Electronic supplementary for

Facile synthesis of viologen and its reversible lithium storage property in organic lithium-ion batteries

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Theoretical gravimetric capacity (C_g) of a redox-active molecule is calculated by the reported procedure.[1]

Theoretical gravimetric capacity = $(26800n/M)$

Where n = number of electrons involved in the redox reaction of per redox-active molecule

M = molecular weight of the redox-active molecule

Now for BTFV, n = 2 and M = 292 g mol^{-1}

Therefore, theoretical capacity (C_g) of BTFV = (26800 x 2/ 292) mAh g^{-1} = 183.5 mAh g^{-1}.

Materials required

4, 4'-bipyridine, Acetonitrile and polyethylene oxide (PEO) were purchased from Sigma Aldrich, diethyl etherated boron trifluoride was from Alfa Aesar, diethyl ether from Merck, conducting carbon black (super P) from Timcal.
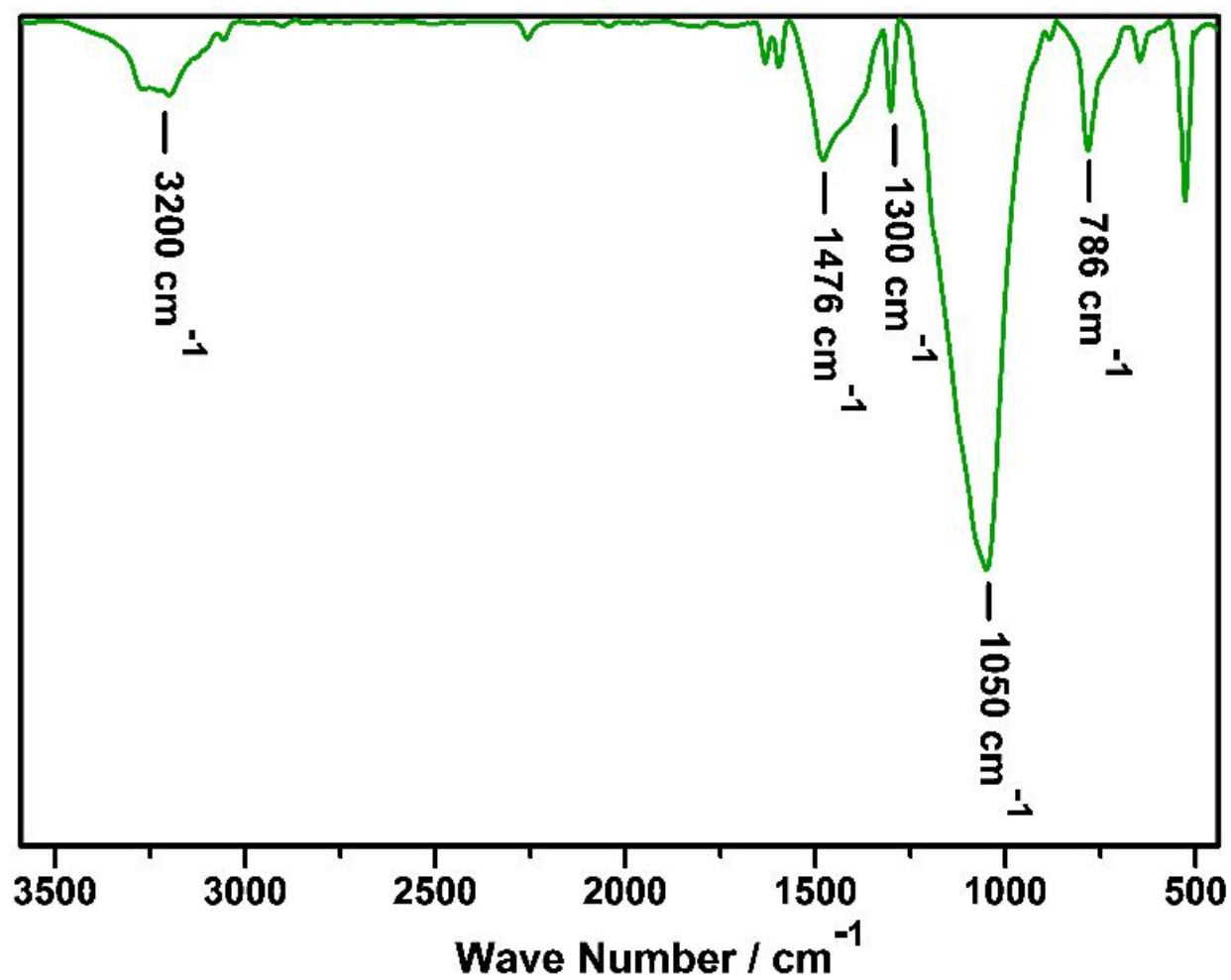
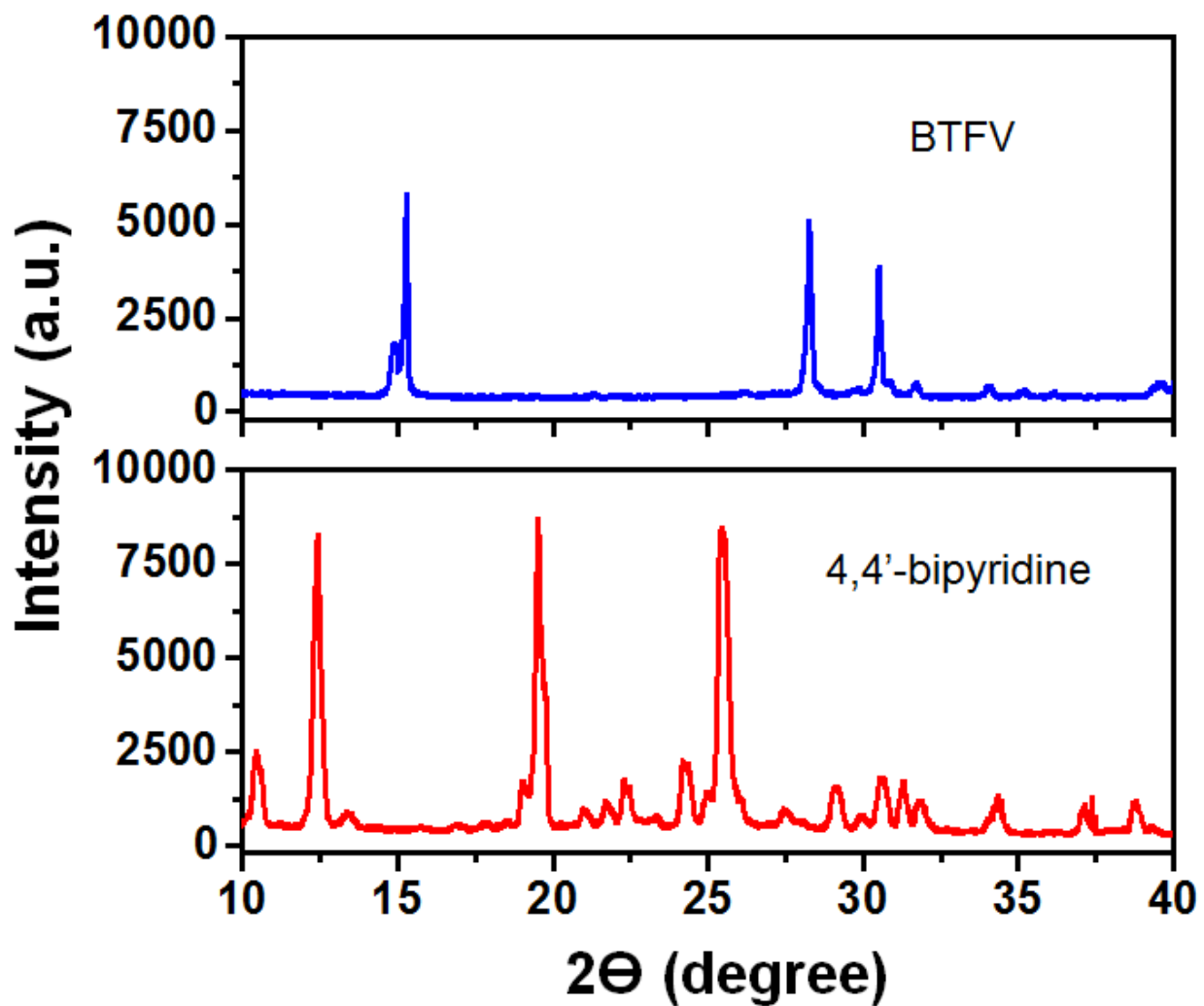**Figure S1.** FTIR spectra of N, N-di-(boron trifluoride)-4, 4'-bipyridine (BTFV).

