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

Supporting Information

Synergistic Electrocatalysis of Polysulfides by a Nanostructured VS_4-Carbon Nanofibers Functional Separator for High-Performance Lithium-Sulfur Batteries

Yongzheng Zhang[a],GuixinXu[a], Qi Kang[b], Liang Zhan*[a], Weiqiang Tang[c], Yaxin Yu[c], Kaili Shen[a], Hucheng Wang[a], Xuan Chu[a], Jinyun Wang[a], Shuangliang Zhao[c], Yanli Wang[a], Licheng Ling*[a]and Shubin Yang*[d]

[a]State Key Laboratory of Chemical Engineering, Key Laboratory for Specially Functional Polymers and Related Technology of Ministry of Education, Shanghai Key Laboratory of Multiphase Materials Chemical Engineering, East China University of Science and Technology, Shanghai 200237, China

[b]Department of Polymer Science and Engineering, Shanghai Key Laboratory of Electrical Insulation and Thermal Aging, Shanghai Jiao Tong University, Shanghai 200240, PR China

[c]State Key Laboratory of Chemical Engineering and School of Chemical Engineering, East China University of Science and Technology, Shanghai 200237, China.

[d]Key Laboratory of Aerospace Advanced Materials and Performance of Ministry of Education, School of Materials Science and Engineering, Beihang University, Beijing 100191, China

*Corresponding authors: Liang Zhan, E-mail: zhanliang@ecust.edu.cn；Licheng Ling lchling@ecust.edu.cn;Shubin Yang,E-mail: yangshubin@buaa.edu.cn

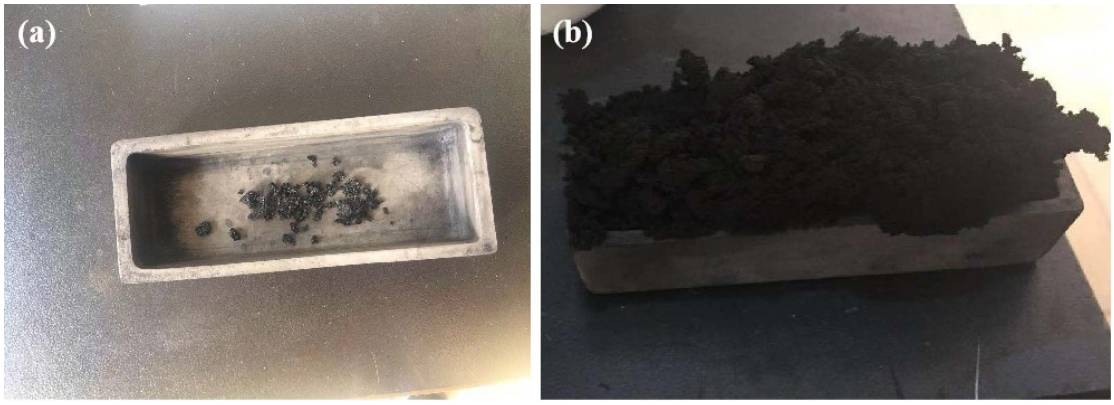

Figure S1. Opticalimages of the sample (a) before and (b) after CVD treatment.

