



Structural and Thermal Stabilities of Li_xCoO_2 cathode for LIB studied by a temperature programmed reduction (TPR).

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In recent years, research and development of battery technology has primarily been focused on the lithium-ion batteries (LIB) due to the high specific energy density, and therefore are widely utilized as the energy source for portable electronics and electric vehicles. However, the battery safety is an essential issue to overcome, as the battery are required higher power density and larger capacity. Many efforts have been conducted to improve the safety of LIB in the active material processing, as well as the cell battery manufacturing and management technology.

In this study, a temperature programmed reduction (TPR) method was introduced to analyze the structural change and thermal stability of Li_xCoO_2 (LCO) cathode material. The thermal behavior and phase changes of LCO were examined at the pristine state and compared with the delithiated LCO (charged state) after the electrochemical activation. As-synthesized LCO has an initial discharge capacity of 158 mAh g^{-1} (4.3 V charged) and shows a stable cyclability, which has 87.4% discharge capacity of the initial one after 50 cycles.

The TPR results revealed two strong reduction peaks in the pristine LCO. The 1st peak mainly corresponds to the reduction of Co^{3+} , Co^{4+} to Co^{2+} , and the 2nd peak corresponds to the reduction of Co^{2+} to Co^0 . On the other hand, the reduction peaks of delithiated LCO are observed at a much lower temperatures. The reduction peak at low temperatures (below 250 °C) may be attributed to the transformation of CoO_2 -like to Co_3O_4 -like phase, which appears similar reduction patterns of CoO_2 phase resulting from the delithiation of LCO structure. The 2nd reduction peak at a low temperatures (300 - 375 °C), corresponds to the reduction of Co_3O_4 -like phase to CoO -like phase. The TPR results indicate the thermal instability of delithiated LCO driven by CoO_2 -like phase on the surface of the delithiated LCO. In addition, kinetic studies were conducted to quantitatively analyze the thermal stability of pristine LCO and delithiated LCO in each phase in the TPR. The experimental results obtained on the current study will be presented and discussed on the Conference.