Surface modification of cathode active materials with bi-conductive polymer

Ik-Su Kang[1], Yun-Chae Jung[1], Yoon-Sung Lee[1],
Sa Heum Kim[2], Kyomin Shin[2], Dong-Won Kim[1,*]

[1]Department of Chemical Engineering,
Hanyang University, Seoul 133-791, Korea
[2]Automotive R & D Division, Hyundai Motor Corp.,
Gyeongi-do 445-706, Korea
*E-mail dongwonkim@hanyang.ac.kr

Rechargeable lithium-ion batteries have been considered as attractive power sources for portable electron devices, electric vehicles and energy storage systems due to their high energy density and long cycle life. As an active cathode material, the layered $LiNi_xCo_yMn_{1-x-y}O_2$ materials have attracted much attention as the promising cathode materials owing to their high capacity and relatively low cost [1,2]. However, the materials become unstable when they are charged to high voltage at elevated temperature because of the dissolution of transition metal from the host structure and the decomposition of organic electrolyte at high voltage. To solve these problems, extensive studies have been carried out by surface coating of cathode active materials with inorganic materials such as SiO_2, Al_2O_3, ZrO_2, $AlPO_4$ and $LiAlO_2$ [3]. We recently reported that polymerizable monomers with suitable oxidation potential can exert a significant influence on the cycling performances of lithium-ion batteries [4,5]. Surface modification of cathode active materials with conductive polymer is easy and effective way to get better electronic conductivity and electrochemical properties. When conducting polymers are coated on the surface of cathode active materials, the polymers can function as an electronic conductor, and the thermal stability of cathode materials can be also greatly enhanced. In this work, we tried to improve the cycling performance and thermal stability of $LiNi_xCo_yMn_{1-x-y}O_2$ active cathode materials by surface modification. In order to improve their electrochemical performance and thermal stability, they are coated by bi-conductive conductive polymer materials. The presence of protective conductive layer formed on the cathode suppresses the growth of a resistive layer, which results in more stable cycling characteristics and thermal behavior, as compared with those of pristine cathode material.

References

1. N. Yabuuchi, T. Ohzuku, J. Power Sources, **146**, 636 (2005).
2. W. Luo, F. Zhou, X. Zhao, Z. Lu, X. Li, J.R. Dahn, Chem. Mater,. **22**, 1164 (2010).
3. S.T. Myung, K. Amine, Y.K. Sun, J. Mater. Chem., **20**, 7074 (2010).
4. K.S. Lee, Y.K. Sun, J. Noh, K.S. Song, D.W. Kim, Electrochem. Commun., **11**, 1900 (2009).
5. Y.S. Lee, K.S. Lee, Y.K. Sun, Y.M. Lee, D.W. Kim, J. Power Sources, **196**, 6997 (2011).