New Materials for Next-Generation Lithium-Ion Batteries

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Lithium-ion battery (LIB) technology is expected to find uses in an ever increasing range of applications, from small electronic devices, to batteries for hybrid electric vehicles and electrical storage back-up systems. These applications come with their own specific power and capacity requirements and the next generation of batteries will be engineered to meet ever increasingly stringent and device-specific criteria.

Current research involves the search for materials with both high capacities (i.e., the ability to reversibly remove and insert more lithium per unit mass or volume), and high power. I will present both an overview of the new chemistries that have been recently developed and some of more novel methods that have been used to characterize these materials. Although the commercial lithium-ion rocking chair battery is based intercalation chemistry, where Li is intercalated between two layered phases, it is now generally appreciated that a wider range of materials may be suitable for LIBs. Materials and reactions include conversion chemistry, where the solid state structure changes noticeably, but reversibly, during the reaction, or reactions involving nanoparticles, which may allow higher rate batteries to be designed. New characterization approaches involve the use of in situ methods (e.g, diffraction and X-ray absorption spectroscopy) and nuclear magnetic resonance to probe local structure.