Fabrication and electrochemical characterization of $LiCoO_2$ cathode powder by surface modification of Li-Co precursor

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$LiCoO_2$ is most widely used as the cathode material use in a high performance battery with 4 V level due to its high energy density, superior cyclability and good environmental stability at normal atmosphere. Because of this, many efforts have been continued to reveal the many factors, which affect the electrochemical properties of $LiCoO_2$. Dynamic property such as power density has become the most important as well as energy capacity. This property is very closely related to structural properties of $LiCoO_2$ such as crystallinity, shape and size. Among these, $LiCoO_2$ granular size is one of the most important things. However, the relationship between the size and dynamic property has not been reported yet since it is hard to synthesis the $LiCoO_2$ powders with variable size.

From these reasons, we investigated that $LiCoO_2$ cathode powders were synthesized by a mechanochemical method. A freeze drying method was used to synthesis Li-Co precursor using a Li and a Co acetate as starting raw materials. We were carried out to surface modification by lapping the precursor using K_2SO_4. In order to surface modification using the K_2SO_4, a very simple ball mill was used. After finishing the perfect surface modification, a heat treatment of the Li-Co precursor at 800^oC was conducted to form high temperature polymoph.

Figure 1 shows SEM images of powder that is treated with heat in surface modified Li-Co precursor is covered with K_2SO_4 (Fig.1-a) and powder that is treated with heat after is not protected by K_2SO_4 (Fig.1-b). When surface modifier is not protected, grain that grain's size is about average 4 - 7 ㎛ and grows to 10 ㎛ by heat treatment is observed. As well as, grain shapes show ununiformity of very sharp form. When surface modifier is been covered, on the contrary with this, grain's sizes is average 1~1.5 ㎛ and have facet form that grain's form also is well-developed.

Figure 2 shows the initial discharge curves for modified $LiCoO_2$ powders and commercial $LiCoO_2$ powders. Specially, for comparison of properties by discharge rate (C rate), discharge rate measured by 0.5, 1, 1.5, 2C and Cut-off voltage is 4.2 - 3.0 V. Comparison cathode material used things of Japan Semi Company. Discharge aspect and whole capacity are almost equal 0.5 and 1C. Powdered case that is manufactured in this research, discharge capacity appeared more greatly in 1.5C's discharge rate, and this difference appeared more greatly in 2C. These properties are very important because the recent electron devices have digital way. Bespeaks, output properties that can emit high energy at short time in case suppose that capacity of battery energy is equal are more important. These high performances, in case all that is composing battery is equal (electrolyte, etc.), can know that is depended on grain size of cathode material. Distribution of grain size of commonly $LiCoO_2$ powder is about 5 ~ 10 ㎛. But, powdered size that is manufactured in this research is 1~1.5 ㎛ and this is thought that influence in diffusion of Li ion when do charge-discharge experiment

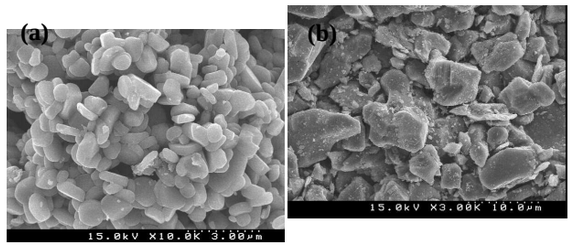
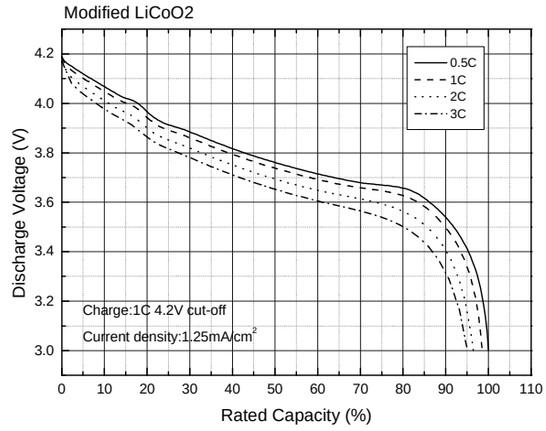


Figure 1. SEM images of powder by heat treatment (a) is covered with K_2SO_4 (b) is not protected by K_2SO_4



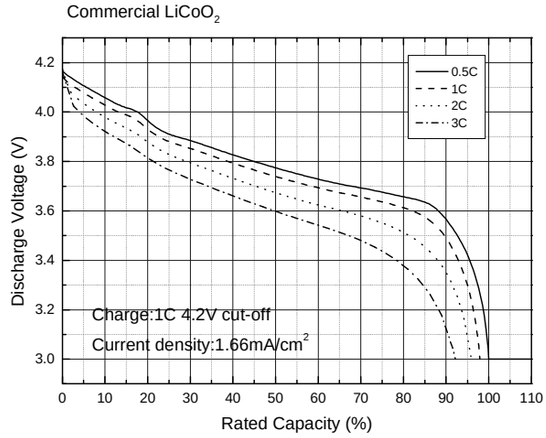


Figure 2. Initial discharge curves for modified $LiCoO_2$ powders and commercial $LiCoO_2$ powders

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