Conducting agents having different morphologies for the high energy anode having SiO for lithium ion battery

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Huge lithium ion battery (LIB) systems for electric vehicles (EVs) and energy storage systems (ESSs) are attracting much attention due to environment issues such as global warming, fine dust pollution and diesel gate. These systems require large scale of LIBs from kWh to MWh, which is much larger than that for small portable electronic devices. For affordable big scale LIBs, it is necessary to improve the energy density of the LIBs. Accordingly, a lot of researchers in LIB community are studying high energy density active materials. Whereas graphite, which is a typical anode material for conventional LIBs, has a small theoretical capacity of 372 mAh g^{-1}, silicon (Si) has a higher theoretical capacity of 4400 mAh g^{-1}. However, there are some problems for the practical applications of Si as an anode material for the practical LIBs. During Li insertion/extraction in Si, big volume change, leading to pulverizing of the electrode causing detrimental cycle life.

SiO-based materials have also attracted attention as a promising anode material because SiO generate a buffer component SiO_2 and Li_2O during the initial lithiation process. Despite it has a smaller capacity than Si, cycle performance can be highly improved being close to the commercialization. However, it can not totally solve above-mentioned problems, new concepts are required to solve these critical problems such as poor electronic conductivity and pulverization.

In this presentation, we tried to improve the electrochemical performances of SiO/C electrode by using various conducting agents having different morphologies, VGCF and Super-P. The optimal combination of VGCF and Super-P for SiO/C electrode is investigated to relieve failure mechanism of high capacity anode material. To elucidate the detail mechanisms, the surface analyses and the electrochemical experiments werer performed. Electrochemical behaviors of half-cells were evaluated with four kinds of electrodes by controlling the ratios between VGCF and Super-P. Also, SiO/C electrode with the optimal combination of VGCF and Super-P exhibits the highest capacity even at the fast discharge rate of 15 C. It was also confirmed that reversibility of the capacity was better in the electrode using the combined conducting agents of VGCF and Super-P than in the electrode using single VGCF or single Super-P. From these results, it is concluded that the use of VGCF and Super-P for the SiO/C electrode is effective in improving cycle performance.