Surface Modification of $\text{LiNi}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3}\text{O}_2$ Hollow Nano-micro Hierarchical Microsphere with MgF_2 Coating as Cathode materials for Lithium-Ion Batteries

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$\text{LiNi}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3}\text{O}_2$ hollow nano-micro hierarchical microsphere synthesized by a template-sacrificial method was modified by different contents of MgF_2 via simple chemical deposition. The lattice parameters calculated from the X-ray diffraction (XRD) patterns by Rietveld refinement reveal that MgF_2 coating does not affect the layered structure of $\text{LiNi}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3}\text{O}_2$. The MgF_2 is satisfactorily coated onto the surface of $\text{LiNi}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3}\text{O}_2$, which is confirmed by scanning electron microscopy (SEM) and energy dispersive spectroscopy (EDS) mapping. The results of galvanostatic charge/discharge experiments demonstrate that the MgF_2 coating can greatly enhance the rate performance and cycling stability of the $\text{LiNi}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3}\text{O}_2$. The 1 wt.% MgF_2 -coated $\text{LiNi}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3}\text{O}_2$ displays the most excellent electrochemical performances. It delivers an initial discharge capacity of 197.1 mAhg^{-1} at 0.1 C in the voltage of 2.5-4.6 V, and the capacity retention of 94.4% after 50 cycles at 0.2 C. The results of electrochemical impedance spectroscopy (EIS) demonstrate that the MgF_2 coating can reduce the HF erosion and the oxygen release from the highly lithium deintercalation by preventing its direct contact with the electrolyte.

Keywords: Lithium-ion battery; cathode materials; $\text{LiNi}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3}\text{O}_2$; MgF_2 coating; template-sacrificial method

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