Spinel LiMn$_2$O$_4$ with Two-step Nano-Al$_2$O$_3$ Coating as High Performance Positive Materials

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To study the influence of the uniformity and integrity of amphoteric metal oxide coating layers on the performance of positive materials in Lithium-ion batteries, nano-Al$_2$O$_3$-coated LiMn$_2$O$_4$ positive material were synthesized by using a two-step sol-gel process. The products were characterized by power X-ray diffraction (XRD), scanning electron microscopy (SEM), Transmission Electron Microscopy (TEM), energy-dispersive X-ray spectrum (EDX), X-ray photoelectron spectroscopy (XPS), galvanostatic charge-discharge test system, and inductively-coupled plasma emission spectrograph (ICP-AES). The results show that the two step method coating can bring with the uniform and glabrous nano-Al$_2$O$_3$ layer tightly coupling with the surface of the LiMn$_2$O$_4$ particles, when being positive material for Lithium-ion batteries, which exhibits capacity losses of only 13.2 \% at 60 \degree C, after 300 cycles, much better than those of the pristine material and the sample synthesized by conventional one step sol-gel method (with the same Al$_2$O$_3$-coating content). Moreover, the ICP-AES tests of Mn$^{2+}$ reveal that the Al$_2$O$_3$ layers with two step coating layer plays an important role in protecting LiMn$_2$O$_4$ from the electrolyte corrosion.

Keywords: LiMn$_2$O$_4$, sol-gel process, positive materials, lithium-ion batteries
FULL TEXT

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