Supporting information

Hydrated vanadium pentoxide xerogel with superior sodium storage capacity

Qiulong Wei,‡[a] Jin Liu,‡[a] Wei Feng,‡[a] Jinzhi Sheng,[a] Xiaocong Tian,[a] Liang He,*[a] Qinyou An[b] and Liqiang Mai*[a]

[a] State Key Laboratory of Advanced Technology for Materials Synthesis and Processing, Wuhan University of Technology, Hubei, Wuhan 430070, China
E-mail:mlq518@whut.edu.cn; hel@whut.edu.cn
Fax: +86-27-87644867; Tel: +86-27-87467595
[b] Cullen College of Engineering, Department of Electrical & Computer Engineering, University of Houston, Houston, USA

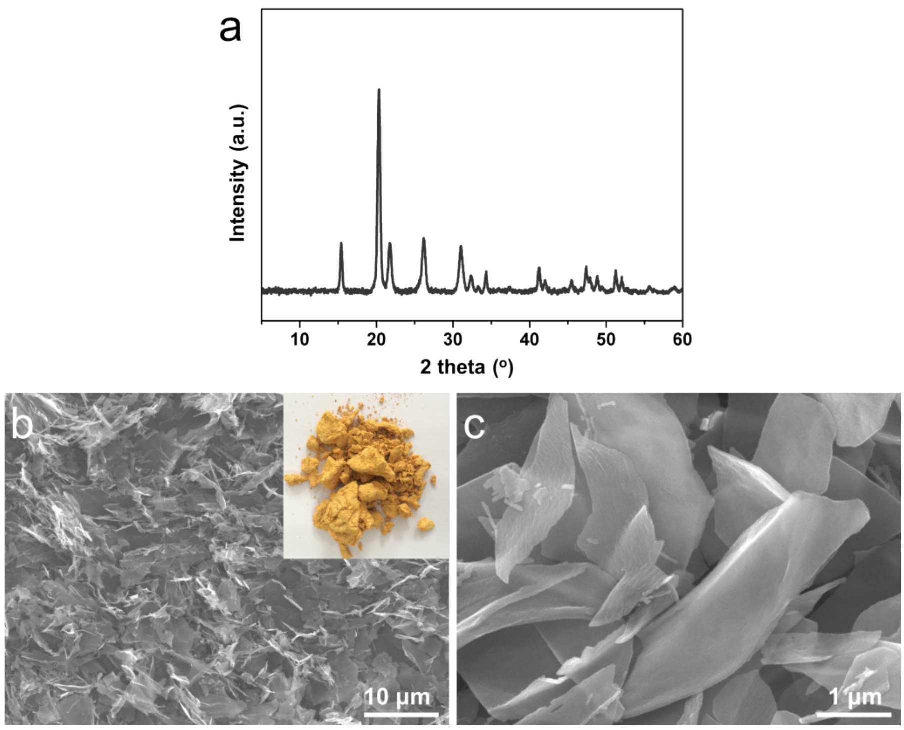

Fig. S1 XRD pattern (a) and SEM images (b,c) of the orthorhombic V_2O_5. Inset of b is the optical image of as-synthesized α-V_2O_5 powders. (JCPDS No. 00-041-1426, space group: Pmmn, a = 11.5160 Å, b = 3.5656 Å, c = 4.3727 Å).

