

Reaction Distribution Analysis of $\text{Li}_4\text{Ti}_5\text{O}_{12}$ by Imaging X-ray Absorption Spectroscopy

Keita Kobayashi, Misaki Katayama, Yasuhiro Inada, Yuki Oriyasa
Ritsumeikan University, 1-1-1 Nojihigashi, Kusatsu, Shige 525-8577 Japan

E-mail: sc0041sx@ed.ritsumeai.ac.jp

In order to realize a further higher capacity of the lithium ion battery, it is desirable to increase the thickness of the composite electrodes. However, it is generally known that the charge / discharge capacity per active material actually obtained decreases with a thick composite electrode. This is presumed to be due to the low lithium ion conductivity in the composite electrode, reaction distribution in the thickness direction occurs, and inactive regions increase. Despite the fact that such a reaction distribution is a dominant factor for practical battery performance, there are not so many analyses reported in the literatures. In the past, we analyzed the reaction distribution in the thickness direction in the electrode by the imaging XAFS method for the electrode composite electrode whose electrode porosity was changed, and discussed the correlation between the reaction distribution and the effective ion conductivity [1]. The charging / discharging reaction proceeds with a delay near the current collector inside the electrode. Therefore, it is presumed that the reaction distribution becomes remarkable in the thickened electrode. In this study, the correlation between the charge / discharge rate capability of the $\text{Li}_4\text{Ti}_5\text{O}_{12}$ anode with the thickness changed and the reaction distribution in the thickness direction was discussed.

$\text{Li}_4\text{Ti}_5\text{O}_{12}$ was synthesized by solid state method. The Li_2CO_3 and TiO_2 were mixed in a ball mill and mixed with acetylene black, and the powder was calcined in argon. For electrode preparation, 75 wt% $\text{Li}_4\text{Ti}_5\text{O}_{12}$ powder, 5 wt% acetylene black and 15 wt% PVDF were mixed in 1-methyl-2-pyrrolidinone anhydrous solvent. The slurries were coated to aluminum foil and dried in a vacuum oven. The thickness of the pressed electrode was from 50 micrometers to 100 micrometers. 1 M LiPF_6 in 3: 7 EC: EMC solution was used as the electrolyte. As the result of rate capability tests, the remarkable capacity decrease of the thicker electrodes at more than 1C rate was observed. 2D-imaging XAFS measurements were performed at the beam line BL-4 at Ritsumeikan SR center (Japan) [2]. Ti K-edge XAS spectra of the electrodes were spared on transmission mode using a CMOS detector.

References:

- [1] Y. Oriyasa, Y. Gogyo, H. Yamashige, M. Katayama, K.Z. Chen, T. Mori, K. Yamamoto, T. Masese, Y. Inada, T. Ohta, Z. Siroma, S. Kato, H. Kinoshita, H. Arai, Z. Ogumi, Y. Uchimoto, *Sci. Rep.*, **6** (2016) 26382.
- [2] M. Katayama, K. Sumiwaka, K. Hayashi, K. Ozutsumi, T. Ohta, Y. Inada, *J. Synchrotron Rad.*, **19**, 717-721 (2012).