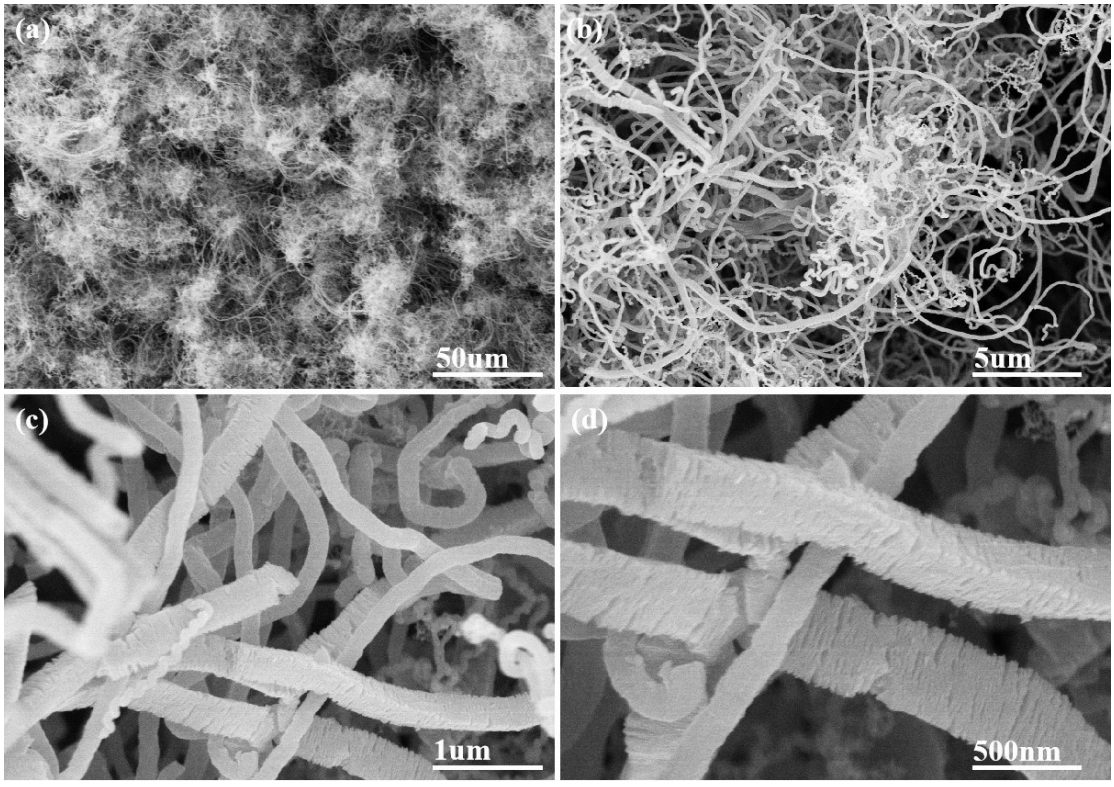

Figure S2. SEM images of the defect-rich CNFs

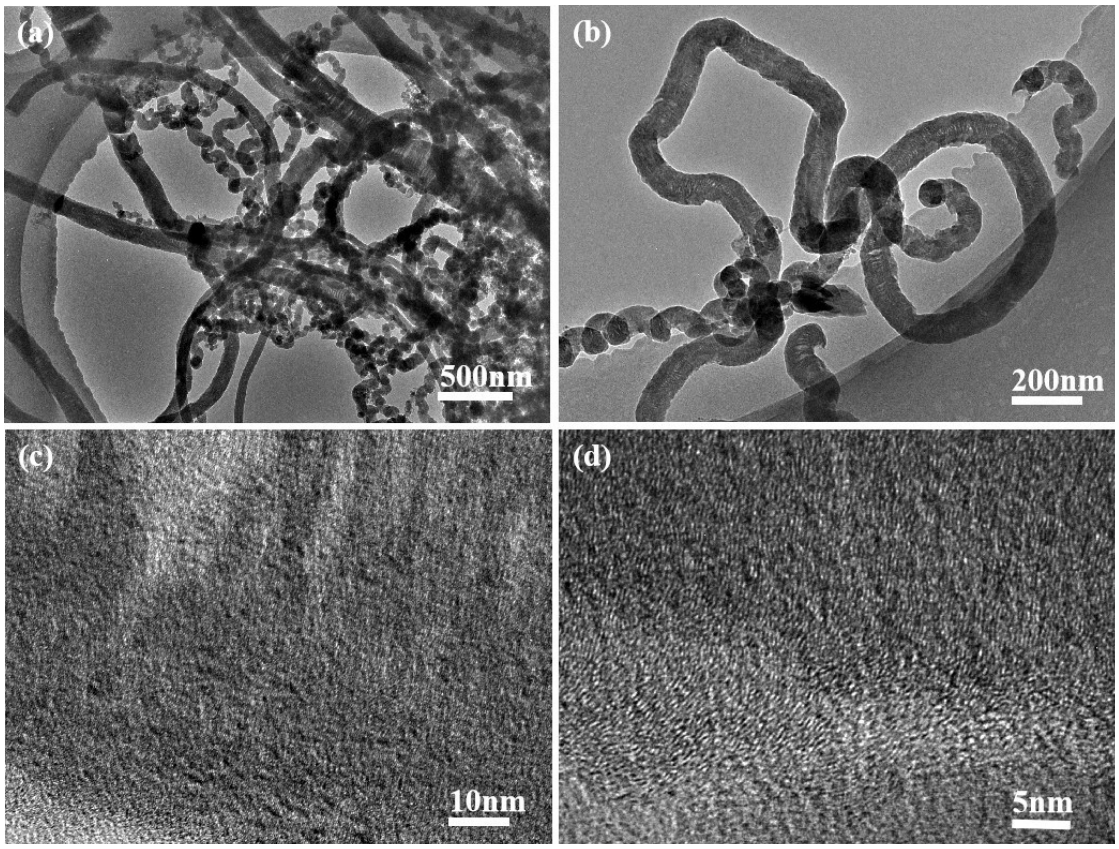

Figure S3. (a-b) TEM and (c-d) HRTEM images of the defect-rich CNFs