Figure S2. XRD patterns of 4, 4'-bipyridine and BTFV showing a remarkable difference in crystallinity of 4, 4'-bipyridine upon adduct formation with boron trifluoride.
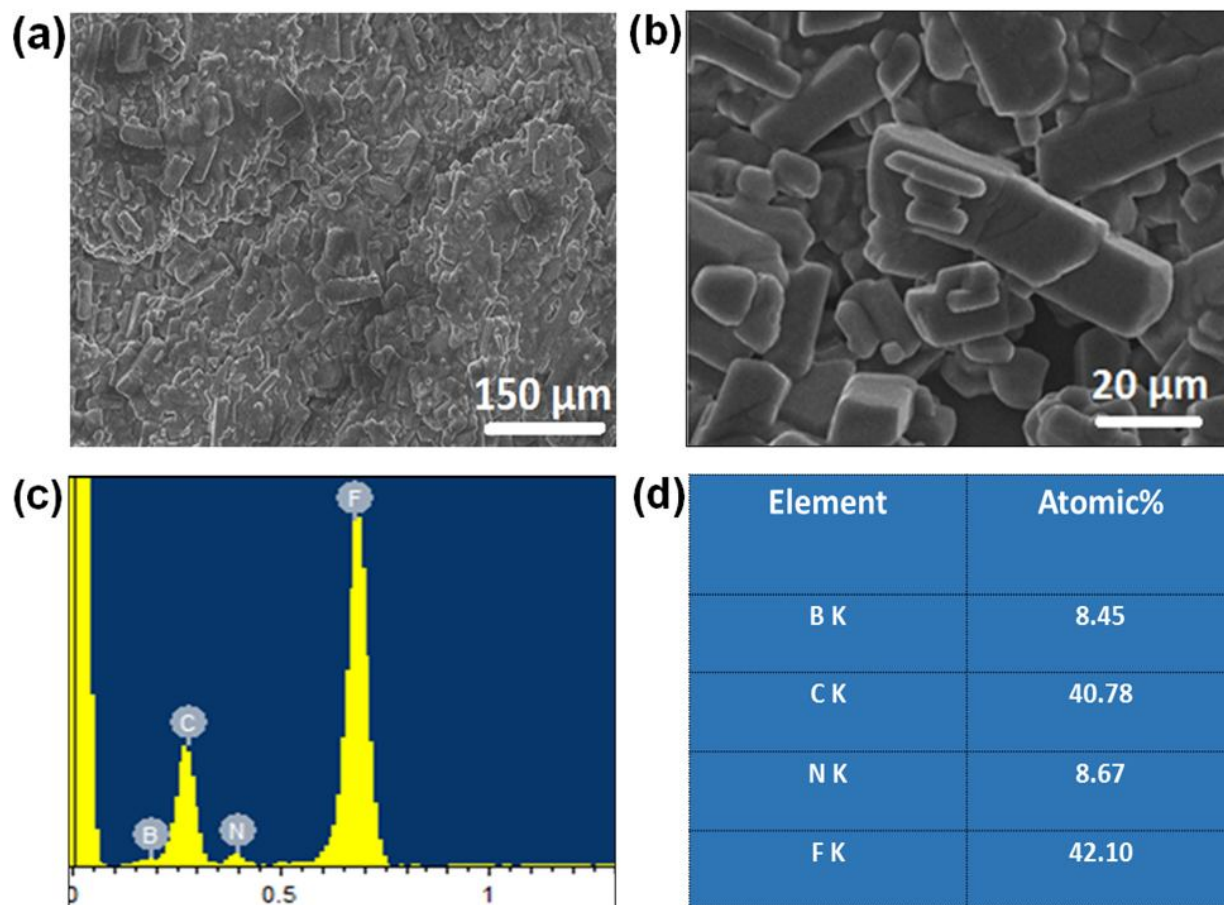
Figure S3. Top view FE-SEM images of BTFV at low magnification (a) and(b) at high magnification; (c) EDX spectrum of