Ultrahigh Capacity Retention of Li_2ZrO_3-Coated Ni-rich LNCM811 Cathode Material through Covalent Interfacial Engineering

Zhangxian Chen[1], Qiuge Zhang[1], Weijian Tang[1], Zhaoguo Wu[1], Juxuan Ding[1], Cheng Huang[1], Zeheng Yang[1], and Weixin Zhang[1]

[1]Hefei University of Technology

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Abstract

Nickel-rich $LiNi_{0.8}Co_{0.1}Mn_{0.1}O_2$ (LNCM811) is a promising lithium-ion battery cathode material, whereas the surface-sensitive issues (i.e., side reaction and oxygen loss) occurring on LNCM811 particles significantly degrade their electrochemical capacity retentions. A uniform Li_2ZrO_3 coating layer can effectively mitigate the problem by preventing these issues. Instead of the normally used weak hydrogen-bonding interaction, we present a covalent interfacial engineering for the uniform Li_2ZrO_3 coating on $LiNi_{0.8}Co_{0.1}Mn_{0.1}O_2$ materials. Results indicate that the strong covalent interactions between citric acid and $Ni_{0.8}Co_{0.1}Mn_{0.1}(OH)_2$ precursor effectively promote the adsorption of ZrO_2 coating species on $Ni_{0.8}Co_{0.1}Mn_{0.1}(OH)_2$ precursor, which is eventually converted to uniform Li_2ZrO_3 coating layers of about 7 nm after thermal annealing. The uniform Li_2ZrO_3 coating endows LNCM811 cathode materials with an exceptionally high capacity retention of 98.7% after 300 cycles at 1 C. This work shows the great potential of covalent interfacial engineering for improving the electrochemical cycling capability of Ni-rich lithium-ion battery cathode materials.

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