Advanced Anodes for Alkali Metal Ion Batteries

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Abstract:

Alkali-metal ion storage shares many similarities in the intercalation chemistry, but a simple extrapolation is not sufficient. Systematic studies on the $Li^+/Na^+/K^+$ storage behaviors will provide insights on the microstructure design of electrode materials, facilitating the development of alkali-metal ion batteries. Herein, carbon nanofibers are prepared by electrospinning and their microstructure, texture, and surface functionality are tailored through carbonization at various temperatures ranging from 650 to 2800 °C. Stepwise carbonization gradually removes the heteroatoms and increases the graphitization degree, enabling us to monitor the corresponding electrochemical performance for establishing a correlation between the carbon characteristics and alkali-metal ion storage behavior. The rate- and temperature- dependence of each site is explored for synthesizing advanced carbon anode materials with tunable properties. To further increase the capacities, alloy anodes including Sn and Bi are investigated. Instead of constructing nanostructures, we turn to engineering the electrolyte–electrode interphase to constrain the volume expansion which enables the stable cyclic performance of microsized particles. The utilization of microsized alloys brings about several advantages including high tap density and high initial Coulombic efficiency, making them promising candidates for the practical application.