BTFV; and (d) Atomic percentage of different building atoms for BTFV. BTFV shows a non-uniform and aggregated particles size of several micrometers. The π- π stacking interaction between the positively charged 4, 4'-bipyridine rings[2] may be responsible for this aggregation.
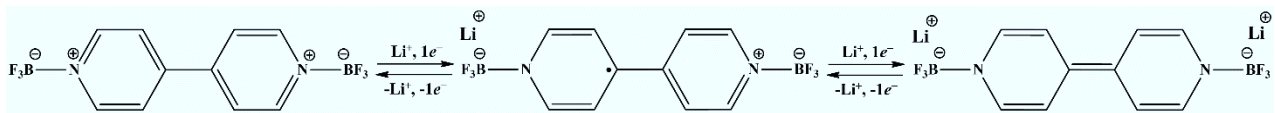
Figure S4. Schematic representation of proposed lithium storage mechanism.
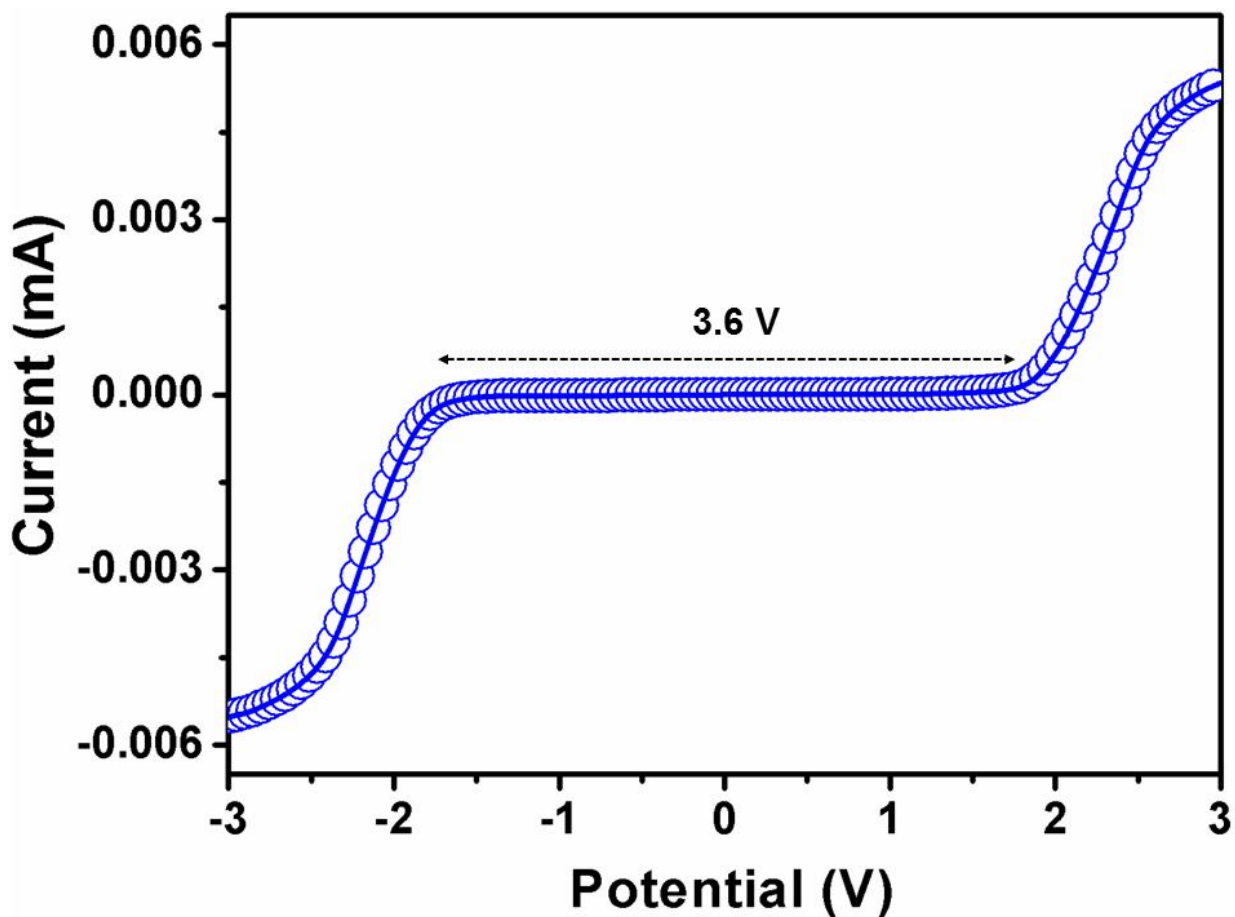

Figure S5. LSV plot of the IL–DMF electrolyte recorded at a scan rate of 20 mV s^{-1}. The IL-DMF electrolyte is found to be electrochemically stable in the applied bias range of -1.8 V to +1.8 V vs. Ag/Ag^{+}.
