BFA9

Synthesis and electrochemical properties of $Li[Li_{(1-2x)/3}Ni_xMn_{(2-x)/3}]O_2$ as a positive materials for rechargeable lithium batteries

리튬 2차전지용 양극물질인 $Li[Li_{(1-2x)/3}Ni_xMn_{(2-x)/3}]O_2$의 합성과 전기화학적 특성에 대한 연구

신선식 · 박상호 · 선양국
한양대학교 응용화학공학부

The presently commercialized lithium-ion batteries use layer structured $LiCoO_2$ cathodes. Because of the high cost and toxicity of cobalt, an intensive search for new cathode materials has been underway in recent years. The research for layered $LiMnO_2$ with the same structure as $LiCoO_2$ is being pursued, but the materials tend to transform to the more stable spinel phase during the eletrochemical cycling due to Jahn-Teller ions of Mn^{3+}

Recently, some research groups have studied to stabilize layered structure by using solid solution between Li_2MnO_3 and $LiMO_2$ (M = Cr, Ni, Co) such as $Li[Li_{(1-2x)/3}Ni_xMn_{(2-x)/3}]O_2$ and $Li[Li_{(1-x)/3}Co(Cr)_xMn_{(2-2x)/3}]O_2$. Li_2MnO_3 has a layered structure similar to $LiCoO_2$, $LiNiO_2$, and $LiCrO_2$. In Li_2MnO_3 and $LiMO_2$ solid solution, M is the redox-active species, while tetravalent manganese in $Li_{1/3}Mn_{2/3}$ clusters is electrochemically inactive. It has been reported that the electrochemical capacity is resulted from oxidation of Cr^{3+} to Cr^{6+}, Ni^{2+} to Ni^{4+}, and Co^{3+} to Co^{4+} in $Li[Li_{(1-x)/3}Cr_xMn_{(2-2x)/3}]O_2$, $Li[Li_{(1-2x)/3}Ni_xMn_{(2-x)/3}]O_2$, and $Li[Li_{(1-x)/3}Co_xMn_{(2-2x)/3}]O_2$, respectively.

In this study, a sol-gel method was employed to prepare layered $Li[Li_{(1-2x)/3}Ni_xMn_{(2-x)/3}]O_2$ (x = 0.41, 0.35, 0.275 and 0.2) powders using glycolic acid as a chelating agent. The $Li[Li_{(1-2x)/3}Ni_xMn_{(2-x)/3}]O_2$ (x = 0.2) electrode delivers the discharge capacities of about 200 mAh g^{-1} at 30 ℃ and 240 mAh g^{-1} at 55 ℃ in the voltage 2.0 ~ 4.6 V and 2.4 ~ 4.5 V, respectively, with excellent cycling behavior.