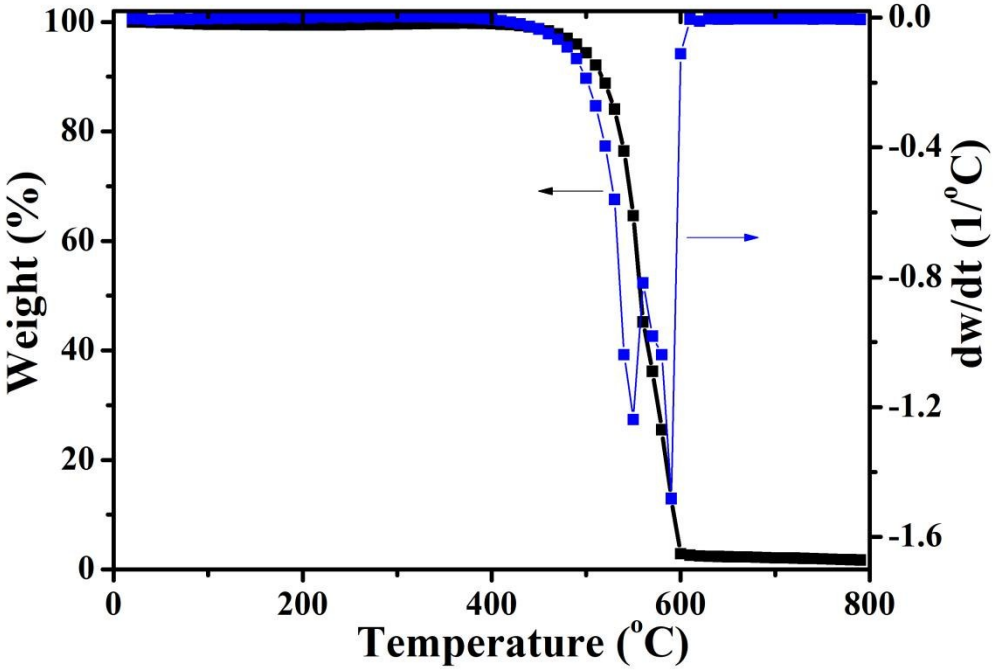

Figure S4.TG curve of the defect-rich CNFs thermal-treated at 800 °Cin air atmosphereat a heating rate of 10°C/min.

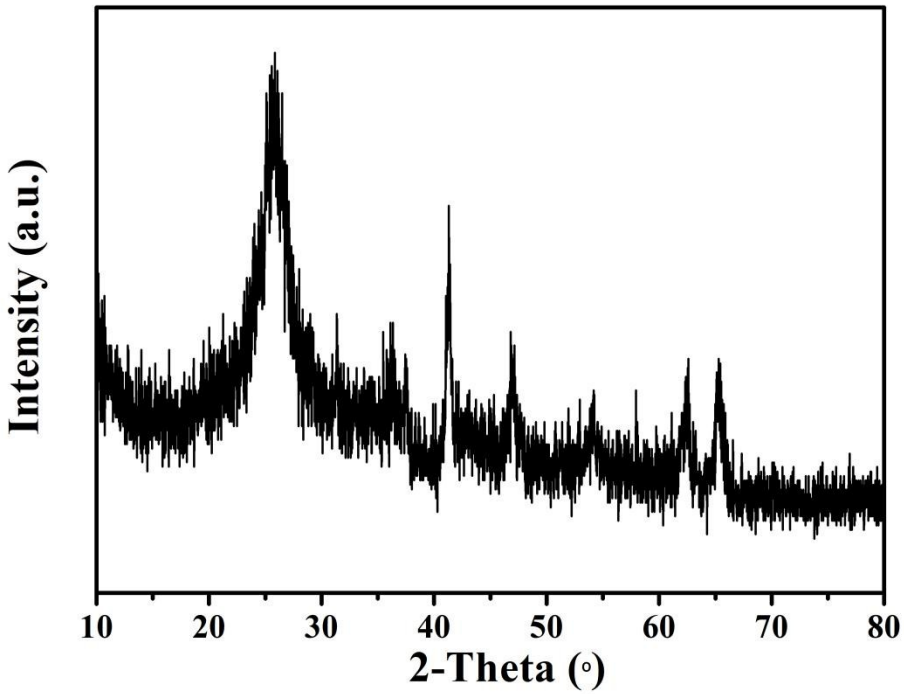

Figure S5. XRD pattern of the CNFs-VS_x hybrid synthesized in water solution

Table S1. Comparison of the BET surface area of the CNFs

Reference	Specific surfacearea/m^2 g^{-1}	Total pore volume/cm^3 g^{-1}
S1	20.354	0.083
S2	19.95	-
S3	249.53	0.36
S4	34.9	-
S5	0.32	-
S6	41.9	0.17
S7	25.3-43.8	-
This work	239	0.31

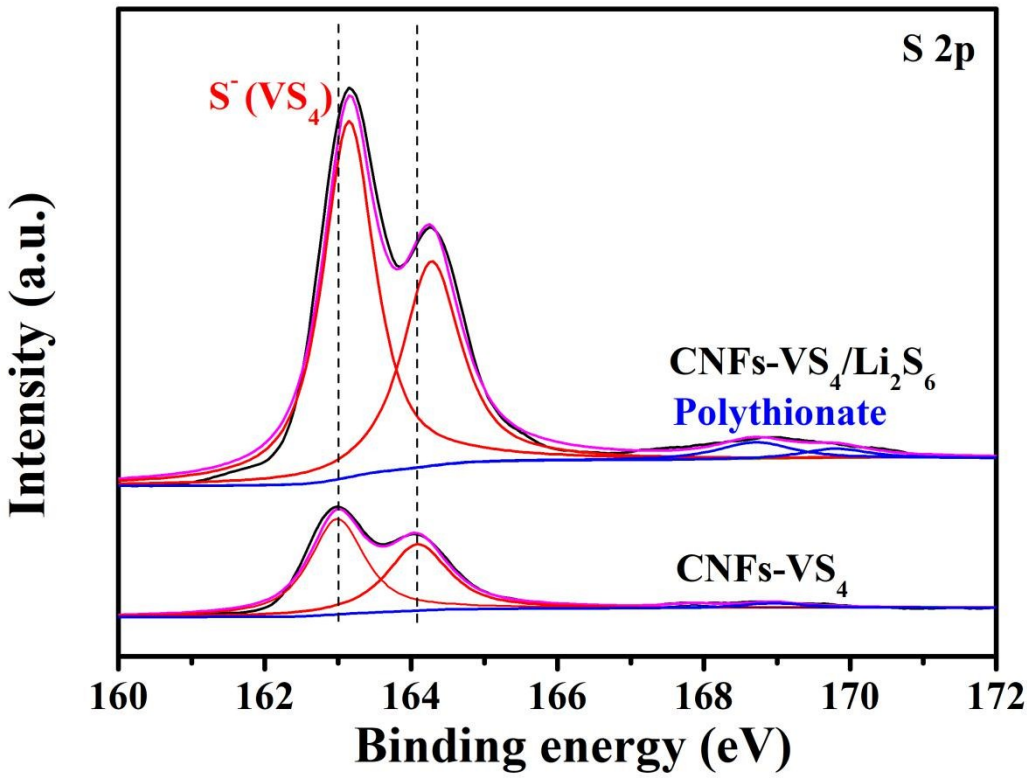

Figure S6. S 2p XPS spectrum of CNFs-VS_4composite before and after adsorption of Li_2S_6.

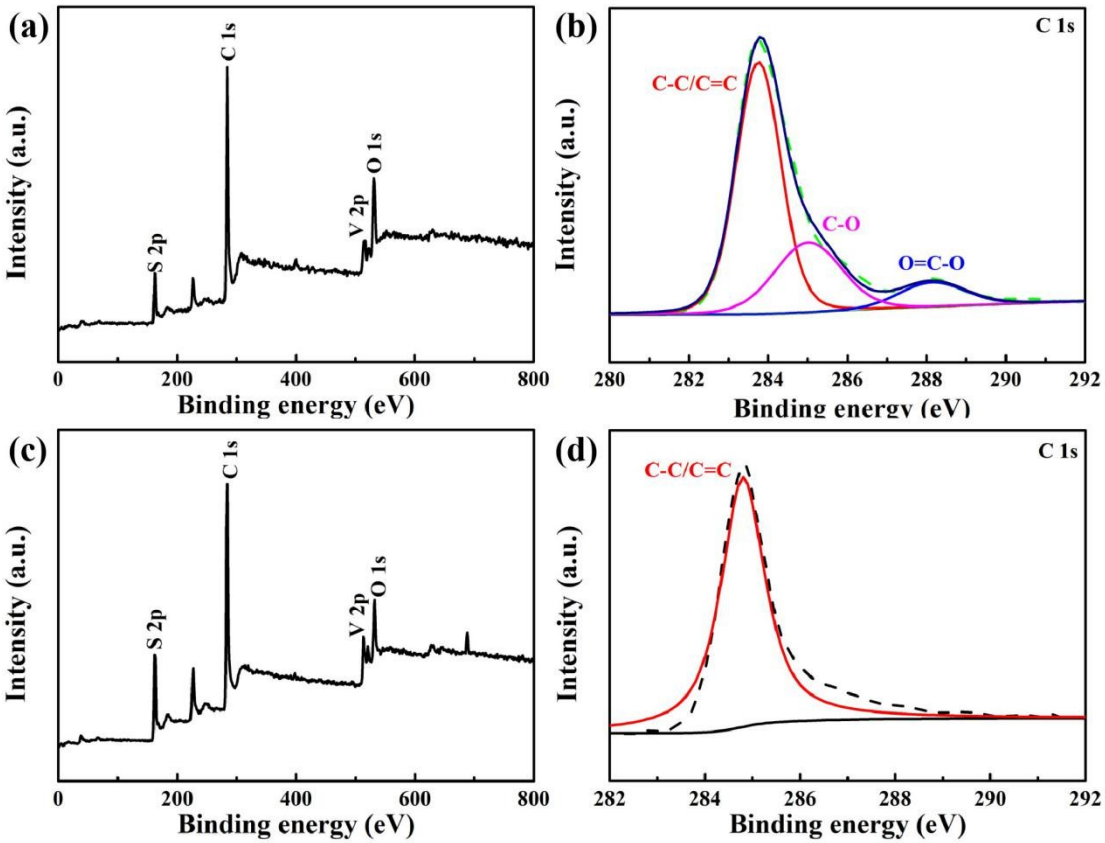

Figure S7. (a) XPS spectra and (b) C 1s spectrum of the pristine CNFs-VS_4 hybrids, (c) XPS spectra and (d) C 1s spectrum of CNFs-VS_4 hybrids after adsorption of Li_2S_6.

