Supporting Information for

Unveiling the Solid-solution Charge Storage Mechanism in 1T Vanadium Disulfide Nanoarrays Cathode

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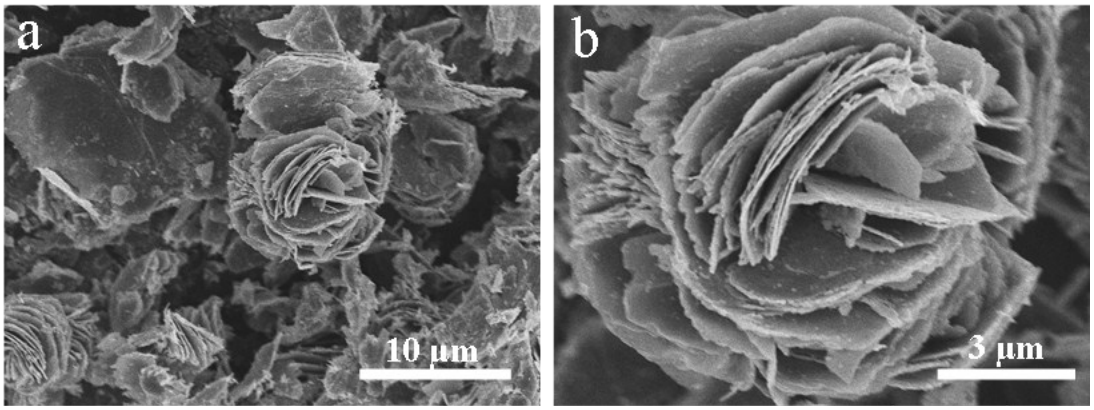

Fig. S1 SEM images of a) low and b) high magnification of VS_2 powder.

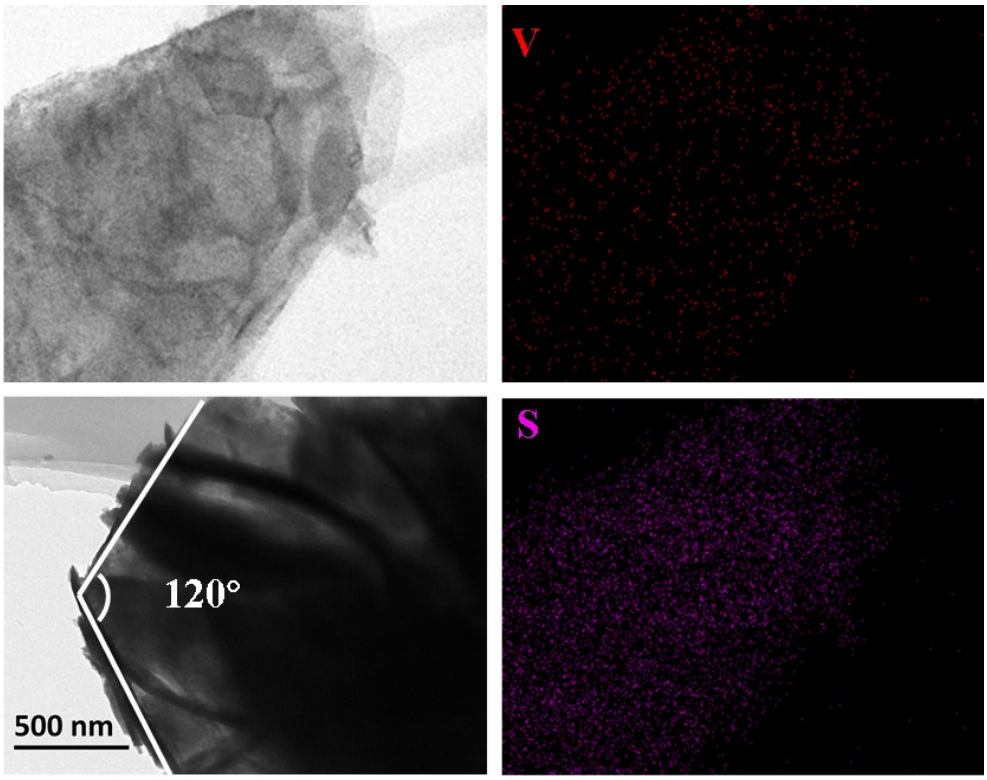

Fig. S2 TEM images of VS_2 and the corresponding element mapping of V and S.

