Nb-doped $\text{Li}_{1.20}[\text{Mn}_{0.54}\text{Ni}_{0.13}\text{Co}_{0.13}]\text{O}_2$ Cathode Material with Enhanced Electrochemical Properties for Lithium-Ion Battery

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To enhance the electrochemical properties and structure stability of the Layered Li-rich Mn-based oxides, the Nb^{5+} with different contents were doped into the $\text{Li}_{1.20}[\text{Mn}_{0.54}\text{Ni}_{0.13}\text{Co}_{0.13}]\text{O}_2$ via using the carbonate co-precipitation method. The effect of the Nb^{5+} doping modification on the microstructure, morphology and electrochemical properties of the $\text{Li}_{1.20}[\text{Mn}_{0.54}\text{Ni}_{0.13}\text{Co}_{0.13}]\text{O}_2$ cathode have been investigated by the XRD, SEM, XPS, galvanostatic discharge-charge tests and electrochemical impedance spectroscopy (EIS) techniques. The results demonstrated the Nb^{5+} doping not only could enhance the cation order degree, but also contributed to enhancing the Li^+ migration speed during cycling. The $\text{Li}_{1.20}[\text{Mn}_{0.54}\text{Ni}_{0.13}\text{Co}_{0.13}]_{0.78}\text{Nb}_{0.02}\text{O}_2$ delivered about 20.6 mAh g^{-1} larger than that of the pristine one at 5C high rate. In addition, the $\text{Li}_{1.20}[\text{Mn}_{0.54}\text{Ni}_{0.13}\text{Co}_{0.13}]_{0.78}\text{Nb}_{0.02}\text{O}_2$ retained a much higher discharge capacity retention of 92.5% after 100 cycles. Whereas, the pristine cathode showed only 85.7% of the capacity retention under identical conditions. These results indicated that Nb^{5+} doping modification could effectively enhance the electrochemical properties of $\text{Li}_{1.20}[\text{Mn}_{0.54}\text{Ni}_{0.13}\text{Co}_{0.13}]\text{O}_2$.

Keywords: $\text{Li}_{1.20}[\text{Mn}_{0.54}\text{Ni}_{0.13}\text{Co}_{0.13}]\text{O}_2$; Nb^{5+} doping; High cation ordering; Superior rate capacity; Cyclic stability.

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