and dynamical entropy on different length scales, from atomic to micron, is shown to have varied effects on ion transport. We have identified lattice dynamics conducive to fast ion transport vs. those with little or no effects on transport. We have shown ion dynamics within grains vs. at grain boundaries are distinctively different, which influence overall transport and metallic microstructure formation in solid electrolytes. We have demonstrated that modification of grain boundary conditions can significantly enhance ion transport. Ion transport across electrode-electrolyte interfaces can be facilitated with improved interfacial contact via elevated temperature or stack pressure. However, these different approaches lead to opposite outcomes regarding dendrite formation. Limiting electron transport across the electrode-electrolyte interface is key to minimizing dendrite formation in solid electrolytes. These new insights into transport have guided the synthesis and discoveries of new inexpensive solid electrolytes and electrode-electrolyte composites with improved transport properties. The fundamental understanding of the complex interfacial phenomena advises strategic measures to improve interfaces for enhanced ion transport, limited electron transport, and minimized dendrite formation in solid-state batteries.

Yan-Yan Hu

Professor of Chemistry & Biochemistry

Florida State University

About the Speaker:

Dr. Yan-Yan Hu earned her B.S. in Chemistry from Tsinghua University (Beijing, China) in 2006 and her Ph. D. in Analytical Chemistry from Iowa State University (Ames, Iowa) in 2011. Dr. Hu worked as a Royal Society Newton Fellow and Marie Curie Research Fellow at the University of Cambridge (2011-2014) before joining the faculty in the Department of Chemistry and Biochemistry at Florida State University as an Assistant Professor in 2014. She was promoted to Associate Professor with tenure in 2019 and Full Professor in 2022. Dr. Hu holds a joint appointment at the National High Field Magnetic Laboratory. Her research is focused on the development and application of advanced solid-state NMR methods for fundamental studies of energy- and bio-materials. She is a recipient of the Marion Milligan Mason Award from the American Association for the Advancement of Science in 2016, the Emerging Young Investigator Award from the Florida Section of the ACS in 2017, and the CAREER award from the National Science Foundation in 2019. She was a Scialog Fellow for Energy Storage from 2017-2020, sponsored by the Research Corporation for Science Advancement, and received the Developing Scholar Award at FSU. She currently serves as the topical editor for Chemistry of Materials.

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