Recent years have witnessed an enormous interest in energy storage (battery) to enable vehicle electrification, renewable energy utilization as well as accommodating an ever-increasing demand in powering myriad portable electronic devices. For example, a critical imperative is to accelerate innovation toward improved performance, life and safety of lithium-ion batteries for electric drive vehicles. These are complex, dynamical systems which include a multitude of coupled physicochemical processes encompassing electronic/ionic/diffusive transport in solid/electrolyte phases, electrochemical and phase change reactions and diffusion induced stress generation in hierarchical, multi-scale porous electrodes. While innovations in nanomaterials and nanoarchitectures have spurred the recent advancements, fundamental understanding of the physicochemical and interface interactions is of paramount interest. In this presentation, the role of mesoscale interplay, with emphasis on interfacial phenomena, will be elucidated with examples from intercalation (Li-ion) and conversion (Li-sulfur) battery chemistry electrodes.

**Keywords:** Battery electrodes, Mesoscale materials and chemistry interaction, Intercalation and conversion chemistry

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