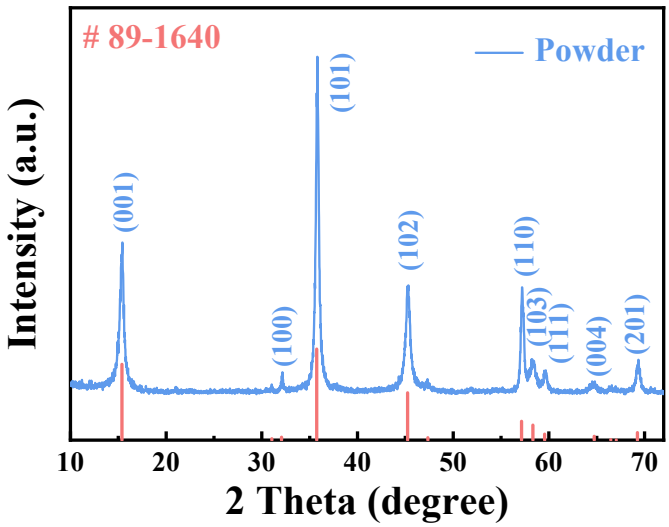

Fig. S3 XRD patterns of the VS_2 powder.

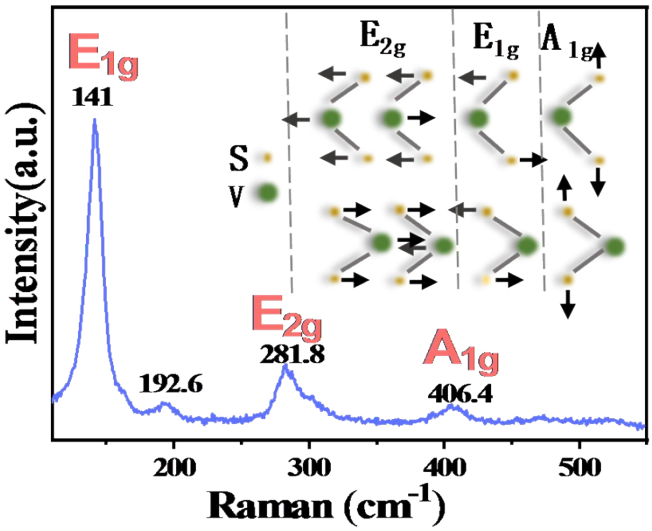

Fig. S4 The Raman shift spectrum of VS_2/CC nanosheeets arrays.

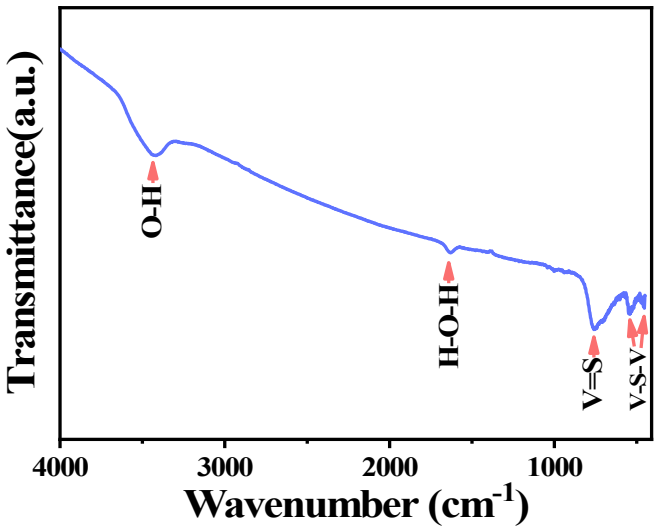

Fig. S5 The FTIR spectrum of VS_2/CC nanosheet arrays.