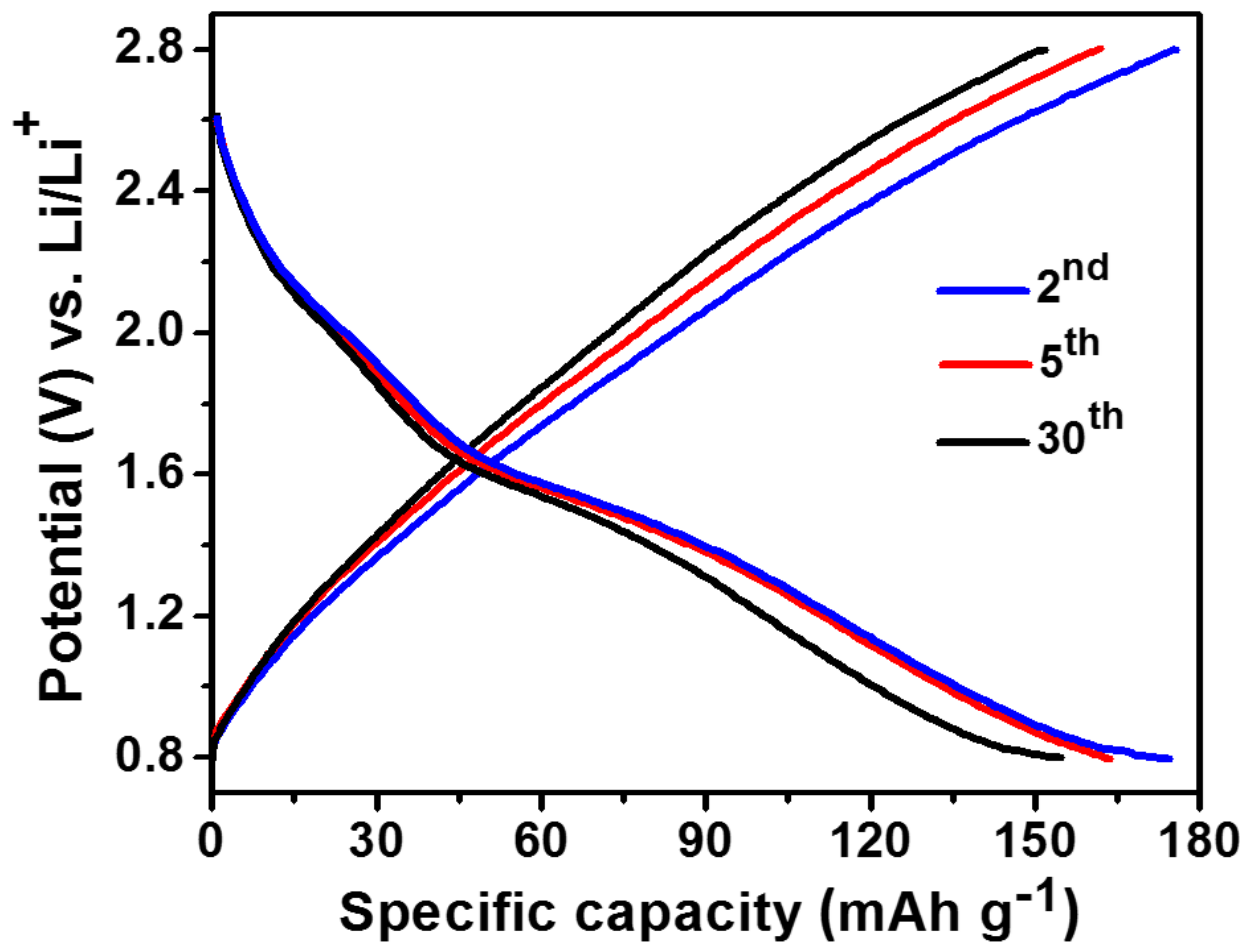
Figure S6. Charge-discharge profiles of BTFV at a current rate of 50 mA g^{-1} and within the potential range of 0.8-2.8 V vs. Li/Li^{+}.
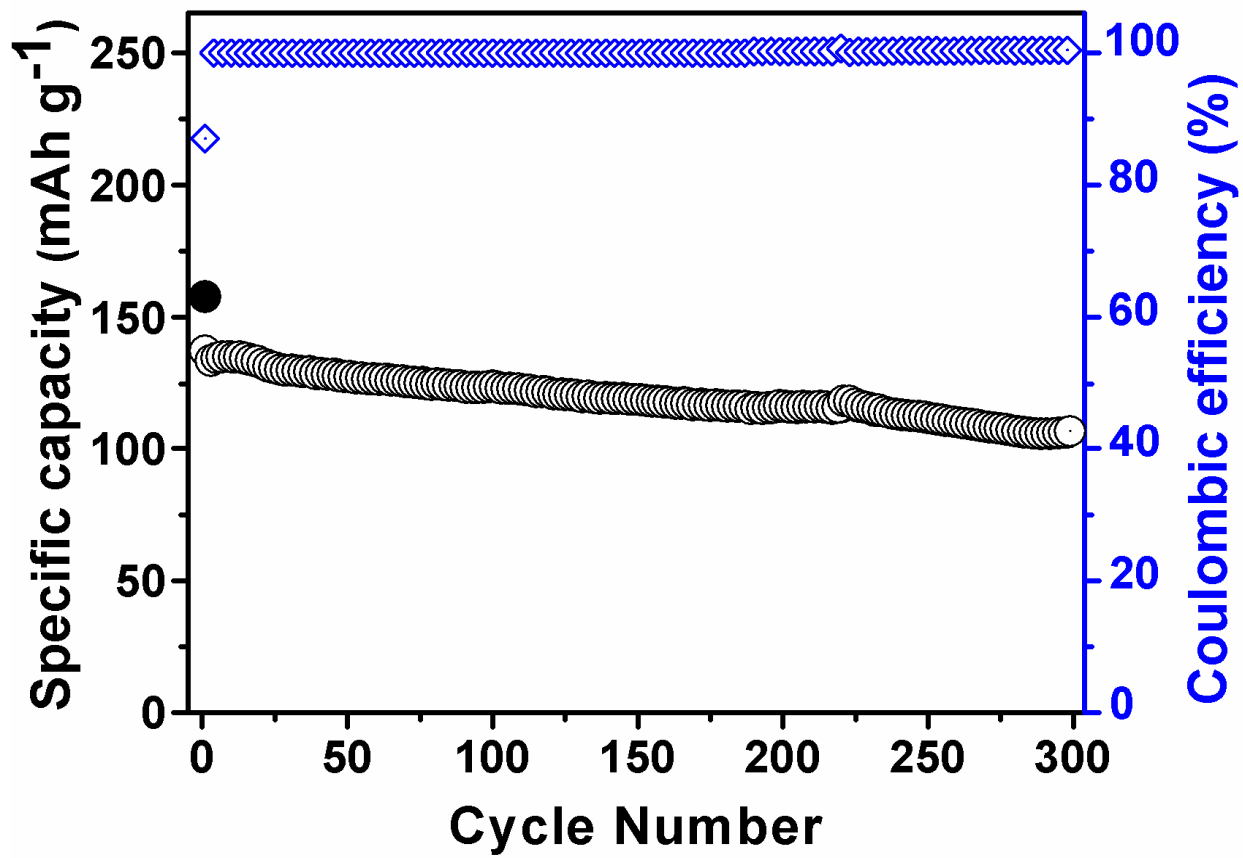
Figure S7. Long term cycling performance for BTFV electrode at the current density of 900 mA g^{-1}within the potential range 0.01-3.0 V vs. Li/Li^{+}.
