Effect of Ti-doping and Octahedral Morphology on Electrochemical Performance of Lithium Manganate Oxide as Cathode Materials for LIBs

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This work proposed a collaborative strategy of Ti-doping and octahedral morphology to improve the cycling property of lithium manganate oxide (LiMn₂O₄). The LiTi_{0.05}Mn_{1.95}O₄ octahedrons were prepared by solid-phase method with Mn₃O₄ octahedrons and TiO₂ nanoparticles as manganese precursor and titanium dopant, respectively. XRD and SEM characterizations indicated that the existence of tetravalent titanium ions presents no substantive impact on the spinel structure. The obtained LiTi_{0.05}Mn_{1.95}O₄ sample well inherited the octahedral morphology of Mn₃O₄ octahedrons. For this sample, the Ti-doping could enhance the crystal structure stability and avoid the reduction of trivalent manganese ions, and the octahedral morphology helped to maintain the spinel structure by inhibiting the manganese dissolution. These functions could effectively enhance the cycling stability of LiMn₂O₄. When tested at 1.0 C, the 1st reversible capacity of LiTi_{0.05}Mn_{1.95}O₄ octahedrons was higher than that of both the LiTi_{0.05}Mn_{1.95}O₄ particles and LiMn₂O₄ particles. After 100 cycles, the capacity retention of LiTi_{0.05}Mn_{1.95}O₄ octahedrons could reach up to 94.2%, which was much higher than that of other two samples (90.3% and 75.2%). Furthermore, the high-rate capability and high-temperature performance were significantly improved due to the synergetic modification of Ti-doping and octahedral morphology.

Keywords: Lithium manganate; Titanium doping; Octahedral morphology; Cycling stability; Synergistic effect

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