

Solid-State Batteries for Electromobility

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Lithium-ion battery technology has brought about a revolution in portable energy storage, spurring the rapid growth of the electric vehicle (EV) market. This growth has focused attention on other urgent needs for electrified transportation, including long-range EVs, electric freight trucking, and electric aviation. Current lithium-ion battery technologies, however, cannot store enough energy per weight and volume and are too expensive to power these electromobility concepts. Solid-state batteries are a rapidly emerging technology that could overcome these challenges by enabling higher energy density and improved safety. This presentation will introduce the theory and concepts behind how solid-state batteries differ from conventional batteries and why they are useful, as well as the key scientific and technological barriers to their development. The presence of solid-solid electrochemical interfaces within solid-state batteries, rather than conventional liquid-solid interfaces, requires different theoretical and analytical tools for understanding their behavior. Notably, physical contact evolution and mechanical properties play an outsized role in these systems and have emerged as critical scientific issues to understand within the research community. In addition, the research tools used to characterize and understand solid-state batteries, and how this knowledge is important for battery advancement, will be discussed. Correlating *operando* and *in situ* measurements to electrochemical behavior is a particularly important area of focus. These real-time experiments shed light on the structural and chemical evolution of the materials inside batteries during charge and discharge, providing useful guidance for engineering improved materials for enhanced durability and performance. Another key to progress of this technology is the interaction between academic/research institutions and industrial entities around the world, and there are number of industry R&D efforts towards commercialization of these systems. Finally, large-scale challenges facing the battery industry will be touched on, including sustainability, materials resourcing and recycling, and scaled manufacturing.