More Stable $LiCo_{1/3}Ni_{1/3}Mn_{1/3}O_2$ Cathode Material Coated with Compound of In_2O_3 and SnO_2 for Lithium Ion Batteries

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Rechargeable Li-ion batteries are one kind of the most attractive energy resources with regard to the reduction of CO_2, which is derived from the burning of fossil fuels and entering the air, and whose greenhouse effect causes global warming. Layered lithium oxide compounds such as $LiCoO_2$ are the most promising cathode materials for these batteries due to their potential for high capacity, safety, and good cycling performance [1]. Ohzuku [2] first reported a layered compound of lithium cobalt-nickel-manganese in 2001, it had been considered as alternative to $LiCoO_2$-based electrode material for lithium-ion batteries.The main advantages of $LiCo_{1/3}Ni_{1/3}Mn_{1/3}O_2$ are high reversible capacity, thermal stability and low cost. However, its rate capability and cycling performance at high current density are not satisfactory [3]. The origin of these problems are mainly related to its low electronic conductivity, the surface reactivity between the highly delithiated cathode and the electrolyte, and the dissolution of transition metal ions into the electrolyte.

Indium Tin Oxide (ITO) is a solid solution of indium oxide (In_2O_3) and tin oxide (SnO_2); typically 90% In_2O_3, 10% SnO_2 by weight. The ITO has good electronic conductivity and good optical performance. Indium tin oxide is one of the most widely used transparent conducting oxide because of its two chief properties. Herein, ITO was used to coat on the surface of $LiCo_{1/3}Ni_{1/3}Mn_{1/3}O_2$ cathode materials particle.

$LiCo_{1/3}Ni_{1/3}Mn_{1/3}O_2$ with ITO (compound of 90% In_2O_3 and 10% SnO_2) coating layer is synthesized successfully by a combination of aerosol method and sol-gel method. The compound layer comes from the decomposition product of isopropyl alcohol tin and isopropyl alcohol indium. Due to the good electrical conductivity of ITO compound and volume control effect to $LiCo_{1/3}Ni_{1/3}Mn_{1/3}O_2$ electrode, the $LiCo_{1/3}Ni_{1/3}Mn_{1/3}O_2$ material with ITO compound coating layer presents more stable electrochemical performance than bare $LiCo_{1/3}Ni_{1/3}Mn_{1/3}O_2$ material. Specially, the $LiCo_{1/3}Ni_{1/3}Mn_{1/3}O_2$ materials with 1% ITO coating layer presents a discharge capacity of 210 mAh g^{-1} at 1 C and contains 178.6 mAh g^{-1} after 200 cycles.

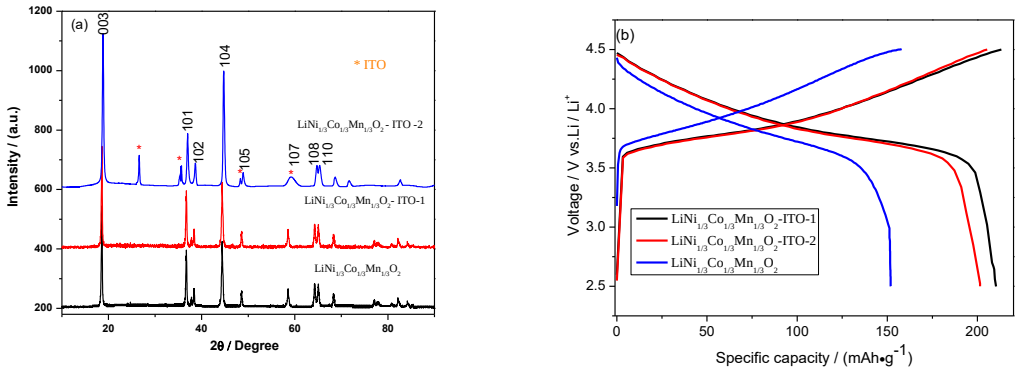

Fig. 1 The XRD patterns of $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$-ITO-1, $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$-ITO-2 and $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$ (a), the charge and discharge profiles of $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$-ITO-1, $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$-ITO-2 and $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$ (b)

References

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