Excellent cycling performance of $\text{LiMn}_{1.92}\text{Al}_{0.04}\text{Si}_{0.04}\text{O}_4$ nanorods as cathode material for lithium-ion battery

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For the purpose of enhancing the cycling performance of LiMn_2O_4 , the strategy of synergistic modification has been developed based on the simultaneous employment of the Al-Si co-doping and nano-rod micrograph. In addition, the preparation of $\text{LiMn}_{1.92}\text{Al}_{0.04}\text{Si}_{0.04}\text{O}_4$ nanorods can be conducted by a simple and low-cost two-step method due to hydrothermal reaction and subsequent process of lithiation. The Al-Si co-doping has positive effect on inhibiting the distortion effect of Jahn-Teller and strengthening the structural stability, and the nano-sized rod-like micrograph can further enhance the electrical conductivity. The results obtained from electrochemical test show that the comprehensive usage of Al-Si co-doping and nano-sized rod-like micrograph demonstrates the synergistic effect. In comparison with the undoped LiMn_2O_4 and $\text{LiMn}_{1.92}\text{Al}_{0.04}\text{Si}_{0.04}\text{O}_4$ particles, the $\text{LiMn}_{1.92}\text{Al}_{0.04}\text{Si}_{0.04}\text{O}_4$ nanorods are able to show more excellent cycling performance and it can present higher capacity retention of 97.1% after 100 cycles when tested at 1.0 C. Especially, the $\text{LiMn}_{1.92}\text{Al}_{0.04}\text{Si}_{0.04}\text{O}_4$ nanorods can deliver a satisfactory reversible capacity of 95.1 mAh g⁻¹ with capacity retention of 89.3% after 100 cycles at 5.0 C under the circumstances of high temperature. It is shown by such excellent performance that the strategy of synergistic modification based on the simultaneous usage of the Al-Si co-doping and nano-rod micrograph is of great significance to developing the lithium manganate-based cathode material of high performance.

Keywords: LiMn_2O_4 ; Al-Si co-doping; Nano-rod micrograph; Synergistic effect; Cycling performance

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