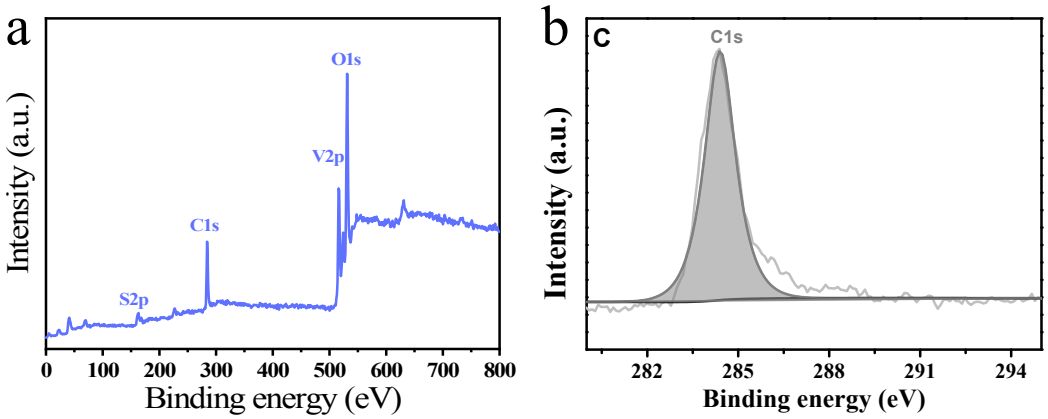

Fig. S6 XPS spectrum. a) Survey spectra. b) C 1s peaks of VS_2/CC nanosheet arrays.

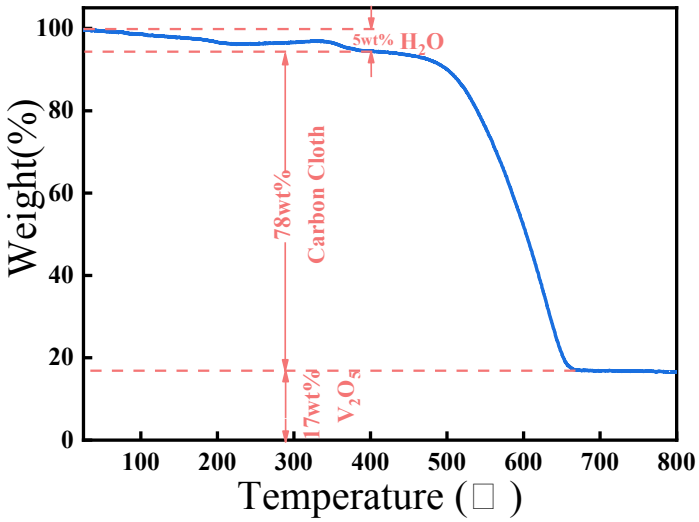

Fig. S7 TGA curve of VS_2/CC nanoarrays electrode under an air atmosphere.

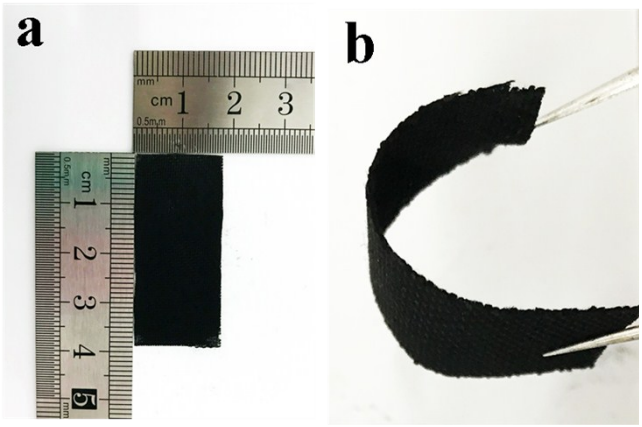

Fig. S8 Photos of self-supported VS_2/CC nanoarrays electrodes, which are bent using very small force. This demonstrates the flexibility and light weight of the electrodes.

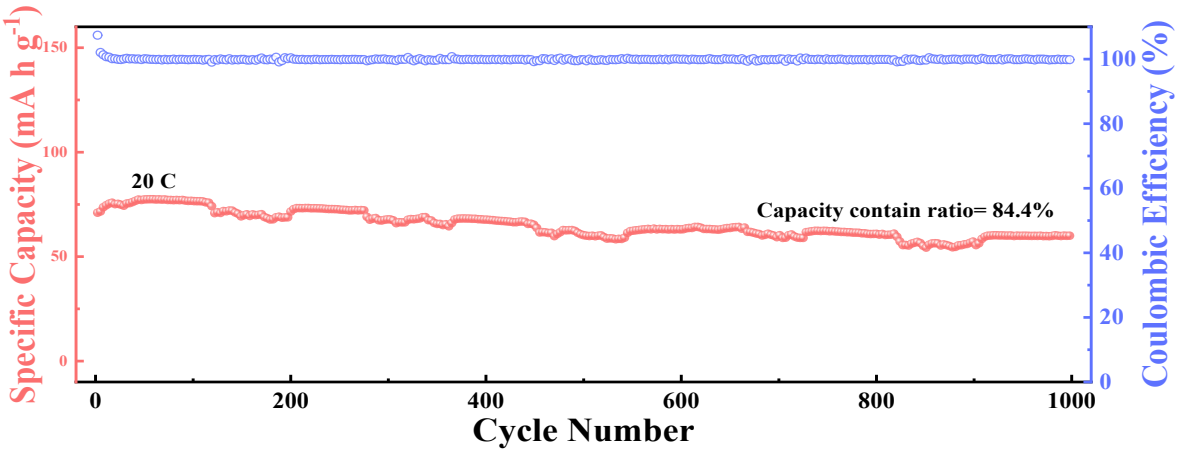

Fig. S9 Cycle stability test at 20 C for 1000 cycles.

