Electrode Performance and Phase Transition Mechanism of $KFeSO_4F$ for K-Ion Batteries

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Potassium-ion batteries (KIBs) have attracted much attention as high-voltage and high-power batteries due to the lower standard electrode potential of K^+/K in ester-based electrolyte and weaker solvation of K^+ ion compared to those of Li^+ ion [1, 2]. Recently, electrochemical and reversible K insertion/extraction into/from graphite has been reported by X. Ji and our groups [1, 3] and graphite is recognized as a promising candidate for the negative electrode material of KIBs. Now, high-energy positive electrode materials are required and developed in the world [4]. Polyanionic materials shuold be suitable for K insertion/extraction due to the rigid open flamework and high working-voltage compared to layered transition metal oxides [5]. In this study, we have forcused on orthorhombic $KFeSO_4F$ (*o*-$KFeSO_4F$) showing high working-voltage [6]. the charge/discharge performances in K cells and the reaction mechanism are investigated.

o-$KFeSO_4F$ synthesized delivers discharge capacity of ca. 115 mAh g^{-1} with average working-voltage of ca. 3.6 V in a K cell with 1 mol dm^{-3} KPF_6/EC:PC(1:1 v/v) in the voltage range of 2.0 – 4.8 V. The capacity is relatively larger and polarization is smaller than those in the previous literature [5], which is probably due to difference of electrolyte solution. Capacity retention is, however, insufficient and ca. 73% after 40 cycles. Excellent cycle stability has been achieved by using highly concentrated KFSA/DME electrolyte. Phase transition of *o*-$KFeSO_4F$ during charge/discharge in K cell is investigated by *operando* and synchrotron *ex-situ* XRD measurements and will be presented.

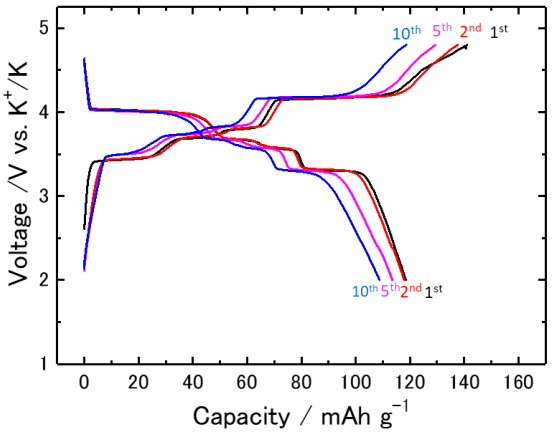

Fig. 1 Charge/discharge curves of *o*-$KFeSO_4F$ in a K cell filled with 1 mol dm^{-3} KPF_6/EC:PC (=1 : 1 v/v).

References:

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