Synthesis and characterization of $LiNi_{0.8}Co_{0.2-x}M_xO_2$ (M=Co, Mg, Zn, Mn, Al) by acid dissolution process

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Lithium secondary batteries are currently used as the main rechargeable power sources in modern portable electronic devices such as cellular phones, PDA's, laptop computers, camcorders, etc because of their high nominal voltage, high specific energy and long cycle life. And $LiCoO_2$, is still the only commercialized cathode material, due to its high specific energy and a long cycle life. The high cost and inherent toxicity of $LiCoO_2$, however, have led to the intensive investigations on the possible alternatives of this material and $LiNi_{1-x}Co_xO_2(0.2<x<0.3)$ is one of the most promising candidates due to its less toxicity and higher specific capacity compared with $LiCoO_2$ as well as its improved safety over $LiNiO_2$.

Recently, our group have developed new synthesis route called acid dissolution method for preparing high-performance cathode materials for the rechargeable lithium batteries and this method was successfully applied to synthesizing $LiNi_{0.8}Co_{0.2-x}M_xO_2$ (x=0.01~0.05, M=Co, Mg, Zn, Mn, Al). Spray drying was introduced as a continuous mass production method of the precursor materials from the solution containing starting materials. In this method, insoluble starting materials such as metal carbonates or metal hydroxides are dissolved by strong organic acid, which also acts as a chelating agent.

In this work, lithium carbonate, nickel hydroxide, cobalt hydroxide and dopant metal hydroxides are used as insoluble starting materials and acrylic acid as chelating agent. And then, the solvent of the solution containing starting materials is eliminated by spray drying or other drying method to obtain the xerogel of the initial solution, whose chemical form is expressed as $Li[MA_3]$, where M is transition metal atom, and A is the anion of the organic acid. The xerogel is then, calcined at the high temperature to polycrystalline cathode materials. The synthesized powders showed high initial capacities and good cyclic performance in the half-cell test.

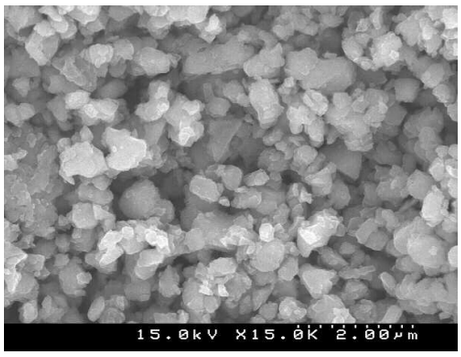

Fig. 1. SEM image of powders synthesized at 800 ^oC

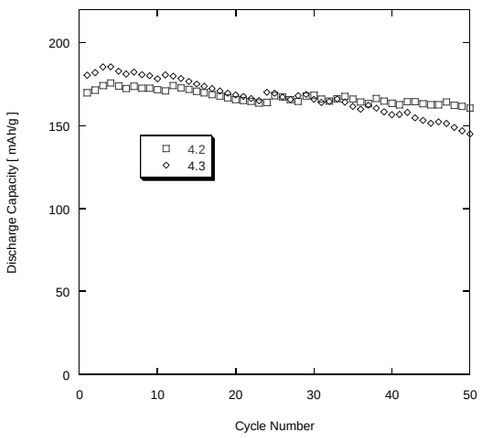

Fig. 2. Cyclic discharge capacities of the half cell, $LiNi_{0.8}Co_{0.2}O_2$/1M $LiPF_6$ in 1:1:1 EC/EMC/DMC/Li with voltage range of 3.0 ~4.2 or 4.3V, at 0.5 C rate, for the powders synthesized at 800 ^oC

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