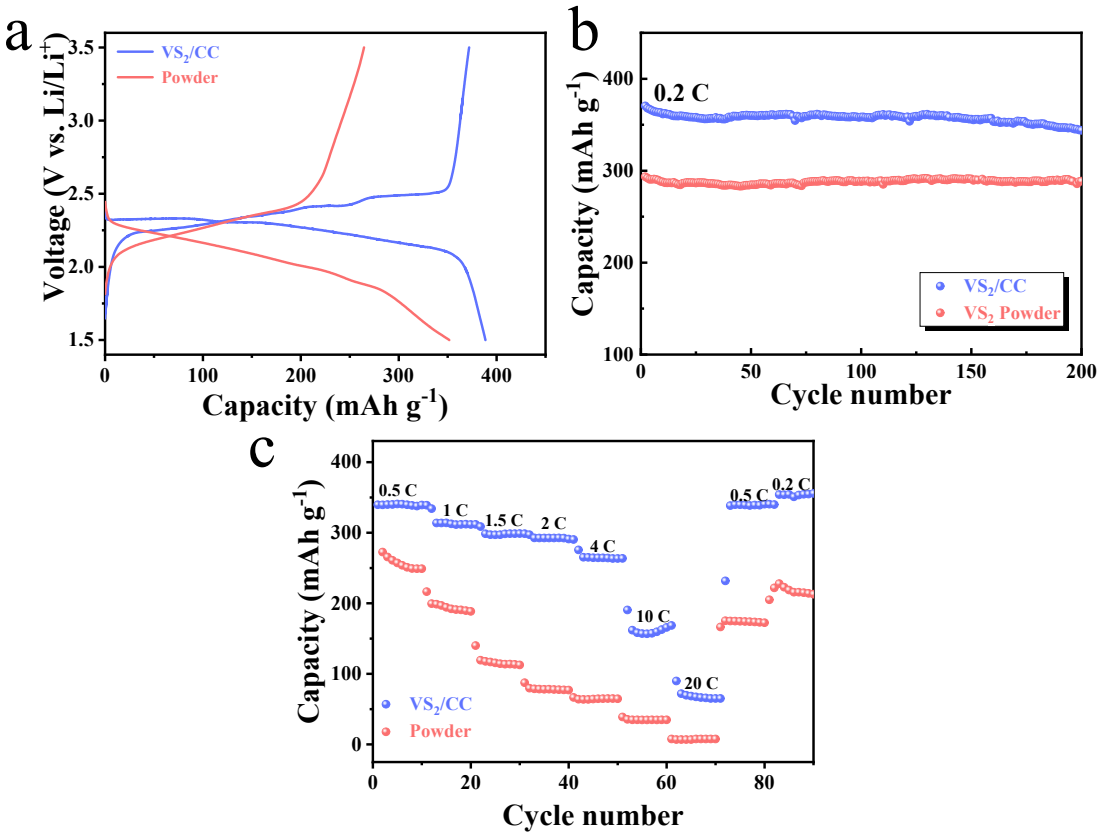

Fig. S10 a) Charge/discharge curves measured between 1.5 and 3.5 V at a rate of 0.2 C. b) Cycle stability test of VS_2/CC nanoarrays and VS_2 powder electrodes at 0.2 C for 200 cycle. c) Rate performance of VS_2/CC nanoarrays electrode and power electrode.