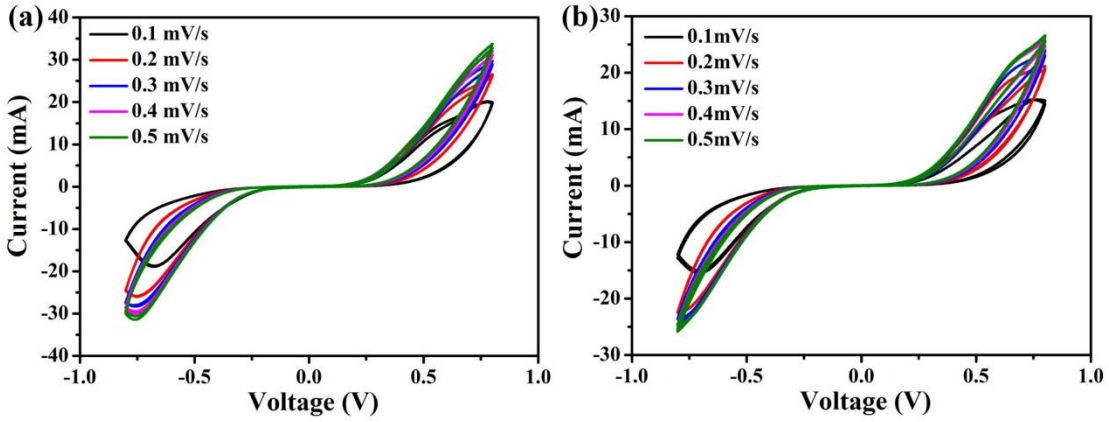

Figure S8. CV curves of symmetric dummy cells employing CNFs-VS_4 and CNFs functional separators at various scan rates.

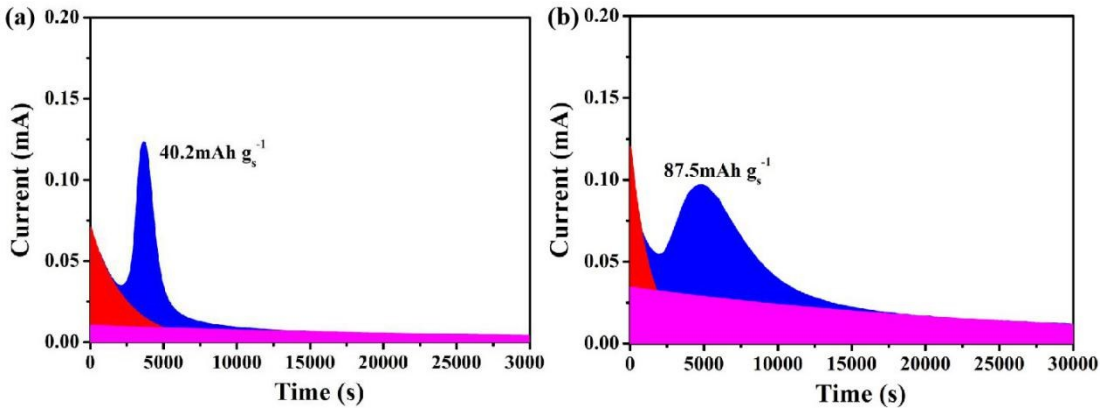

Figure S9. The curve of Li_2S precipitation experiments of CNFs and CNFs-VS_4 electrodes.

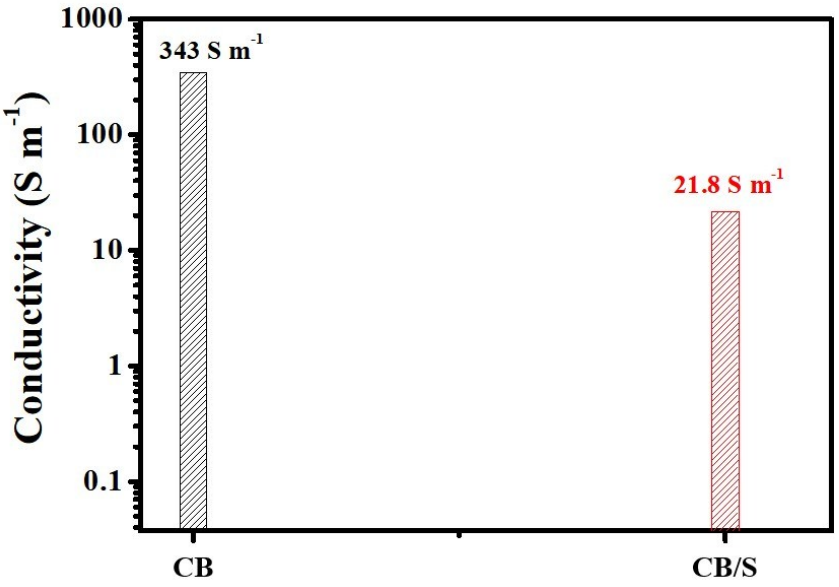

Figure S10. Comparative conductivity of CB and 80wt% CB/S cathode.

