Modified Low Temperature Solution Combustion Synthesis and Electrochemical Properties of $\text{Li}_{1-x}\text{Na}_x\text{Ni}_{0.5}\text{Mn}_{1.5}\text{O}_4$ ($x=0.05, 0.10$) Materials as Cathode for Lithium-Ion Batteries

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The $\text{Li}_{0.95}\text{Na}_{0.05}\text{Ni}_{0.5}\text{Mn}_{1.5}\text{O}_4$ and $\text{Li}_{0.90}\text{Na}_{0.10}\text{Ni}_{0.5}\text{Mn}_{1.5}\text{O}_4$ cathode materials were first synthesized by a modified low temperature solution combustion synthesis method. XRD and SEM are used to characterize the phase structure and micro morphologies of samples. The results show that the main crystal phase is $\text{LiNi}_{0.5}\text{Mn}_{1.5}\text{O}_4$ with traces of secondary phase of $\text{Na}_{0.70}\text{MnO}_2$ for both samples. And the impurity phase increases with the increasing of Na doping content. Meanwhile, both samples exhibit perfect octahedral spinel structure. The electrochemical properties are studied by galvanostatic charge-discharge testing, cyclic voltammetry(CV) and electrochemical impedance spectroscopy(EIS) techniques in detail. The electrochemical performances results indicate that the initial coulomb efficiencies of the $\text{Li}_{0.95}\text{Na}_{0.05}\text{Ni}_{0.5}\text{Mn}_{1.5}\text{O}_4$ and $\text{Li}_{0.90}\text{Na}_{0.10}\text{Ni}_{0.5}\text{Mn}_{1.5}\text{O}_4$ are 89.2% and 84%, respectively. The two samples both deliver remarkable capacity retention approximately 91.0% after 500 cycles at 1C rate at 25°C. The capacity retention of $\text{Li}_{0.95}\text{Na}_{0.05}\text{Ni}_{0.5}\text{Mn}_{1.5}\text{O}_4$ sample is 96.5% after 100 cycles at 10C rate, and can still deliver a specific capacity of more than 110mAh/g, indicating that it is a promising cathode material for Li-ion batteries.

Keywords: $\text{LiNi}_{0.5}\text{Mn}_{1.5}\text{O}_4$, Lithium ion batteries, Na doping, Electrochemical performance

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