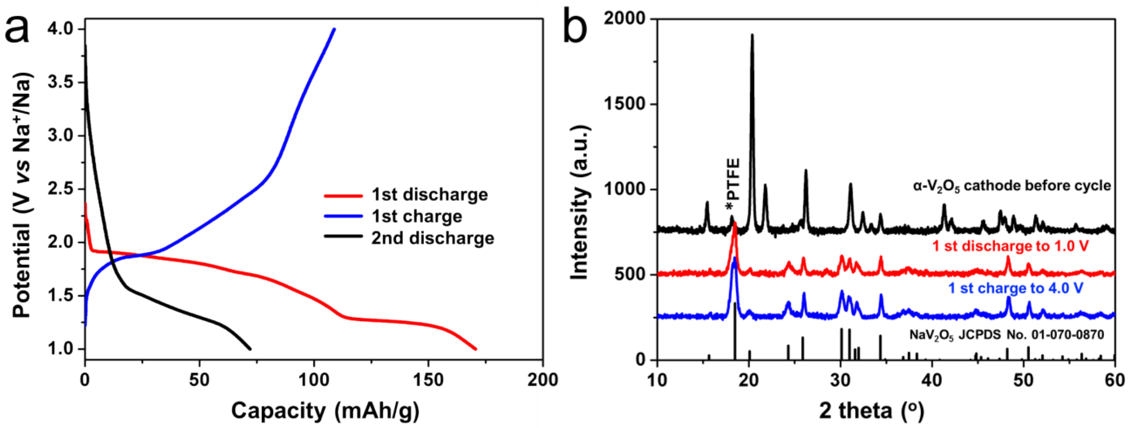

Fig. S2 (a) The discharge-charge curves of the α-V_2O_5 cathode in SIB test. The 1st discharge curve displays two plateaus. However, the 2nd discharge curve display one main plateau, which indicating the irreversible phase transition occurs during the first cycle, which resulting the large capacity fading. (b) The ex-situ XRD patterns of α-V_2O_5 cathode at various charge/discharge states. (NaV_2O_5, JCPDS No. 01-070-0870, space group: P21mn, a = 11.3180 Å, b = 3.6110 Å, c = 4.7970 Å, α=β=γ= 90.0°). The phase transition from the α-V_2O_5 phase to NaV_2O_5 phase is irreversible, which could not be recovered to the α-V_2O_5 phase after charging back to 4.0 V, indicating the phase changes of α-V_2O_5 layer structure are irreversible after the Na^+ ions inserting.

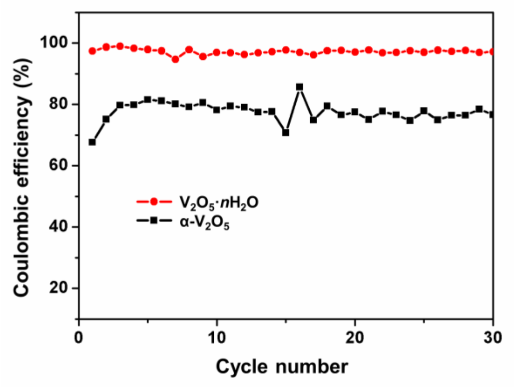

Fig. S3 Coulombic efficiency *vs* cycle number of the $V_2O_5{\cdot}nH_2O$ and α-V_2O_5 cathodes in SIB test.

