Analysis of Degradation Mechanisms of Si/mesoporous carbon\(\text{LiNi}_{0.5}\text{Mn}_{0.3}\text{Co}_{0.2}\text{O}_2\)

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Silicon-based materials are considered to be the anode material of choice for advanced Li ion batteries\(^1\) due to its high theoretical specific capacity (4200 mAh g\(^{-1}\)) and a low lithiation potential (~0.2 V vs. Li/ Li\(^+\)). In the previous work, we developed Si/mesoporous carbon composites as an active anode material by dispersing Si nanoparticles with particle size of 30 – 50 nm in a Resorcinol-Formaldehyde polymer, followed by pyrolysis and HF etching. In a half-cell configuration, our prepared Si/mesoporous carbon composite electrodes showed an excellent reversible capacity of 903 mAh g\(^{-1}\) at 1 C and 683 mAh g\(^{-1}\) and 2 C\(^2\) in a state-of-the-art LiPF\(_6\)-based electrolyte with 5 wt.% vinylene carbonate (VC) as additive. Here, we present the electrochemical performance of Si/mesoporous carbon\(\text{LiNi}_{0.5}\text{Mn}_{0.3}\text{Co}_{0.2}\text{O}_2\) in a full cell configuration. In this study, we combine the galvanostatic cycling with Electrochemical Impedance Spectroscopy (EIS) and ex-situ X-ray Diffraction (XRD) analysis. The correlation between electrochemical performance, impedance growth, polarization, and structural changes of electrode materials when cycled at different upper cut-off potentials will be presented. For comparison, the electrochemical performance of graphite\(\text{LiNi}_{0.5}\text{Mn}_{0.3}\text{Co}_{0.2}\text{O}_2\)-based full cells was investigated as well.

References: