Fabrication of nano-sized cobalt oxide powder by thermochemical process

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1. Introduction

Owing to increasing demands for portable electronic devices, lithium-ion batteries have attracted a considerable attention. Graphite has been used as an anode material in lithium-ion batteries. In order to develop lithium-ion batteries with high energy density, high performance cathode and anode materials must be developed.

As graphite has a low theoretical gravimetric capacity of 372 mAh/g, many researches have been made to search alternative anode materials. Recently, P. Poizit found that cobalt oxide has the best electrochemical properties as anode lithium storage materials in Li-ion cells among transition metal oxides.

In this research, the process of making cobalt oxide powders with nano-size by a thermochemical process was studied. The thermochemical process consists of spray drying of metallic liquid solution, calcination treatment, and milling.

2. Experimental procedures

Cobalt nitrate was dissolved in a distilled and stirred. Spray drying by hot air was performed using a rotary atomizer with solution feed rate of 11 cc/min. The spray-dried powders were calcined at 400- 900℃ for 1-3 h in air atmosphere, and then ball milled to get the nano-sized Co oxide powders. The milled powders were dried and the shape and size were observed by FE-SEM and TEM. The specific surface area of powders was also measured.

3. Experimental results

During calcination treatment of spray dried powder, the moisture and NOx component were removed at 200°C and 350°C, respectively. The calcined oxide powder is spherical cluster of agglomerated nano-sized particles. The Co_2O_3 phase was detected in X-ray diffraction patterns of powders irrespective of heat-treatment temperature. After milling 24 hours, agglomerated powders are fragmented into very fine powders with particle size below 100 nm.

4. Conclusions

Nano-sized cobalt powders were successfully fabricated by a thermochemical process. The agglomerated spherical powder after calcination was easily fragmented into nano-sized powders. Synthesized Co oxide powder has a high first discharge capacity of 1100 mAh/g.