Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting Information

Potassium-rich iron hexacyanoferrate/dipotassium terephthalate-carbon nanotube composite for K-ion batteries with optimized electrolyte

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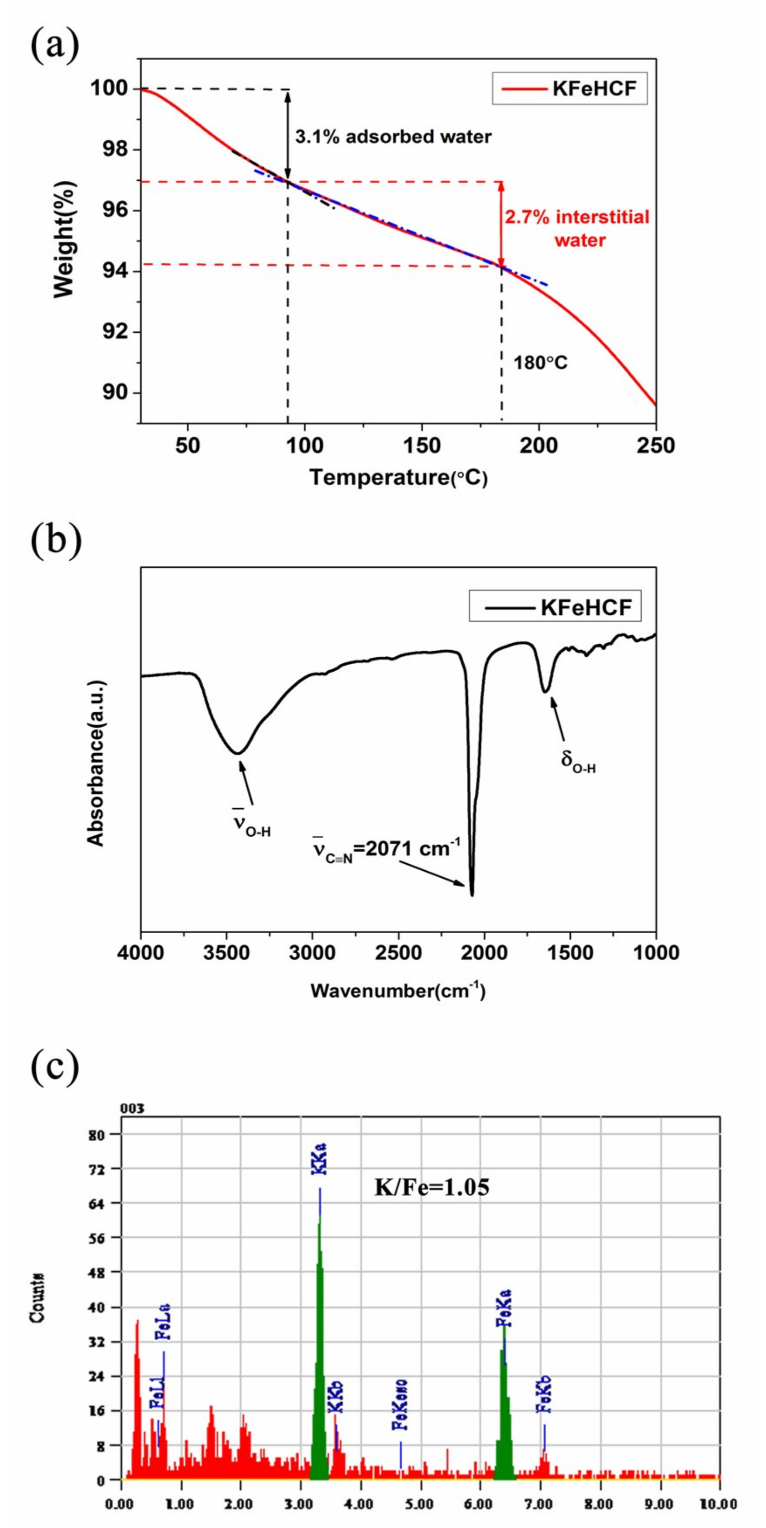

Fig. S1 The characterizations of KFeHCF: (a) TG curve, (b) FTIR spectrum, (c) EDS results.