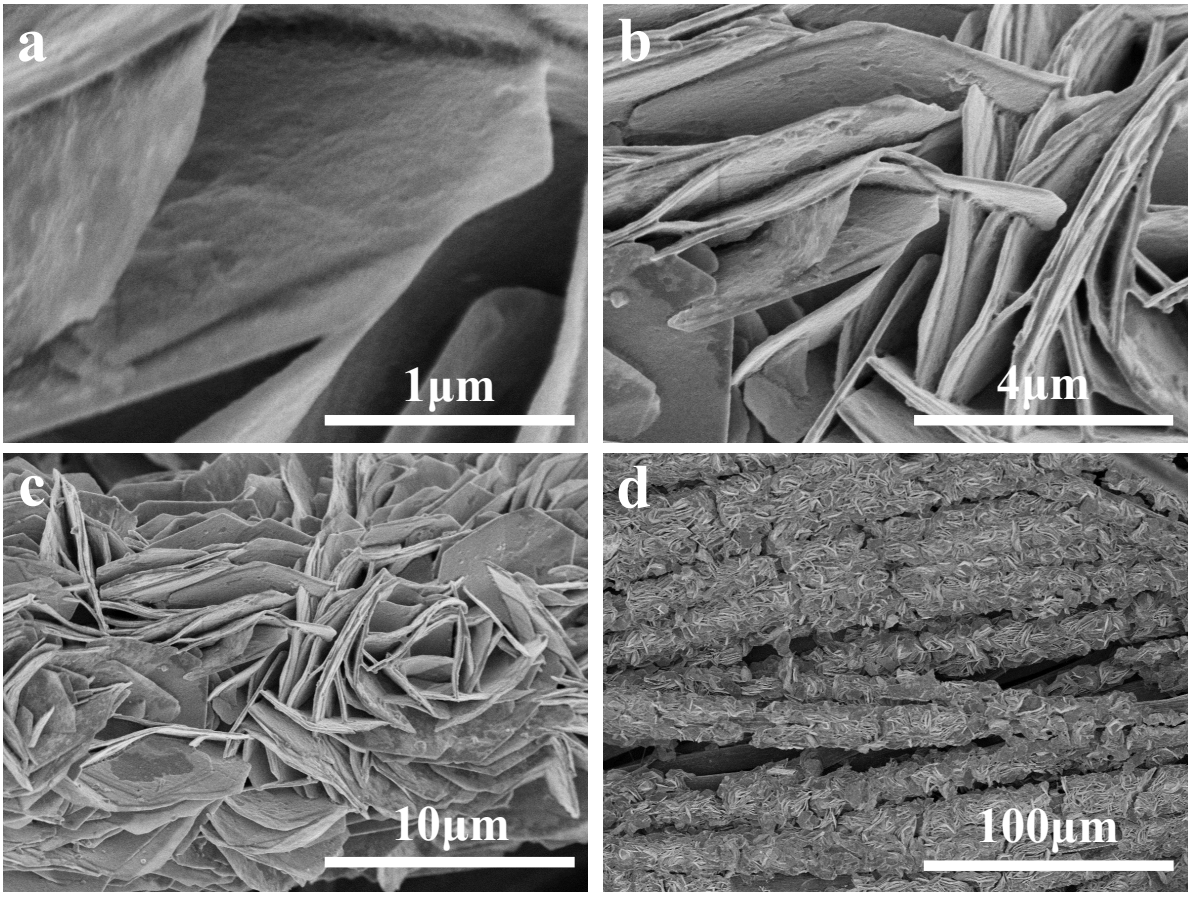

Fig. S11 SEM images of VS_2/CC nanoarrays electrode after 200 cycles at different magnification.

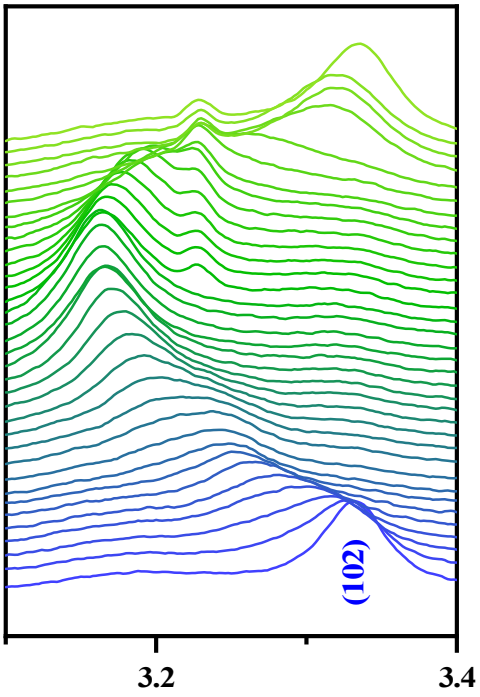

Fig. S12 In situ XRD profile evolution of diffraction peak 102 of VS_2 at 0.04C according to the electrochemical discharging and charging profile nearby. It can be seen that after charging the 102 peak restores to the initial position exactly as the other peaks in Fig. 3a and b new diffraction peak appearing during charging does not match with any related substance consisting of V or S, it is most probably coming from the side effects of the electrolytes.

