

Study on Capacity Fading Mechanism of O3-Type Sodium Layered Oxide Cathode

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A spherical O3-type layered oxide cathode, composed of compactly-packed nanosized primary particles, is synthesized by the coprecipitation method so that the high tap density of the cathode ensures increased volumetric energy density for energy storage applications. However, drastic volume changes in the deeply charged states contribute to structural degradation, by inducing mechanical stress and the eventual disintegration of the cathode particles by the formation of microcrack. The microcrack traversing the entire secondary particle compromise the mechanical integrity of the cathode and accelerate electrolyte infiltration into the particle interior, causing the subsequent degradation of the exposed internal surfaces. In this study, we investigated the capacity fading mechanisms related to microcracks for the O3-type $\text{Na}[\text{Ni}_{0.5}\text{Mn}_{0.5}]\text{O}_2$ cathode which is one of the most widely studied materials for SIBs. The electrochemical performance cycled at different upper cut-off voltages demonstrate that the P3' to O3' phase transition above 3.6 V is primarily responsible for the loss of the structural stability of the O3-type $\text{Na}[\text{Ni}_{0.5}\text{Mn}_{0.5}]\text{O}_2$ cathode.