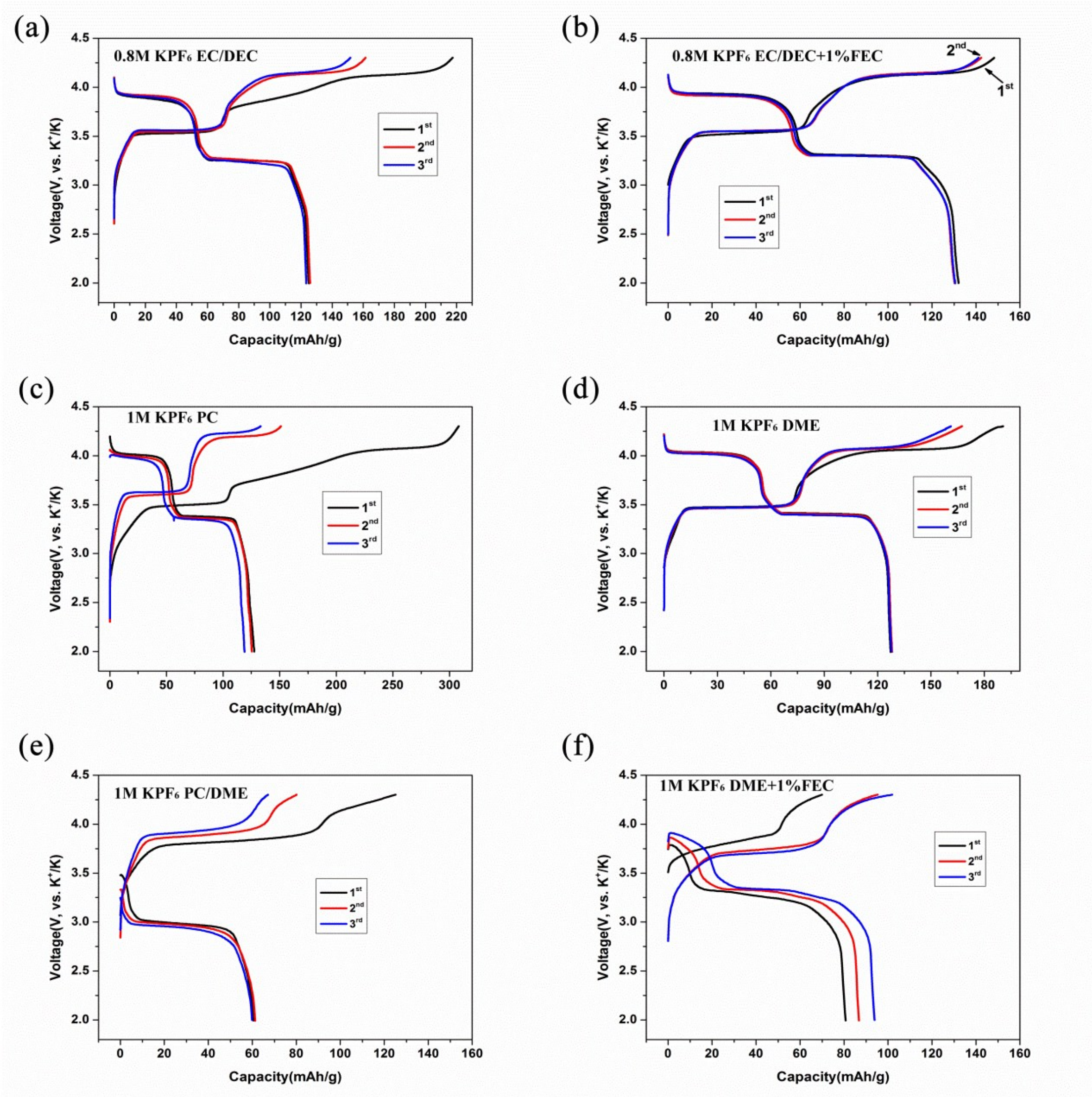

Fig. S2 Charge-discharge curves of the initial 3 cycles of KFeHCF in different electrolytes at a current density of 26 mA g^{-1} (0.2C).