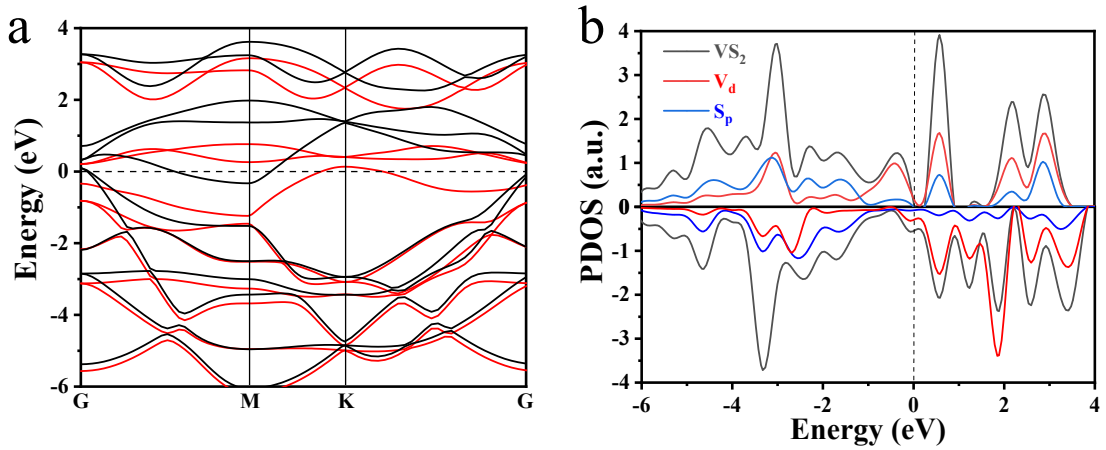

Fig. S13 a) Calculated band structure of 1T VS_2 monolayer, in which the black (red) line indicates spin up (down) states. b) Total density of states of VS_2 and projected density of states consisting of 3d orbit of V atoms and 2p orbit of S atoms.

Table S1. Performance comparison with reported LIBs cathodes.

Electrode description	Specific capacity	Rate capability	Cycling retention	Ref
VS_2/CC array (this work)	336 mA h g^{-1} at 0.5 C between 1.5-3.5 V	66 mA h g^{-1} at 20 C	84.4 % after 10,00 cycles at 20 C	This work
State of art VANADIUM-based LIBs cathodes				
V_2O_5/CNT	339 mA h g^{-1} at 0.1 C	128 mA h g^{-1} at 10 C	83% after 100 cycles at 10 C	1
V_2O_5/PEDOT	265 mA h g^{-1} at 5 C	168 mA h g^{-1} at 60 C	98% after 1000 cycles at 60C	2
$LiVO_3$	298.4 mA h g^{-1} at 50 mA g^{-1}	160.5 mAhg^{-1} at 800 mA g^{-1}	53 % after 100 cycles at 500 mA g^{-1}	3
Li_3VO_4/NG	139 mA h g^{-1} at 1 C	114 mA h g^{-1} at 8C	91.4% after 300 cycles at 10C	4
$LiVPO_4F$	141.3 mA h g^{-1} at 0.1 C	104.2 mA h g^{-1} at 5C	98% after 50 cycles at 0.1C	5
$LiVPO_4F$@C	134.7 mA h g^{-1} at 0.2 C	97.9 mA h g^{-1} at 10 C	93.74 % after 800 cycles at 10C	6
$LiVPO_4F$/NG	152.7 mA h g^{-1} at 0.1 C	90.1 mA h g^{-1} at 20 C	87.4% after 500 cycles at 20C	7
Co-doped $LiVPO_4F$/C	125 mA h g^{-1} at 0.2 C	72.2 mA h g^{-1} at 10 C	96.4% after 50 cycles at 3C	8
$LiVOPO_4$	127 mA h g^{-1} at 0.1 C	83 mAhg^{-1} at 1C	78.1 % after 30 cycles at 0.1C	9
$LiVOPO_4$@V_2O_5	158 mA h g^{-1} at 0.1 C	112mA h g^{-1} at 3 C	87.9 % after 200 cycles at 0.1C	10

Supplementary References

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