

High-rate NaCrO₂ electrode for rechargeable sodium ion batteries

Seung-Taek Myung and Chan-Yeop Yoo,

Department of Nano Technology and Advanced Materials Engineering, Sejong University, Gunja-dong, Gwangjin-gu, Seoul, 143-747, Republic of Korea

Corresponding to smyung@sejong.ac.kr

Layered lithium intercalation compounds LiMeO₂ (where Me is transition element) materials have been widely studied and applied as cathode materials for practical lithium ion batteries. Cost of lithium resource, however, has doubled since commercialization in 1991, and tight supply is expected due to the ever increasing demands of electric vehicles and energy storage systems. Indeed, the lithium resource is unevenly distributed in Southern America. Meanwhile, sodium resources are abundant and unlimited everywhere. Recently, layered NaMeO₂ materials are being intensively studied because of reversible Na⁺ insertion/extraction, in particular, NaCrO₂ (R-3m) in Na cell [1]. Here, we report physical and electrochemical properties of NaCrO₂.

The NaCrO₂ powder was synthesized by solid-state method. Stoichiometric mixture of Na₂CO₃ and Cr₂O₃ powders were pelletized, and the pellet was heated at 900 °C in Ar. All chemicals and products were handled in an Ar-filled gloved box to avoid air exposure. Phase identification of the products was made using X-ray diffraction (XRD) with Cu K α radiation and the collected XRD data were analyzed by the Rietveld refinement. Electrochemical test were carried out in coin type sodium cells. Galvanostatic electrochemical charge and discharge tests in 1M NaClO₄ in PC solution were carried out at room temperature.

XRD pattern of the produced NaCrO₂ demonstrated a phase-pure product and it was crystallized to O3 type layer structure with space group of R-3m. The delivered capacity was approximately 110 mAh (g-NaCrO₂)⁻¹ in voltage range of 2 – 3.6 V and 97 % of the capacity was retained during 50 cycles. Also, the Na/NaCrO₂ cell exhibited surprising high rate properties, namely, 84 % of capacity retention at 100 C-rates. Details will be discussed in the conference site.