Supporting Information

Mesoporous VCN nanobelts For High-Performance Flexible Zn-ion batteries

Zeyan Zhou[1,], Taotao Zeng[1], Haoran Zhang[3], Ding Chen[1, 2,*]*

[1]*School of Materials Scinence and Engineering, Hunan University, Changsha City, 410082, P.R. China.*

[2]*State Key Laboratory of Advanced Design and Manufacturing for Vehicle Body, College of Mechanical and Vehicle Engineering, Hunan University, Changsha City,410082, People's Republic of China*

[3]*National Engineering Research Center for Marine Aquaculture, Marine Science and Technology College, Zhejiang Ocean University, Zhoushan, Zhejiang Province 316004, China*

Corresponding authors. E-mails: zhouzeyan@hnu.edu.cn (Z. Zhou)
chending@hnu.edu.cn (D. Chen)

The capacitances C_{device} (F) were calculated from discharging profiles (GCD) according to equation (1):

$$C_{device} = It/U \quad (1)$$

in which U(V) is the working voltage window; ν (V s^{-1}) is the scan rate; I(A) is the current. And areal capacitances C_A (F cm^{-2}) were calculated by the following equation:

$$C_A = C_{device}/A \quad (2)$$

in which A(cm^2) is the effective area of the device.

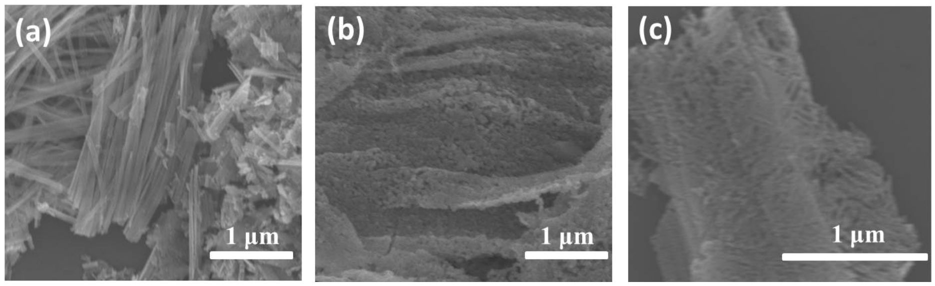


Figure S1. Typical SEM of sample (a) VN, (b) VCN-1 and (c) VCN-3.

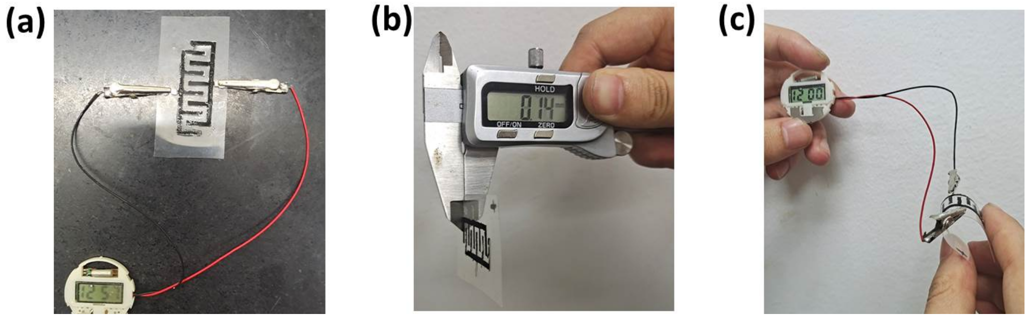


Figure S2. (a) the flexible battery after 1h can still power a digital clock normally. (b) Thickness of the FZIB, the number shows that only 0.14 mm. (c) The flexibility test of the FZIB.

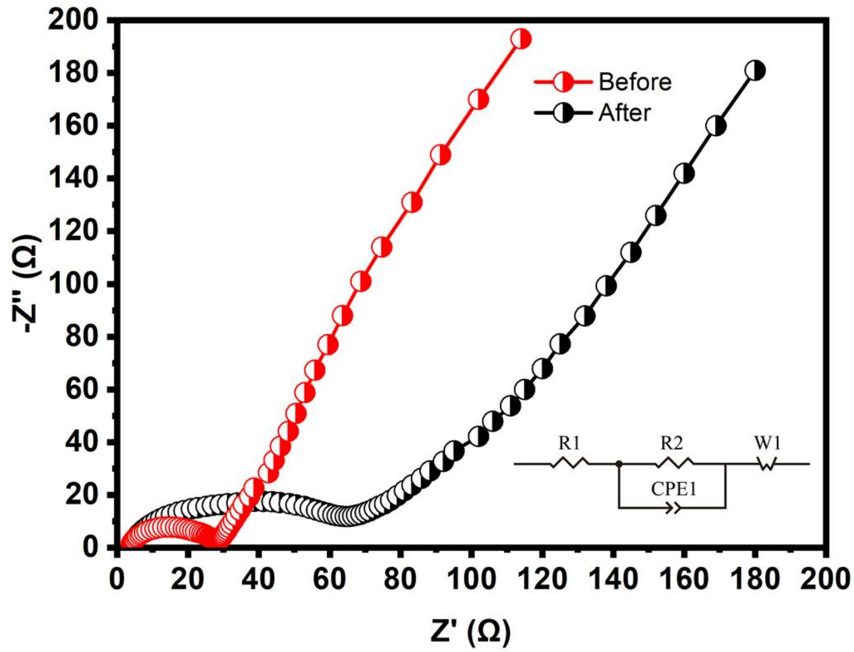
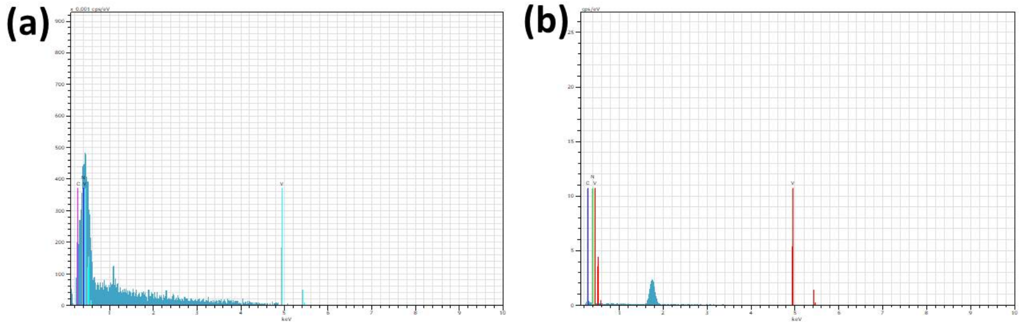


Figure S3. EIS curve before and after cycling, with the equivalent circuit model in the lower right corner.



Element	Atom.C(at. %)
V	32.47
N	38.27
C	29.26

Element	Atom.C(at. %)
V	20.41
N	18.64
C	60.65

Figure S4. Representative EDX spectrum of sample (a)VCN-1 and (b)VCN-3.

Table S1. Comparison of Electrochemical performance between VCN electrode and other previously reported Vanadium-based Electrodes

Electrode	Electrolyte	Capability	Ref.
$Zn_3V_2O_7(OH)_2\cdot 2H_2O@HfO_2$	1 M $ZnSO_4$(L)	227/0.2	1
$Ba_{1.2}V_6O_{16}\cdot 3H_2O$	2 M $ZnSO_4$(L)	241/0.5	2
Zn-$VO(CH_2O)_2$	3 M $Zn(CF_3SO_3)_2$(L)	217/0.1	3
Polyaniline-VOH	3 M $Zn(TfO)_2$ + 6 M LiTFSI(L)	323/1	4
$K_2V_3O_8$	3 M $Zn(CF_3SO_3)_2$(L)	302.8/0.1	5
NaV_3O_8	3 M $ZnSO_4$ + 0.5 M Na_2SO_4(L)	280/0.05	6
$NaVPO_4F$/C	15 M $NaClO_4$ + 1 M $Zn(CF_3SO_3)_2$(L)	89.6/0.1	7
Urchin-like spinel MgV_2O_4	2 M $Zn(CF_3SO_3)_2$(L)	272/0.2	8
Coral VN/C	3.5 M $ZnSO_4$(L)	322/0.5	9
Mesoporous VCN nanobelts	PVA/KOH + 2 M $ZnSO_4$(S)	318.2/0.3	This work

References

1. Guo, J.; Ming, J.; Lei, Y.; Zhang, W.; Xia, C.; Cui, Y.; Alshareef, H. N., Artificial Solid Electrolyte Interphase for Suppressing Surface Reactions and Cathode Dissolution in Aqueous Zinc Ion Batteries. *ACS Energy Lett.* **2019,** *4* (12), 2776-2781.
2. Wang, X.; Xi, B.; Ma, X.; Feng, Z.; Jia, Y.; Feng, J.; Qian, Y.; Xiong, S., Boosting Zinc-Ion Storage Capability by Effectively Suppressing Vanadium Dissolution Based on Robust Layered Barium Vanadate. *Nano Lett.* **2020,** *20* (4), 2899-2906.
3. Tang, W.; Lan, B.; Tang, C.; An, Q.; Chen, L.; Zhang, W.; Zuo, C.; Dong, S.; Luo, P., Urchin-like Spinel MgV_2O_4 as a Cathode Material for Aqueous Zinc-Ion Batteries. *ACS Sustainable Chemistry & Engineering* **2020,** *8* (9), 3681-3688.
4. Bin, D.; Wang, Y.; Tamirat, A. G.; Zhu, P.; Yang, B.; Wang, J.; Huang, J.; Xia, Y., Stable High-Voltage Aqueous Zinc Battery Based on Carbon-Coated $NaVPO_4F$ Cathode. *ACS Sustainable Chemistry & Engineering* **2021,** *9* (8), 3223-3231.
5. Shan, X.; Kim, S.; Abeykoon, A. M. M.; Kwon, G.; Olds, D.; Teng, X., Potentiodynamics of the Zinc and Proton Storage in Disordered Sodium Vanadate for Aqueous Zn-Ion Batteries. *ACS*

Appl. Mater. Interfaces **2020,** *12* (49), 54627-54636.

6. Li, Z.; Wu, B.; Yan, M.; He, L.; Xu, L.; Zhang, G.; Xiong, T.; Luo, W.; Mai, L., Novel Charging-Optimized Cathode for a Fast and High-Capacity Zinc-Ion Battery. *ACS Appl. Mater. Interfaces* **2020,** *12* (9), 10420-10427.
7. Wang, M.; Zhang, J.; Zhang, L.; Li, J.; Wang, W.; Yang, Z.; Zhang, L.; Wang, Y.; Chen, J.; Huang, Y.; Mitlin, D.; Li, X., Graphene-like Vanadium Oxygen Hydrate (VOH) Nanosheets Intercalated and Exfoliated by Polyaniline (PANI) for Aqueous Zinc-Ion Batteries (ZIBs). *ACS Appl. Mater. Interfaces* **2020,** *12* (28), 31564-31574.
8. Nagaraj, R.; Pakhira, S.; Aruchamy, K.; Yadav, P.; Mondal, D.; Dharmalingm, K.; Sanna Kotrappanavar, N.; Ghosh, D., Catalyzing the Intercalation Storage Capacity of Aqueous Zinc-Ion Battery Constructed with Zn(II) Preinserted Organo-Vanadyl Hybrid Cathode. *ACS Applied Energy Materials* **2020,** *3* (4), 3425-3434.
9. Su, Q.; Rong, Y.; Chen, H.; Wu, J.; Yang, Z.; Deng, L.; Fu, Z., Carbon-Doped Vanadium Nitride Used as a Cathode of High-Performance Aqueous Zinc Ion Batteries. *Industrial & Engineering Chemistry Research* **2021,** *60* (33), 12155-12165.