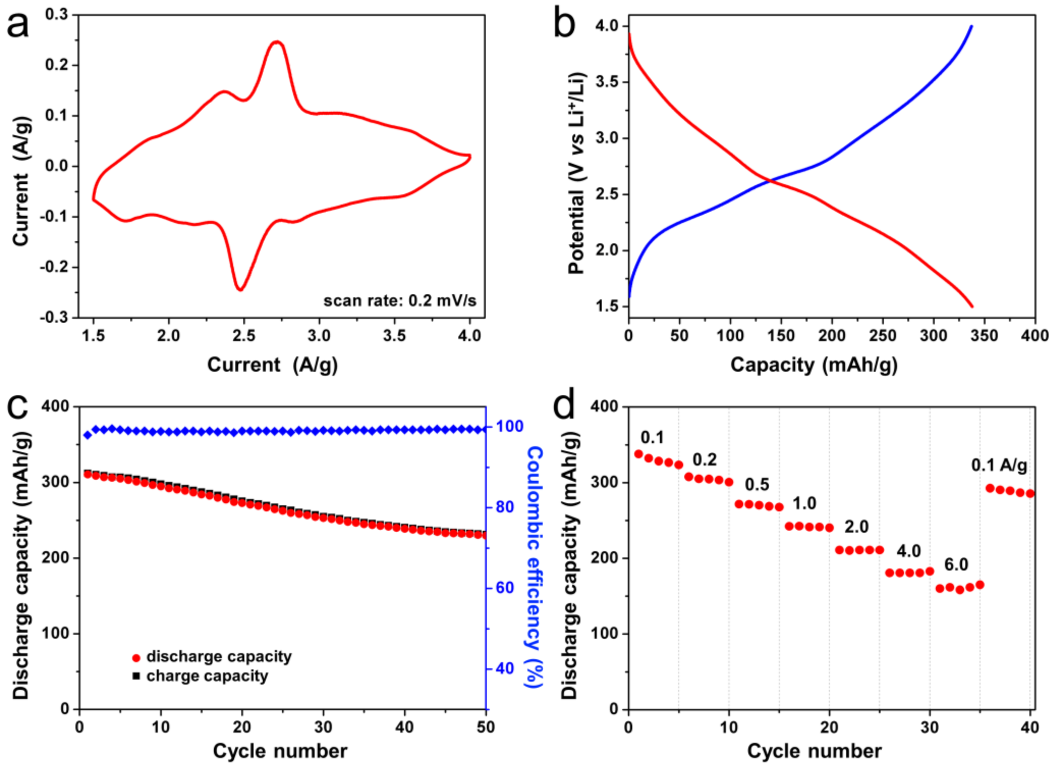

Fig. S4 LIB performance of the $V_2O_5{\cdot}nH_2O$ cathode. CV curves (a) and discharge-charge curves at current density of 0.1 A/g (b). Cycling performance at the current density of 0.5 A/g (c) and the rate performance (d).

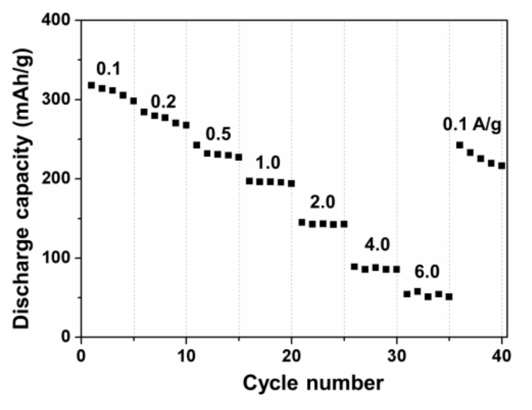

Fig. S5 LIB rate performance of the α-V_2O_5 cathode.

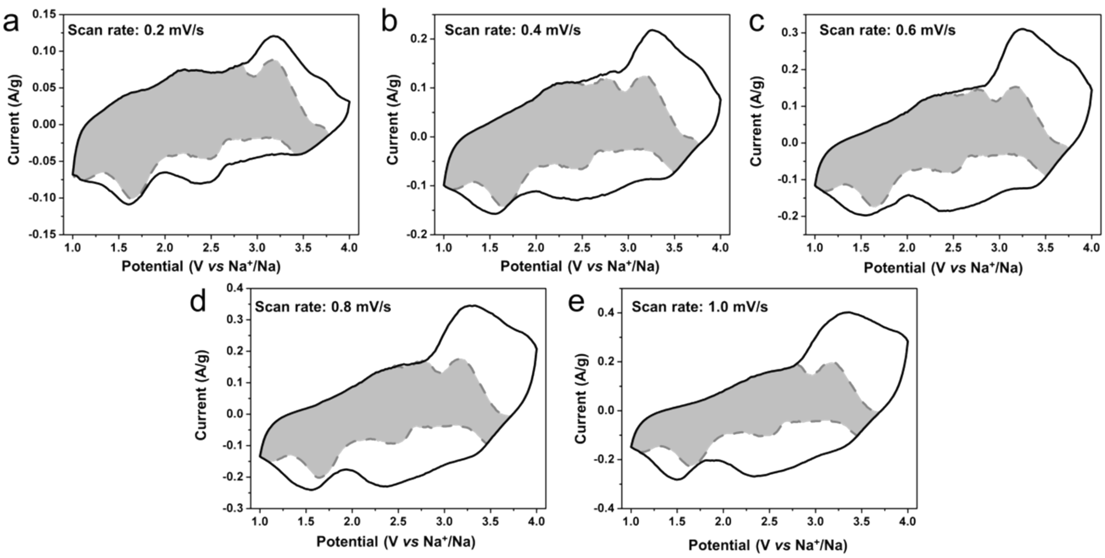

Fig. S6 Cyclic voltammetric responses $V_2O_5 \cdot nH_2O$ at scan rate of 0.2 (a), 0.4 (b), 0.6 (c), 0.8 (d) and 1.0 mV/s (e), respectively. The diffusion contribution to the current is represented as the shaded area.

