Nanocomposite Ceramic Based Positive Electrodes for Li-ion Batteries

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Today, the importance of energy storage in telecommunication, automotive, energy and satellite technologies gradually increased. Lithium ion technology are lately extensively employed energy storage device for electric vehicles and all portable electronics. High gravimetric energy densities (up to 150 Wh/kg), cost friendly and enhanced safety with performance make Li-ion batteries suitable candidates for these applications. However, development of new cathode electrodes with higher energy densities with improved stability is still needed for enhanced devices. An intercalation cathode is a solid host network, which can store guest ions. The guest ions can be inserted into and be removed from the host network reversibly. In a Li-ion battery, $Li^+$is the guest ion and the host network compounds are metal chalcogenides, transition metal oxides, and polyanion compounds. These intercalation compounds can be divided into several crystal structures, such as layered, spinel, olivine, and tavorite.

This review covers key technological developments and scientific challenges for a broad range of Li-ion battery electrodes. Periodic table and potential/capacity plots are used to compare many families of suitable materials. Performance characteristics, current limitations, and recent breakthroughs in the development of commercial intercalation materials such as lithium cobalt oxide (LCO), lithium nickel cobalt manganese oxide (NCM), lithium nickel cobalt aluminum oxide (NCA) and lithium iron phosphate (LFP). New polyanion cathode materials are also discussed. The cost, abundance, safety, Li and electron transport, volumetric expansion, material dissolution, and surface reactions for each type of electrode materials are described. Both general and specific strategies to overcome the current challenges as in the form of composites are covered and categorized.

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