

**Electrochemical characteristics of metal oxide coated LiCoO<sub>2</sub> prepared by fluidized bed spray method for the lithium secondary battery**

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LiCoO<sub>2</sub> has been commercially employed as active material of the cathode of Li-ion cells due to its high energy density and stable capacity. The capacity of the cell depends on the electrochemical characteristics of cathode active materials. Therefore, much work should be focused on the optimization of the active materials. The modification of surface properties of the cathode materials by coating its particles with some metal oxides recognized as one of the reliable techniques. The advantage of this technique is that the side reactions on the surface with electrolyte are avoided and the structural breakage of LiCoO<sub>2</sub> during charge discharge cycling can be lessened [1].

In the present study, metal oxides such as Al<sub>2</sub>O<sub>3</sub> and NiO were coated on the surface of LiCoO<sub>2</sub> particles by fluidized-bed spray method and then investigations of effects of surface modification on electrochemical characteristics were carried out for lithium secondary battery.

Used raw LiCoO<sub>2</sub> powder was a commercial product (Nippon chemical Industrial) with average particle diameter of about 5 μm. For coating solutions, the employed metal salts were Aluminum lactate and Nickel acetate tetrahydrate. These metal salts were dissolved into a mixture of distilled water and ethanol. Spray coating was based on fluidized-bed process where fluidized LiCoO<sub>2</sub> powder was coated by spraying coating solution and dried simultaneously inside the chamber. The LiCoO<sub>2</sub> powder which coated metal solution was calcined in the furnace at 300 °C for 3h and at 500 °C for 3h under O<sub>2</sub> atmosphere. Coated LiCoO<sub>2</sub> was mixed with Acetylene black for conductor and a PVDF binder at weigh ratio of metal oxide coated LiCoO<sub>2</sub>/ acetylene black /binder=85:9:6 in a solvent to prepare a slurry. The slurry was spread on Al foil by dipping method to make the positive electrode. Half cells were assembled in dry room with LiCoO<sub>2</sub> as the working electrode, Lithium foil as the counter electrode, 1M LiPF<sub>6</sub> in EC:DMC:EMC(1:1:1) as the electrolyte and polypropylene-based film as the separator. Typical charge-discharge tests were carried out using galvanostatic cycling at 0.2C rate between 3 and 4.2V.

Fig. 1 compared surface morphologies between raw LiCoO<sub>2</sub> and Al<sub>2</sub>O<sub>3</sub> and NiO coated LiCoO<sub>2</sub>, respectively.

Table 1 shows quantitative analysis of weight percent of metal oxide coating on LiCoO<sub>2</sub> surface by ICP.

Fig. 2 shows the discharge curves of the raw LiCoO<sub>2</sub> and metal oxide coated LiCoO<sub>2</sub>. The difference in discharge capacity between raw and surface modified LiCoO<sub>2</sub> was observed with cycling. Fig. 3 shows the cycling profiles of raw LiCoO<sub>2</sub> and metal oxide coated LiCoO<sub>2</sub>. The discharge capacity of raw LiCoO<sub>2</sub> is 144mAh/g at first cycle, but it decreases sharply after 10cycles and then reached to 100mAh/g after 50cycles. As for Al<sub>2</sub>O<sub>3</sub> and NiO coated LiCoO<sub>2</sub>, the discharge capacity maintains about 90% of their initial capacity even after 50cycles.

**References**

[ 1 ] Z. Wang, L. Liu, L. Chen, X. Huang, J. Solid State

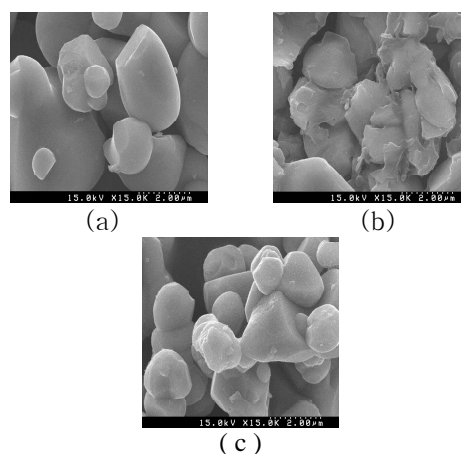


Fig. 1. Scanning electron micrographics of (a) raw LiCoO<sub>2</sub>, (b) Al<sub>2</sub>O<sub>3</sub> coated LiCoO<sub>2</sub>, (c) NiO coated LiCoO<sub>2</sub>.

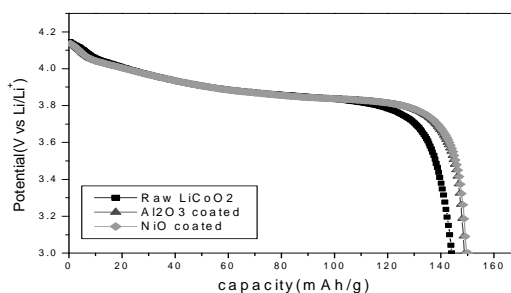


Fig. 2. Comparison of initial discharge curves between LiCoO<sub>2</sub> and the surface modified LiCoO<sub>2</sub>s at 0.2 C rate.

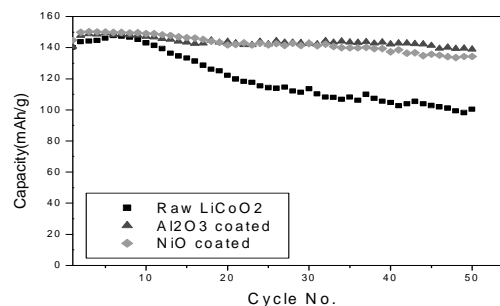


Fig. 3. The change of discharge capacities with cycles for LiCoO<sub>2</sub> and the surface modified LiCoO<sub>2</sub>s

Table 1. Elemental analysis for LiCoO<sub>2</sub> and the surface modified LiCoO<sub>2</sub>s

	Coating weight Percent (Wt%)	Element analysis by ICP (Wt%)	BET Surface Area (cm <sup>2</sup> /g)
LiCoO <sub>2</sub> as Received	0	0	0.2782
Al <sub>2</sub> O <sub>3</sub> coated LiCoO <sub>2</sub>	1.00	1.00	0.7302
NiO coated LiCoO <sub>2</sub>	1.00	1.05	0.5833

