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Synthesis and Electrochemical Properties of Ni Doped Spinel $\text{LiNi}_x\text{Mn}_{2-x}\text{O}_4$ ($0 \leq x \leq 0.5$) Cathode Materials for Li-Ion Battery

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Abstract

Spherical pristine LiMn_2O_4 and Ni doped $\text{LiNi}_x\text{Mn}_{2-x}\text{O}_4$ ($x=0.1, 0.2, 0.3, 0.4, 0.5$) cathode materials for lithium ion battery with high first cycle discharge capacity and excellent cycle performance were synthesized using the solution-combustion technique. XRD analysis revealed peak shift towards higher angle and lattice shrink as a result of Ni doping. CSAFM result confirms $\text{LiNi}_{0.5}\text{Mn}_{1.5}\text{O}_4$ provides higher current of 10nA than pristine LiMn_2O_4 of 0.05nA. The EIS result displays that small Ni content ($x=0.1, 0.2$) doping reduced the impedances of pristine LiMn_2O_4 . The composition $\text{LiNi}_{0.1}\text{Mn}_{1.9}\text{O}_4$ exhibits higher capacity and better cycleability than other Ni content compositions. Charge/discharge cycling result shows that Ni substitution substantially improved the capacity retention of LiMn_2O_4 . All Ni doped $\text{LiNi}_x\text{Mn}_{2-x}\text{O}_4$ ($x= 0.1, 0.2, 0.3, 0.4, 0.5$) compositions are able to retain 99% of their respective first cycle discharge capacities, whereas LiMn_2O_4 retains only 60% of its first cycle discharge capacity of 122 mAh/g after 50 cycles.