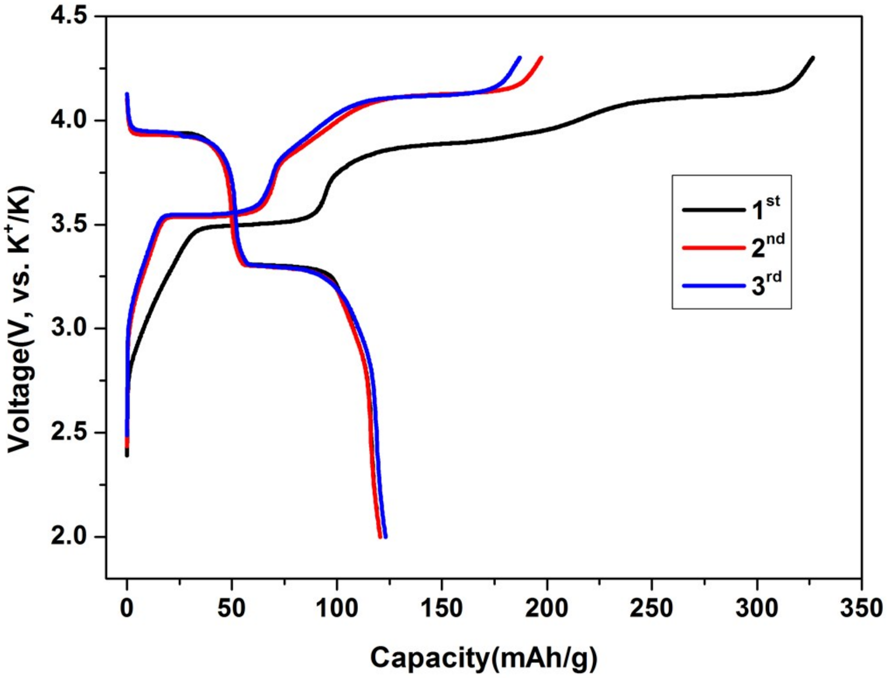

Fig. S3 Charge-discharge curves of KFeHCF in 0.8 M KPF_6 EC/DEC. It was first charged and discharged in 0.8 M KPF_6 EC/DEC+1 vol% FEC, washed by DEC and then reassembled.

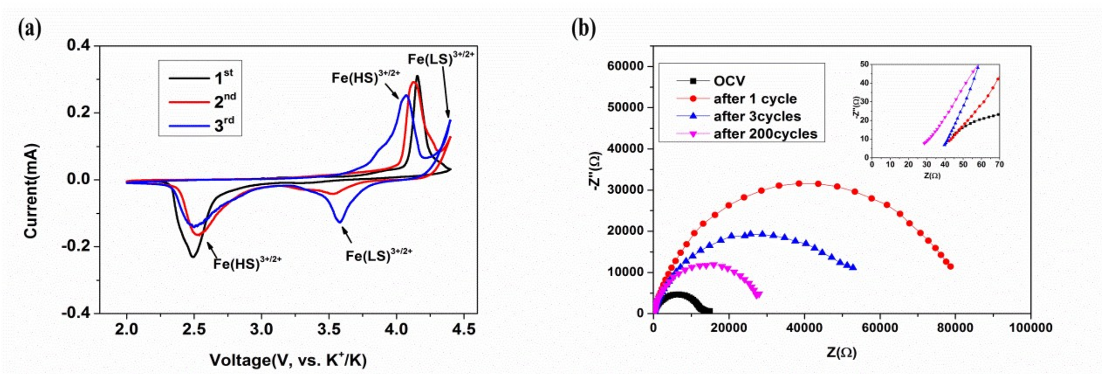

Fig. S4 (a) Initial three-cycle CV curves of KFeHCF in 0.05 M $KClO_4$/PC from 2.0-4.4V at a scan rate of 0.1 mV s^{-1}; (b) The comparison of EIS spectra of KFeHCF in 0.05 M $KClO_4$/PC at different cycles. (The inset graph is the enlarged region at the high frequency end).

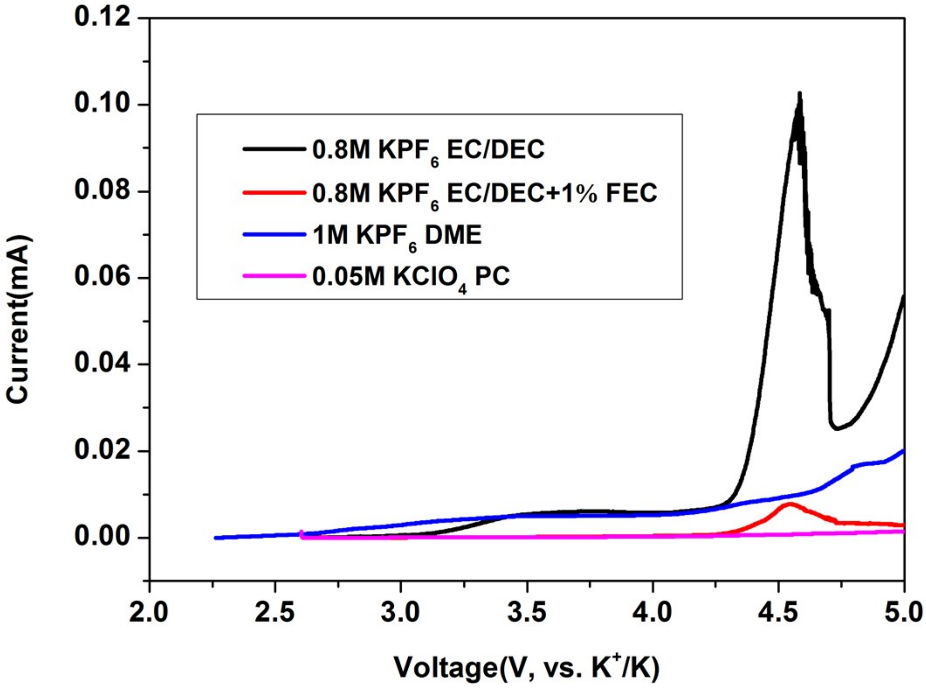

Fig. S5 Linear sweep voltammetry of potassium half cells using aluminum foil as counter electrode in different electrolytes from OCV to 5.0 V at a scan rate of 0.1 mV s^{-1}.

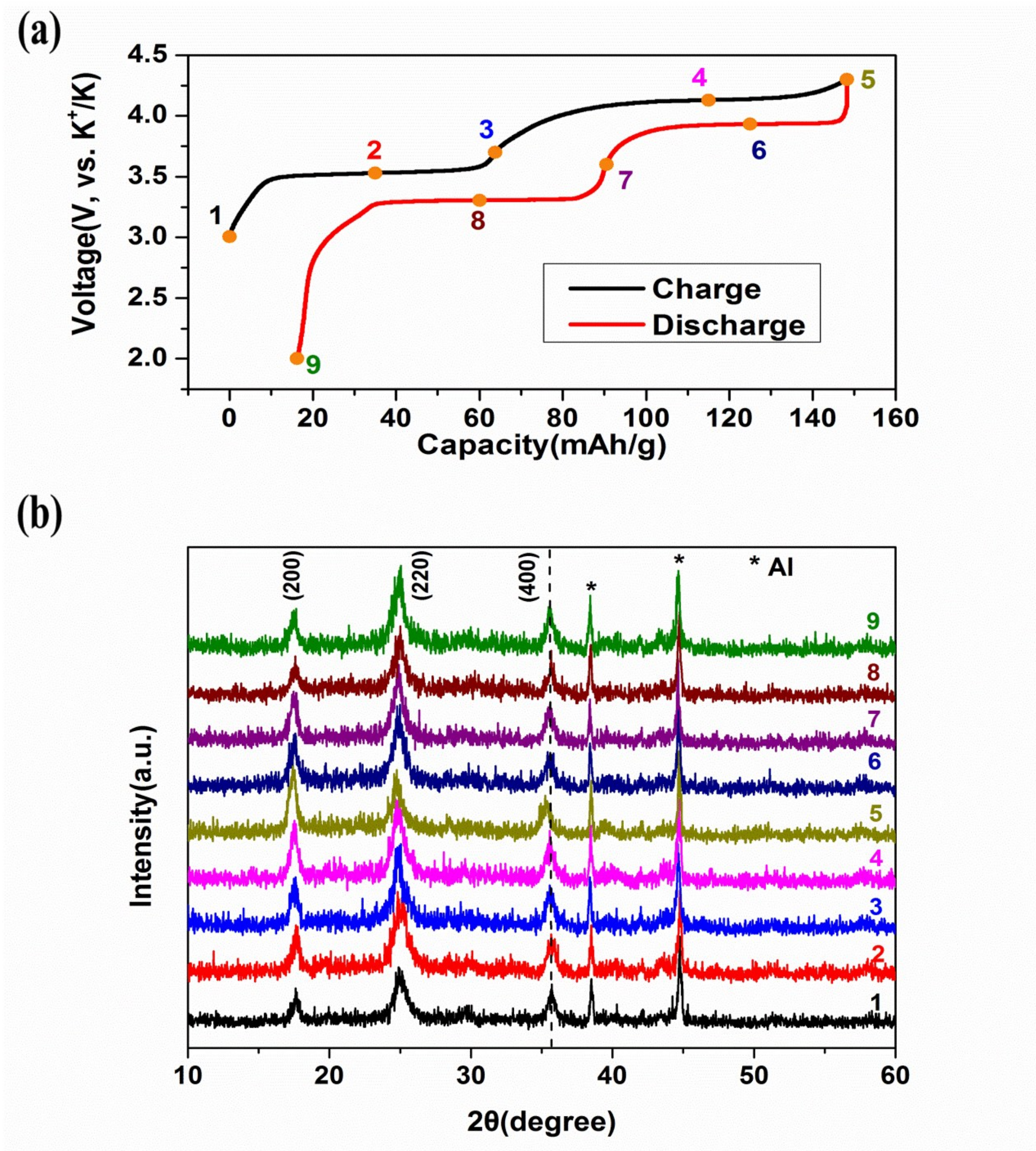

Fig. S6 (a) Different states of KFeHCF during the first charge-discharge process. It was tested in 0.8 M KPF_6 EC/DEC+1%FEC at 0.2C. (b) Ex-situ XRD patterns at these states.