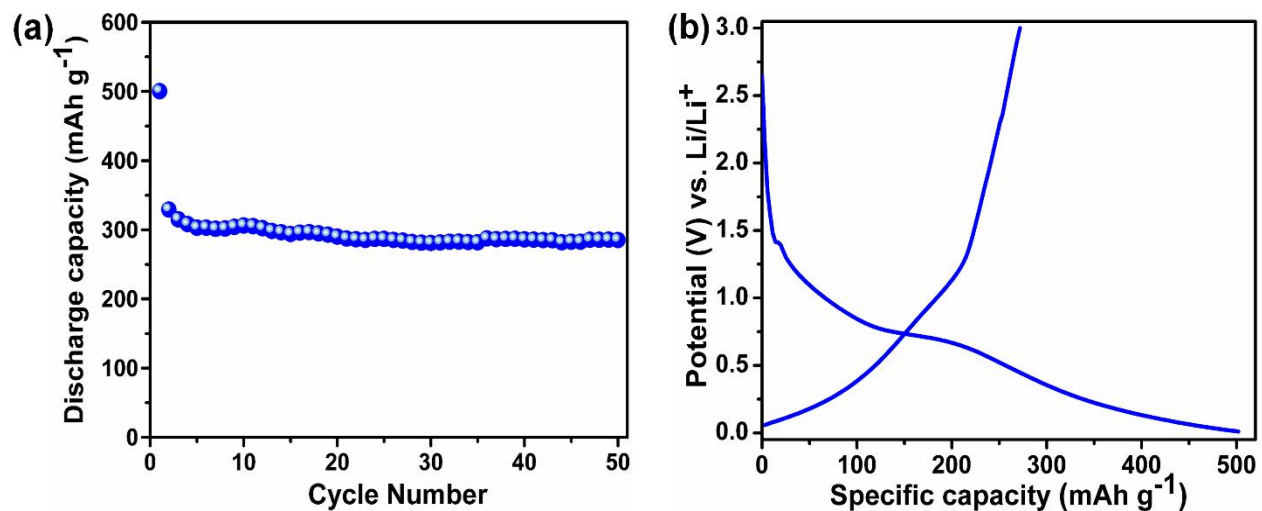
Figure S8.(a) Cycling performance for super P carbon at the current density of 50 mA g^{-1} within the potential range 0.01-3.0 V vs. Li/Li$^+$; (b) First cycle charge-discharge profile for super P carbon at the same current rate (50 mA g^{-1}).
