Fundamental considerations in search for better intercalation electrodes for lithium-ion batteries and beyond

Lithium ion batteries are playing indispensible role in our modern life full of portable electronics and in constant move. However, the advancement of lithium ion batteries has lagged way behind electronics, in spite of extensive research efforts across research venues and industries. Search for better electrode materials with both high energy and power densities as well as excellent cyclic stability must consider (1) proper chemical reaction at the interface between electrode and electrolyte: alloying, conversion reaction and intercalation, (2) crystal structure with available space to accommodate guest species such as spinel, olivine and layer structured crystals, (3) reversible phase transition, and (4) manageable volume change. In addition, the charge/discharge voltage and transport kinetics play determining roles in the energy density and power density of resulting batteries. In this presentation, I will first present an overview what to be considered for an effective electrodes for lithium ion batteries and then present some of our research results to illustrate how the impacts of defects such as dopants and vacancies, particularly the surface defects, nanostructures, and low crystallinity or amorphous nature of electreodes on the lithium-ion intercalation capacity and voltage, as well as energy efficiency when such materials are used as electrodes in lithium ion batteries as well as sodium and zinc ion batteries.

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Refreshments will be available at 3:30 PM.

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