Potassium-ion batteries (KIBs) have attracted much attention as high-voltage and high-power batteries due to the lower standard electrode potential of $\text{K}^+/\text{K}$ in ester-based electrolyte and weaker solvation of $\text{K}^+$ ion compared to those of $\text{Li}^+$ 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 should be suitable for K insertion/extraction due to the rigid open framework and high working-voltage compared to layered transition metal oxides [5]. In this study, we have focused on orthorhombic $\text{KFeSO}_4\text{F}$ ($\alpha$-KFeSO$_4$F) showing high working-voltage [6]. The charge/discharge performances in K cells and the reaction mechanism are investigated.

$\alpha$-KFeSO$_4$F 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 $\alpha$-KFeSO$_4$F during charge/discharge in K cell is investigated by operando and synchrotron ex-situ XRD measurements and will be presented.

References: