XAFS Imaging Study on Inhomogeneous Reaction of $LiFePO_4$ Cathode

Misaki Katayama[a], Tomoya Sano[a], Takashi Kameyama[a], Hirona Yamagishi[a], Yuki Orikasa[a], and Yasuhiro Inada[a]

[a] *Department of Applied Chemistry, College of Life Sciences, Ritsumeikan University, 1-1-1 Noji-Higashi, Kusatsu 525-8577, Japan*

E-mail: katayama@fc.ritsumei.ac.jp

Inhomogeneous reaction for $LiFePO_4$ cathodes has been studied during the charging and discharging processes by means of in-situ XAFS imaging technique, and it has revealed that the inhomogeneous reaction is caused by the inhomogeneous electronic conductivity in the composite cathode [1]. The electronic conductivity is controlled by the contacts between the cathode material particles. A composite electrode generally consists of an active material, a conductive additive and a binder material on an Al current collector sheet. In this research, the reaction distributions for the $LiFePO_4$ cathodes with the various contents of the conductive additive were analyzed using the XAFS imaging technique [2]. The effect of surface modification for the Al current collector was also investigated.

Cathode sheets were prepared using composite mixture of $LiFePO_4$, acetylene black, and polyvinylidene difluoride binder. The weight percentage of the binder was fixed to 10 wt%, and that of acetylene black was varied from 10 to 14 wt%. The Al current collectors with a carbon layer and with a vapor deposited Au layer were prepared. A lithium foil was used as an anode. XAFS imaging measurements at the Fe K edge were performed at BL-4 of Ritsumeikan Synchrotron Radiation Center and BL-7C of Photon Factory (KEK).

Observed chemical state map is shown in Figure 1(A) for the $LiFePO_4$ cathode with 11 wt% of acetylene black after the discharging process. The map shows the inhomogeneous distribution of the discharged area in the cathode plane. For the $LiFePO_4$ cathodes using the plain and the Au-coated Al current collector, the chemical state maps during the discharging process are compared in Figure 1(B). The inhomogeneous reaction observed for the former was prevented by the conductive treatment to the current collector surface. These results provide the guideline to produce the high-performance battery and its electrode for the safty and stable utilization.

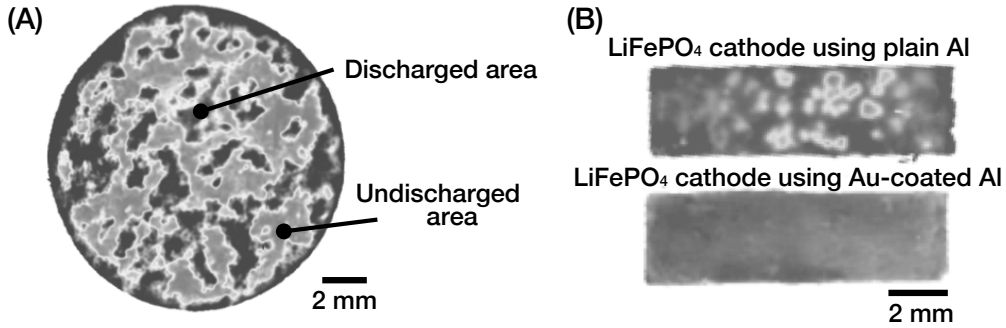

Figure 1 Chemical state maps for the $LiFePO_4$ cathode containing 11 wt% acetylene black after the discharging process at 2.5 V (A) and the $LiFePO_4$ cathodes using the plain Al current collector and the Au-coated Al current collector during the discharging process (B).

References:

[1] M. Katayama, K. Sumiwaka, R. Miyahara, H. Yamashige, H. Arai, Y. Uchimoto, T. Ohta, Y. Inada, Z. Ogumi, J. Power Sources 269 (2014) 994–999.

[2] M. Katayama, K. Sumiwaka, K. Hayashi, K. Ozutsumi, T. Ohta, Y. Inada, J. Synchrotron Rad. 19 (2012) 717–721.