

# Crystal structure analyses of cathode material in lithium-ion battery for high-safety

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**Abstract** The reaction of the combustibility electrolyte gas evaporated by heat and oxygen discharged by pyrolytic reaction of the cathode is a main cause of the unusual heat / fume in lithium-ion battery. In this study, to suppress a quantity of oxygen discharged by thermal decomposition reaction, we made samples which gave  $\text{Li}_x\text{CoO}_2$  ( $x>1$ ) oxygen deficits.  $\text{Li}_x\text{CoO}_2$  ( $x>1$ ) is reported as cathode material which does not cause phase transformations. And we aim at high-safety of cathode material in lithium-ion battery by decreasing a quantity of oxygen and exothermicity that occur at the time of thermolytic reaction.

**Experimental** The  $\text{Li}_x\text{CoO}_2$  ( $x>1$ ) sample sintered respectively in argon, in nitrogen, in the atmosphere and in oxygen by a standard solid reaction method by the use of raw powder  $\text{Li}_2\text{CO}_3$  and  $\text{Co}_3\text{O}_4$ , and made the sample.

$\text{LiCoO}_2$  and  $\text{Li}_{1.07}\text{CoO}_2$  reported that  $\text{Li}/\text{Co} = 1.07$  showed superior cycling stability to the  $\text{Li}/\text{Co} = 1.0$  sample was made in this study. It confirmed it by calculating powdery X-ray diffractometric (RT), the lied belt crystal structure analysis, the SEM observation, and the relative density whether to be able to make a target sample. Chemical delithiation of  $\text{LiCoO}_2$  was carried out by stirring a suspension of 0.6g of  $\text{LiCoO}_2$  in 30 ml of 0.5 M  $\text{H}_2\text{SO}_4$  for 4, 16, 20, 24 H.

**Results and Discussion** Unit cell of all the making samples is rhombohedral crystal from a lied belt analysis result. Moreover, the oxygen share of the sample has decreased because of the thing that lowers the partial pressure of oxygen and sinters. The size of  $\text{Li}_{1.07}\text{CoO}_2$  of the crystal particle is overall larger than that of  $\text{LiCoO}_2$  in the SEM observation result, and it grows up by excessively adding Li. It is thought that this is because the excessively added lithium ion of the unreaction remains as  $\text{Li}_2\text{O}$ , and it promoted heterogeneous nucleation of the crystal grain.

Therefore, it is thought that the rate characteristic of  $\text{LiCoO}_2$  is superior to that of  $\text{Li}_{1.07}\text{CoO}_2$ . A reactive area of  $\text{LiCoO}_2$  in cathode is larger than that of  $\text{Li}_{1.07}\text{CoO}_2$  because of the thing with a large surface area.

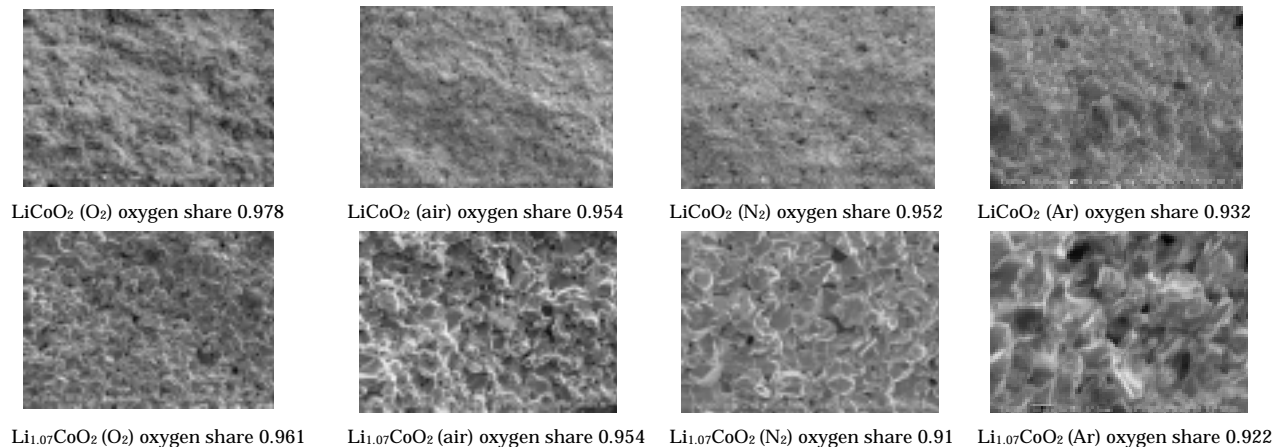


Fig.1 SEM Image (× 1000)