Materials Design and Diagnosis for Rechargeable Battery Energy Storage

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Energy storage in the electrochemical form is attractive because of its high efficiency and fast response time. New and improved materials for rechargeable battery energy storage are urgently required to make more efficient use of our finite supply of fossil fuels, and to enable the effective use of renewable energy sources. In this presentation, I will discuss a few new perspectives for energy storage materials including new Li intercalation compounds, new Na intercalation compounds and their micro and nanostructured electrodes. I hope to demonstrate how to combine knowledge-guided synthesis /characterization and first principles computational modeling to develop and optimize new higher energy/power density electrode materials for lithium ion and sodium ion batteries. With recent advances in characterization tools and computational methods, we are able to diagnose the electrode materials *in operando*, exploring the changes in ionic mobility, charge transfer and phase stabilities. Such knowledge is critical in designing new materials and battery architecture for higher energy/power density, longer cycle life and better safety.