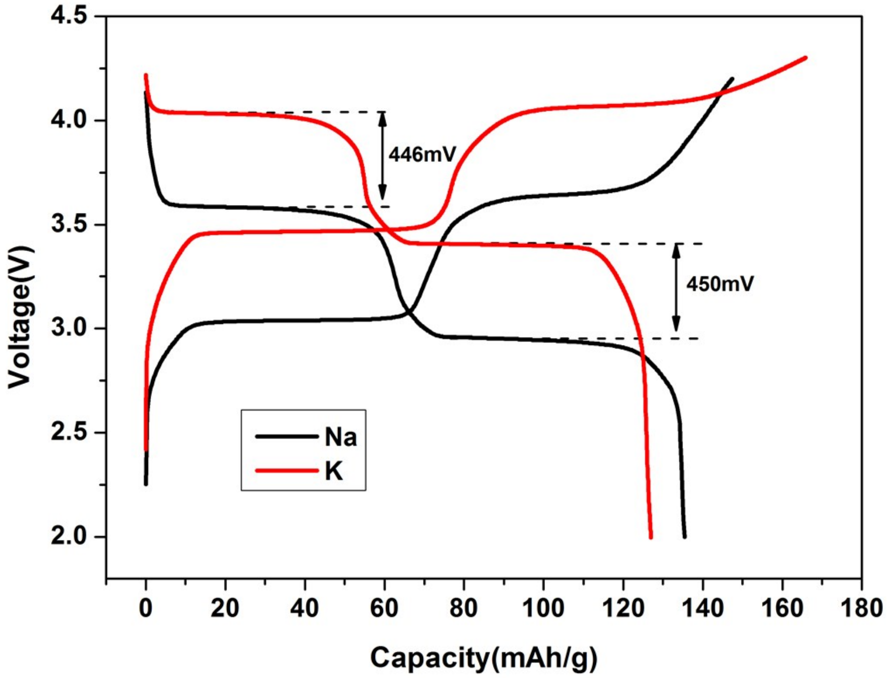

Fig. S7 The comparison of the second charge-discharge curves of KFeHCF in sodium (black line) and potassium (red line) half cells.

The voltage difference resulted from K^+ concentration in sodium-ion battery is calculated as :

$$K_2FeFe(CN)_6 + xNa^+ \leftrightarrow K_{2-x}FeFe(CN)_6 + xK^+ + xNa$$

$$E = E^{\Theta} - \frac{RT}{xF}\ln\frac{\left[K^+\right]^x}{\left[Na^+\right]^x}$$

$$\Delta E = -\frac{RT}{F}\ln\frac{\left[K^+\right]}{\left[Na^+\right]} = 0.11\,\mathrm{V}$$

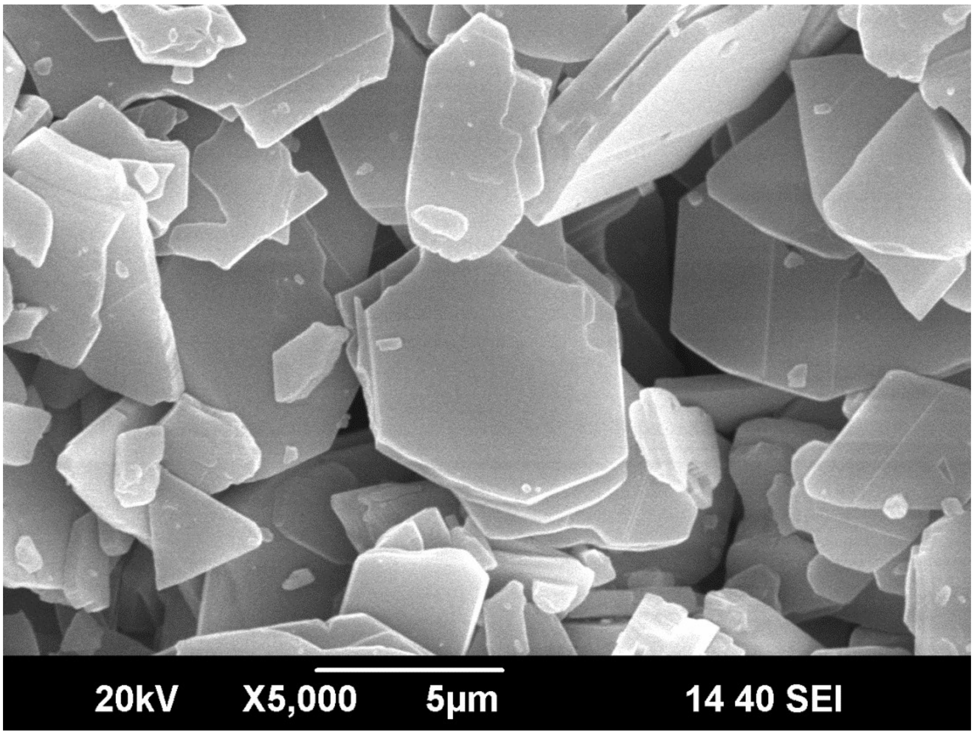

Fig. S8 The SEM image of bulk K_2TP.

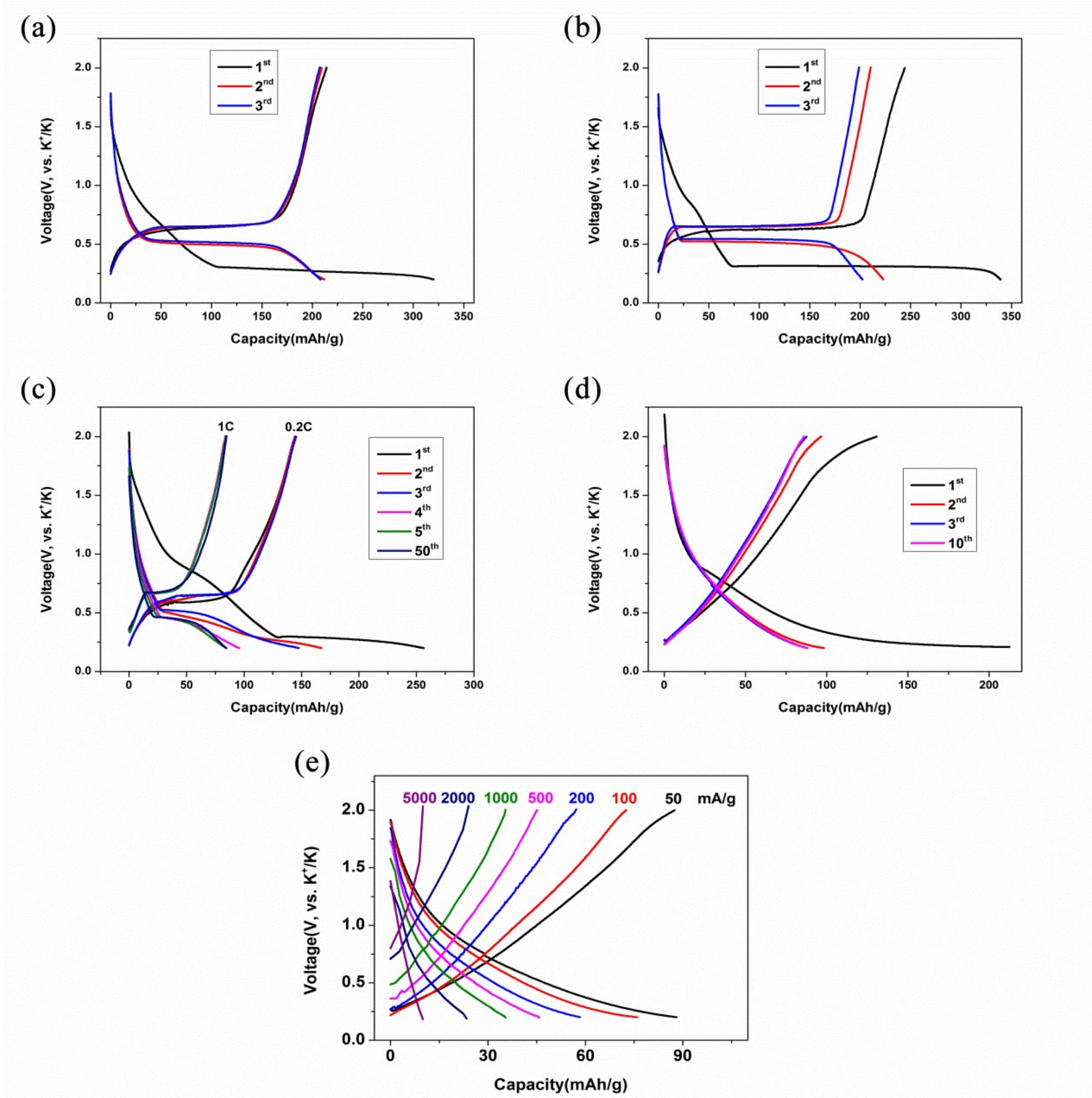

Fig. S9 The charge-discharge curves of K_2TP-60 (a), K_2TP-120 (b), bulk K_2TP (c) and CNT (d) in 1 M KPF_6/DME. (e) Charge-discharge curves of CNT at different current densities.

