Ethoxy-functional-group of polysiloxane coated high-nickel $\text{LiNi}_{0.80}\text{Co}_{0.15}\text{Al}_{0.05}\text{O}_2$ (NCA) composite cathode materials with excellent cycling stability

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Received: 31 August 2021 / *Accepted:* 28 September 2021 / *Published:* 6 December 2021

Interfacial side reactions and HF erosion have been the most important challenges hindering the development of high-nickel $\text{LiNi}_{0.80}\text{Co}_{0.15}\text{Al}_{0.05}\text{O}_2$ (NCA) cathode material that is used in lithium-ion batteries. In the present study, a silicon-based coating, mainly consisting of ethoxy groups, is proposed to overcome issues of interfacial side reactions and HF erosion. The silicon-based coating is formed by in situ hydrolysis condensation between tetraethyl orthosilicate (TEOS) and trace amounts of water adsorbed on the surface of NCA. X-ray diffraction (XRD) analysis shows that TEOS treatment did not affect the crystal structure of NCA, which maintained a layered structure. Both the scanning electron microscopy (SEM) and transmission electron microscopy (TEM) confirmed that the polysiloxane protective shell was successfully formed on the surface of NCA particles, which could help avoid the direct contact between the active material and the electrolyte, and inhibit the interfacial side reactions. After 150 cycles at 1 C rate, the capacity retention was only 52.41%, whereas the capacity retention of NCA-3 was significantly higher and exemplary. The excellent cycling performance was due to the reason that the trace water was depleted due to the formation of ethoxy-functional-group of polysiloxane, which reduced the efficiency of interfacial reaction and improved the stability of interface by consuming HF.

Keywords: Lithium-ion battery; NCA; Coating; Cycling stability

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