

‘There’s plenty of room in the middle’: a mechanistic perspective for beyond Li-ion batteries

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Lithium-ion batteries are currently pervasive across portable electronics and electric vehicles and are on the ascent for emergent technology segments including grid storage, long-haul/heavy-duty transportation, and electric aviation. However, current lithium-ion battery technologies have nearly reached their theoretical energy density limits, making it difficult to meet the rapidly growing demands for energy storage. In this regard, metal-electrode-based chemistries hold a key potential toward enabling a wide range of next-generation battery technologies. For example, solid-state batteries have garnered tremendous attention in recent years, owing to their promise toward improving energy and power densities, and safety. Successful realization of such beyond lithium-ion energy storage systems requires fundamental understanding of the underlying mechanistic challenges over the spatio-temporal spectrum. A conceptual framework will be discussed in this presentation that will highlight how hierarchical physics-based modeling and high-resolution analytics can play a pivotal role in unraveling the mechanistic mysteries at myriad interfaces and architectures and enable co-design from system-thinking in exemplar beyond Li-ion batteries.

Bio:

Partha P. Mukherjee is a Professor of Mechanical Engineering and University Faculty Scholar at Purdue University. His prior appointments include Assistant Professor and Morris E. Foster Faculty Fellow of Mechanical Engineering at Texas A&M University (2012-2017), Staff Scientist at Oak Ridge National Laboratory (2009-2011), Director’s Research Fellow at Los Alamos National Laboratory (2008-2009), and Engineer at Fluent India (subsidiary of Fluent Inc., currently Ansys Inc., 1999-2003). He received his Ph.D. in Mechanical Engineering from The Pennsylvania State University in 2007. His awards include Scialog Fellows’ recognition for advanced energy storage, University Faculty Scholar and Faculty Excellence for Early Career Research awards from Purdue University, The Minerals, Metals & Materials Society Young Leaders Award, to name a few. His research interests are focused on mesoscale physics and stochastics of transport, chemistry, and materials interactions, including an emphasis in the broad spectrum of energy storage and conversion.

