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Synthesis and Characterization of LiCoO2 Cathode Material by Sol-Gel Method

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Abstract : Lithium-transition metals and some of their oxides, such as LiCoO2, LiMn2O2, LiFePO4, and LiNiO2 have been used as cathode materials in high performance lithium-ion rechargeable batteries. Among the cathode materials, LiCoO2 has potential to been widely used as a lithium-ion battery because of its layered crystalline structure, good capacity, high cell voltage, high specific energy density, high power rate, low self-discharge, and excellent cycle life. This cathode material has been widely used in commercial lithium-ion batteries due to its low irreversible capacity loss and good cycling performance. However, there are several problems that interfere with the production of material that has good electrochemical properties, including the crystallinity, the average particle size and particle size distribution. In recent years, synthesis of nanoparticles has been intensively investigated. Powders prepared by the traditional solid-state reaction have a large particle size and broad size distribution. On the other hand, solution method can reduce the particle size to nanometer range and control the particle size distribution. In this study, LiCoO2 was synthesized using the sol–gel preparation method, which Lithium acetate and Cobalt acetate were used as reactants. The stoichiometric amounts of the reactants were dissolved in deionized water. The solutions were stirred for 30 hours using magnetic stirrer, followed by heating at 80°C under vigorous stirring until a viscous gel was formed. The as-formed gel was calcined at 700°C for 7 h under a room atmosphere. The structural and morphological analysis of LiCoO2 was characterized using X-ray diffraction and Scanning electron microscopy. The diffraction pattern of material can be indexed based on the α-NaFeO2 structure. The clear splitting of the hexagonal doublet of (006)/(102) and (108)/(110) in this patterns indicates materials are formed in a well-ordered hexagonal structure. No impurity phase can be seen in this range probably due to the homogeneous mixing of the cations in the precursor. Furthermore, SEM micrograph of the LiCoO2 shows the particle size distribution is almost uniform while particle size is between 0.3-0.5 microns. In conclusion, LiCoO2 powder was successfully synthesized using the sol–gel method. LiCoO2 showed a hexagonal crystal structure. The sample has been prepared clearly indicate the pure phase of LiCoO2. Meanwhile, the morphology of the sample showed that the particle size and size distribution of particles is almost uniform.

Keywords : cathode material, LiCoO2, lithium-ion rechargeable batteries, Sol-Gel method
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