Effect of Aluminum Doping on the Stability of Lithium-Rich Layered Oxide $\text{Li}[\text{Li}_{0.23}\text{Ni}_{0.15}\text{Mn}_{0.52}\text{Al}_{0.10}]\text{O}_2$ as Cathode Material

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Lithium-rich layered oxide $\text{Li}[\text{Li}_{0.23}\text{Ni}_{0.15}\text{Mn}_{0.62}]\text{O}_2$ and its Al-doped product $\text{Li}[\text{Li}_{0.23}\text{Ni}_{0.15}\text{Mn}_{0.52}\text{Al}_{0.10}]\text{O}_2$ are synthesized via a sol-gel and calcining method, and are used as the cathode materials for lithium-ion batteries. Both samples show a layered $\alpha\text{-NaFeO}_2$ structure with $R\bar{3}m$ symmetry. Compared with $\text{Li}[\text{Li}_{0.23}\text{Ni}_{0.15}\text{Mn}_{0.62}]\text{O}_2$, $\text{Li}[\text{Li}_{0.23}\text{Ni}_{0.15}\text{Mn}_{0.52}\text{Al}_{0.10}]\text{O}_2$ shows better crystallinity, and exhibits more stable capacities and better rate performance during cycling. It possesses a capacity of $>180 \text{ mAh g}^{-1}$ at the current density of 20 mA g^{-1} , and displays nice capacity retention after rapid charging/discharging. Although the doped aluminum in $\text{Li}[\text{Li}_{0.23}\text{Ni}_{0.15}\text{Mn}_{0.52}\text{Al}_{0.1}]\text{O}_2$ does not show obvious redox during cycling, it enhances the structural and electrochemical stability of the lithium-rich layered oxide.

Keywords: Cathode material; Lithium-rich layered oxide; Aluminum doping; Electrochemical performance

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