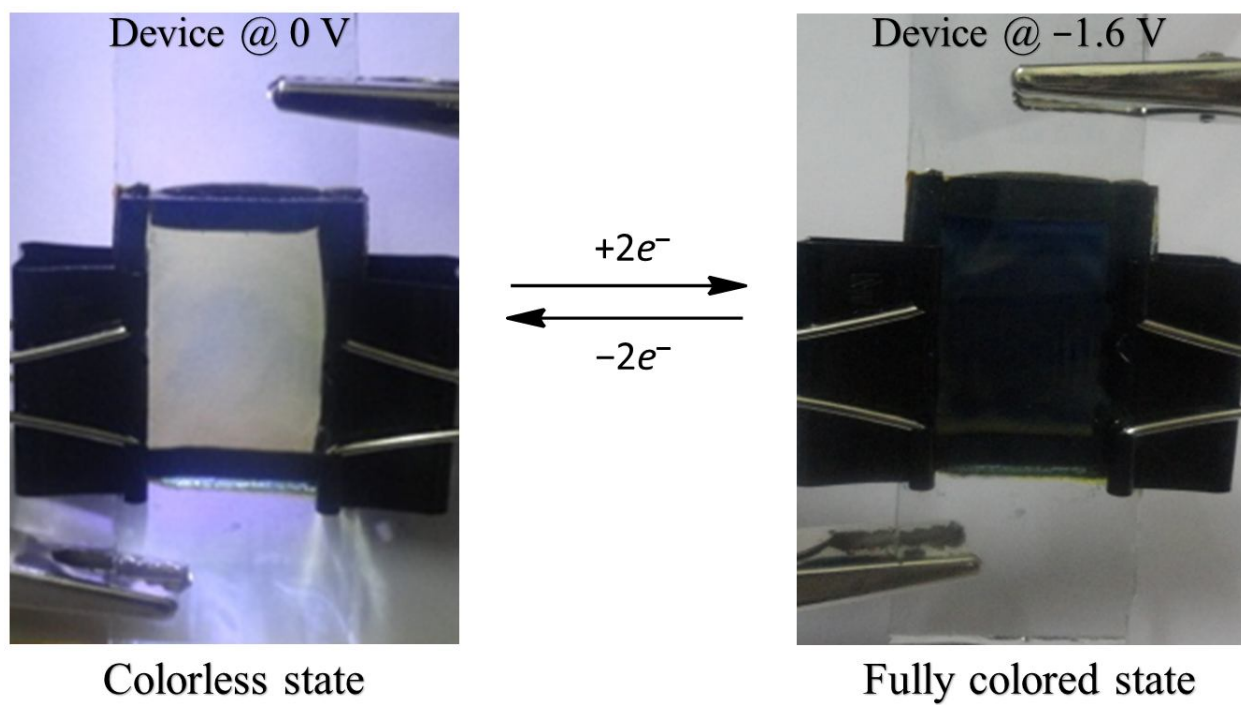
Figure S9. Electrochromic behavior of BTFV.

References

1. C. Han, Z. Li, W.-J. Li, S.-L. Chou and S.-X. Dou, *J. Mater. Chem. A*, 2014, **2**, 11683.

2. X. Yang, J. Li, X. H. Zhao, H. W. Wang and Y. K. Shan, *ActaCrystallogr C.*, 2007, **63**, 171.