Effects on Structure and Electrochemical Performance of $\text{Li}[\text{Li}_{0.2}\text{Ni}_{0.15}\text{Mn}_{0.55}\text{Co}_{0.1}]\text{O}_2$ by Surface Modification with MnO_2

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Lithium-rich $\text{Li}[\text{Li}_{0.2}\text{Ni}_{0.15}\text{Mn}_{0.55}\text{Co}_{0.1}]\text{O}_2$ cathode materials prepared by a sol-gel method were coated by various content of MnO_2 (1%, 3%, 5% in mass) via high temperature sintering. The effects of surface modification with MnO_2 on crystal structure and morphology have been characterized by X-ray diffraction (XRD) and scanning electron microscope (SEM), which reveals that the bulk structures of all samples maintain a typical $\alpha\text{-NaFeO}_2$ layered oxide structure and the surface becomes relatively rough after modification. Electrochemical performances were investigated by charge/discharge cycling tests performed at room temperature and 55 °C, respectively. The 3wt.% MnO_2 -coated material delivers discharge capacity of 253.8 $\text{mAh}\cdot\text{g}^{-1}$ and 312.2 $\text{mAh}\cdot\text{g}^{-1}$ with first columbic efficiency of 82% and 91% at room temperature and 55 °C, respectively, which are much higher than those of the pristine material, 236.7 $\text{mAh}\cdot\text{g}^{-1}$ with first columbic efficiency of 69% at 25 °C and 298.2 $\text{mAh}\cdot\text{g}^{-1}$ with first columbic efficiency of 83% at 55 °C. After 50 cycles, the 3wt.% coated material exhibits a capacity retention of 94%, compared to a capacity retention of 83% for the pristine one. The cyclic voltammetry measurement confirms that the MnO_2 modification facilitates the structural stability of the materials. The suppression of side reaction between active materials and electrolyte and the changes of the structure of MnO_2 coating layer during cycling, as well as more oxygen vacancies retention caused by MnO_2 would be responsible for the improvement of the electrochemical properties.

Keywords: lithium-ion battery; lithium-rich layered cathode; coating; MnO_2 ; electrochemical performance

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