Interfacial Engineering for Advanced Lithium-Ion Batteries

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High energy-density lithium-ion batteries have been long pursued worldwide to significantly improve the mobility of modern portable electronics. This global R&D effort was also driven by the emerging application of high energy-density lithium-ion batteries to electrify the transportation system so that a significant reduction on both the consumption of non-renewable fossil fuels and the emission of greenhouse gas can be achieved. From the perspective of engineering optimization, the energy-density of lithium-ion batteries can be improved from proper engineering designs to reasonably reduce the volumetric and gravimetric contribution the supporting components like current collectors and cell packaging materials. Optimization of the morphology of active materials is also reported as an effective approach to improve the packing efficiency of the active material for an improved volumetric energy-density. On the chemistry side, advanced non-aqueous electrolytes with better electrochemical/chemical compatibility with the electrode materials have been developed to extend the capacity/energy retention of lithium-ion cells so that small cells/packs can be designed to meet the end-of-life electrochemical requirements for targeted applications.

It is believed here that the continuous parasitic reactions between the active materials and non-aqueous electrolytes at the interface hold the major contribution to the performance degradation of lithium-ion batteries. It has been our major R&D focus to stabilize the solid-electrolyte interface for high-performance lithium-ion batteries. The first approach to achieve our goal is to develop functionalized electrolyte additives that can provide a more stable artificial SEI layer to protect active materials from reacting with the electrolyte [1,2]. An alternative approach is to develop functional coating layer on active materials [3,4]. In this talk, the latest advance on both areas will be discussed.

Reference:

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