

## **Fabrication of NCM ( $\text{LiNi}_x\text{Co}_y\text{Mn}_z\text{O}_2$ ) cathode materials prepared by degradation oxalate anion**

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NCM ( $\text{LiNi}_x\text{Co}_y\text{Mn}_z\text{O}_2$ ) is material which is composed of 3 ingredients (Ni, Co, and Mn).  $\text{LiCoO}_2$  is one of cathode materials that are widely used these days. It is easy to make on a mass production basis. But Cobalt is rare earth material and supply problem occurs. For this reasons, using of  $\text{LiNiO}_2$  and  $\text{LiMn}_2\text{O}_2$  is increasing.  $\text{LiNiO}_2$  has an advantage in capacity relatively but its operating voltage is lower than  $\text{LiCoO}_2$ . Also, it has a problem in safety. Although  $\text{LiMn}_2\text{O}_2$  has low price and safe about over-charging, it has a problem to destroy its crystal structure on high temperature.

In this study, NCM powder synthesized by degradation of oxalate anion is more economical than other commercial electrode material. It is more stable than  $\text{LiCoO}_2$  and also has a higher capacity than  $\text{LiNiO}_2$ .

$(\text{Ni}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3})\text{C}_2\text{O}_4 \cdot x\text{H}_2\text{O}(\text{s})$  was synthesized by mixing ammonium oxalate monohydrate, nickel nitrate hexahydrate, cobalt nitrate hexahydrate, and manganese acetate tetrahydrate in aqueous solution.

The solution was centrifuged and the residue was dried for 3 hours at  $200^\circ\text{C}$  temperature. The obtained precursor powder of NCM was mixed with LiOH and sintered at  $900^\circ\text{C}$  temperature for 6 hours. Sintering at  $500^\circ\text{C}$  was done again, to obtain the crystalline form of the NCM.

With the sintered NCM, cathode was fabricated by mixing PVDF (polyvinylidene fluoride) and Super-P in NMP (N-methylpyrrolidone). Its cycle life, c-rate, and impedance were investigated.

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