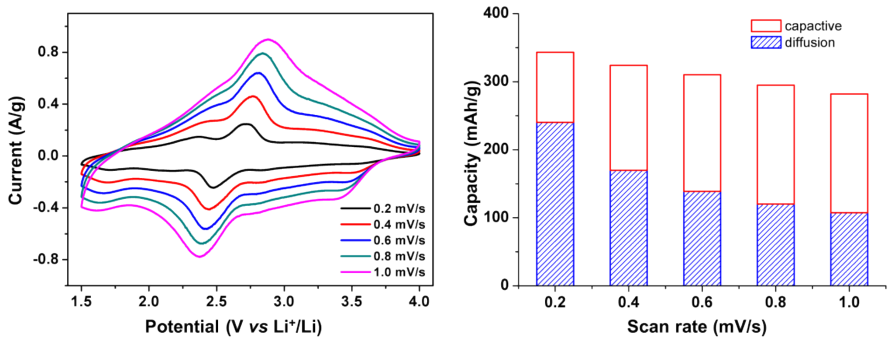

Fig. S7 CV curves (a) and corresponding capacity contribution (b) of the total stored charge at various scan rates for LIB test.

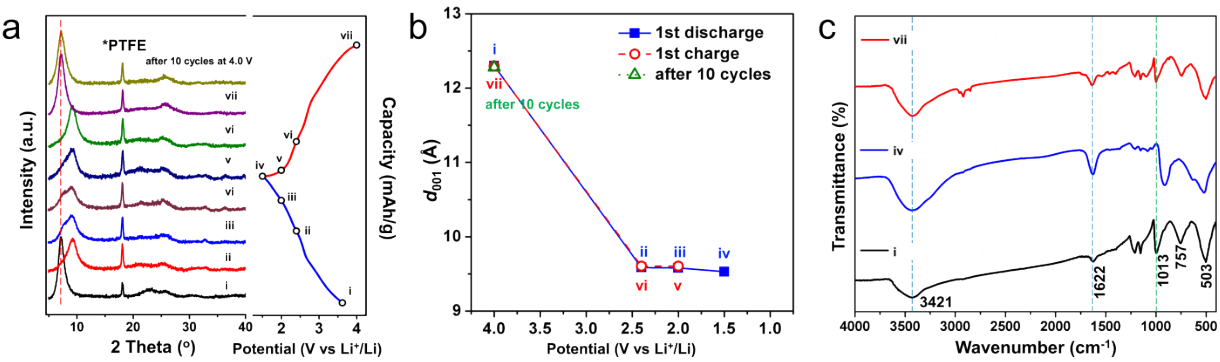

Fig. S8 *Ex-situ* XRD pattern (a), related d_{001} value changes (b) and FTIR spectra (c) of the cathodes in LIB test collected at various charge/discharge states: (i) before cycle, (ii) discharged to 2.4 V, (iii) discharged to 2.0 V, (iv) discharged to 1.5 V, (v) re-charged to 2.0 V, (vi) re-charged to 2.4 V and (vii) re-charged to 4.0 V.

Table S1. A survey of electrochemical properties of vanadium oxides and their composites for SIBs.

Electrode description (%)	Potential range (V)	Specific capacity (mAh/g)	High rate capacity
$V_2O_5 \cdot nH_2O$ xerogels [this work]	1.0-4.0	338 mAh/g at 50 mA/g	96 mAh/g at 1000 mA/g
bilayered V_2O_5 nanobelts [1]	1.0-4.0	231.4 mAh/g at 80 mA/g	134 mAh/g at 640 mA/g
V_2O_5 nanoparticles generated in nanoporous carbon[2]	1.5-3.8	170 mAh/g at 40 mA/g	90 mAh/g at 640 mA/g
nanostructured bilayered vanadium oxide [3]	1.5-3.8	250 mAh/g at 20 mA/g	---
amorphous vanadium oxide [4]	1.5-3.8	241 mAh/g at 23.4 mA/g	~80 mAh/g at 1170 mA/g
hierarchical orthorhombic V_2O_5 hollow nanospheres [5]	1.0-4.2	230.0 mAh/g at 20 mA/g	~90 mAh/g at 1280 mA/g
V_6O_{13} microflowers [6]	1.5-3.4	225.7 mAh/g at 20 mA/g	159.8 mAh/g at 160 mA/g
VO_2 nanosheets [7]	1.5-4	220 mAh/g at 50 mA/g	~80 mAh/g at 1000 mA/g

References

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