

Superconcentrated KFSA Solution for 4 V Class Potassium-Ion Batteries

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Potassium-ion batteries (KIBs) have attracted much attention as potential high-voltage and high-power secondary batteries thanks to low standard electrode potential of K/K^+ in ester-based electrolyte and low Lewis acidity of K^+ [1,2]. Recently, we demonstrated a 4 V class K-ion full cell with graphite// $\text{K}_{1.75}\text{Mn}[\text{Fe}(\text{CN})_6]_{0.93} \cdot 0.16\text{H}_2\text{O}$ configuration showing high energy density [3]. However, most of studies on KIBs suffer from large irreversible capacity and capacity degradation due to anodic/cathodic decomposition of carbonate ester-based electrolyte. To improve the Coulombic efficiency and cyclability of KIBs, we here study superconcentrated potassium bis(fluorosulfonyl)amide (KFSA)/1,2-dimethoxyethane (DME) electrolyte [4].

Physical properties of the electrolytes were characterised by using ionic conductivity measurement, viscosity measurement, and Raman spectroscopy. Electrochemical properties of $\text{K}_2\text{Mn}[\text{Fe}(\text{CN})_6]$ and graphite electrodes in K cells filled with the electrolyte were examined by using galvanostatic charge/discharge tests.

The KFSA/DME solution shows higher ionic conductivity and lower viscosity at a concentration of 7 mol kg^{-1} (40 mol%) compared to LiFSA/DME and NaFSA/DME, because of weaker Coulombic interaction K^+ cation than Li^+ and Na^+ . Figures 1a and 1b show charge/discharge curves of the $\text{K}_2\text{Mn}[\text{Fe}(\text{CN})_6]$ and graphite electrodes, respectively, in K half cell. Both the electrodes show high Coulombic efficiency and good cyclability in the K cells with 7 mol kg^{-1} KFSA/DME electrolyte. In addition, the graphite/ $\text{K}_2\text{Mn}[\text{Fe}(\text{CN})_6]$ full cell achieves average Coulombic efficiency of 99.3% and good capacity retention higher than 85% of the initial after 100 cycles. Solvent and concentration dependence on electrochemical properties of the K cells will be also presented.

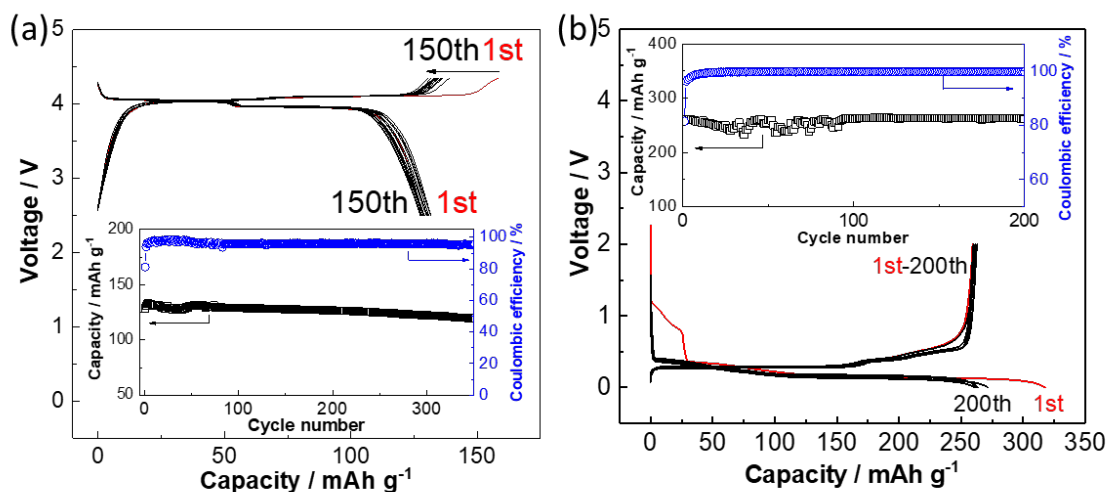


Fig. 1 Charge/discharge curves of (a) $\text{K}_2\text{Mn}[\text{Fe}(\text{CN})_6]$ electrode and (b) graphite one in K cells with 7 mol kg^{-1} KFSA/DME electrolytes, and the insets display their cycle performance and Coulombic efficiency.

References:

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