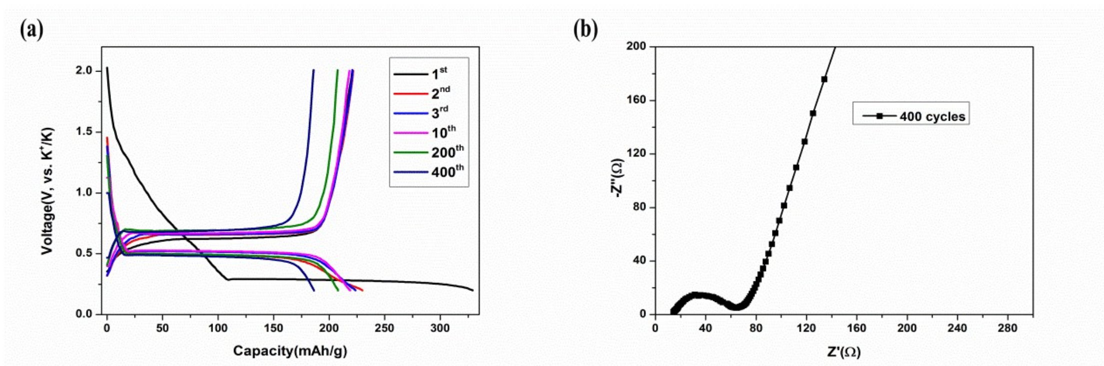

Fig. S10 (a) The charge-discharge curves of the selected cycles of K_2TP-75 in 1 M KPF_6/DME at a current density of 5C (1250 mA g^{-1}). (b) EIS spectrum of K_2TP-75 after 400 cycles.

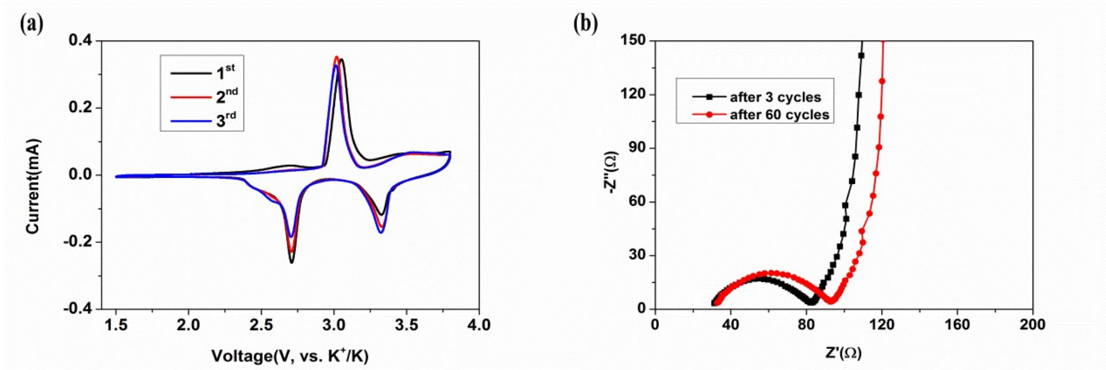

Fig. S11 (a) Initial three-cycle CV curves of the KFeHCF/K_2TP full cell from 1.5 to 3.8V at a scan rate of 0.1 mV s^{-1}. (b) EIS spectra of the KFeHCF/K_2TP full cell after 3 and 60 cycles.