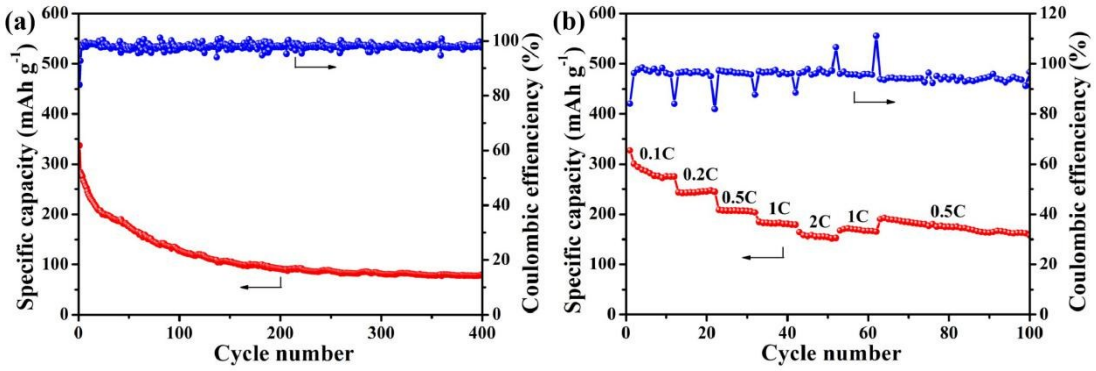

Figure S11. (a) Cyclic (at 0.2C) and rate performance of the CB/S cathode based on the pristine separator.

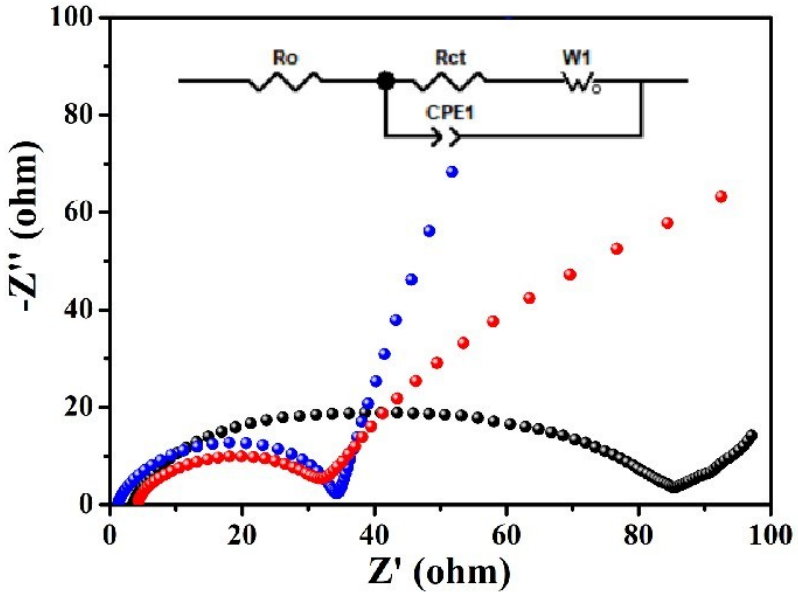

Figure S12. EIS curves of the fresh cell with (black) Cathode+PP, (blue) Cathode+CNFs-VS_4 functional separator, (red) Cathode/CNFs-VS_4+PP.

Table S2. The impedance parameters simulated from the equivalent circuit fitting of different cells

Sample	$R_o(\Omega)$	$R_{ct}(\Omega)$
Cathode+PP	1.90	83.34
Cathode+CNFs-VS_4 functional separator	1.09	33.97
Cathode/CNFs-VS_4+PP	3.77	30.64

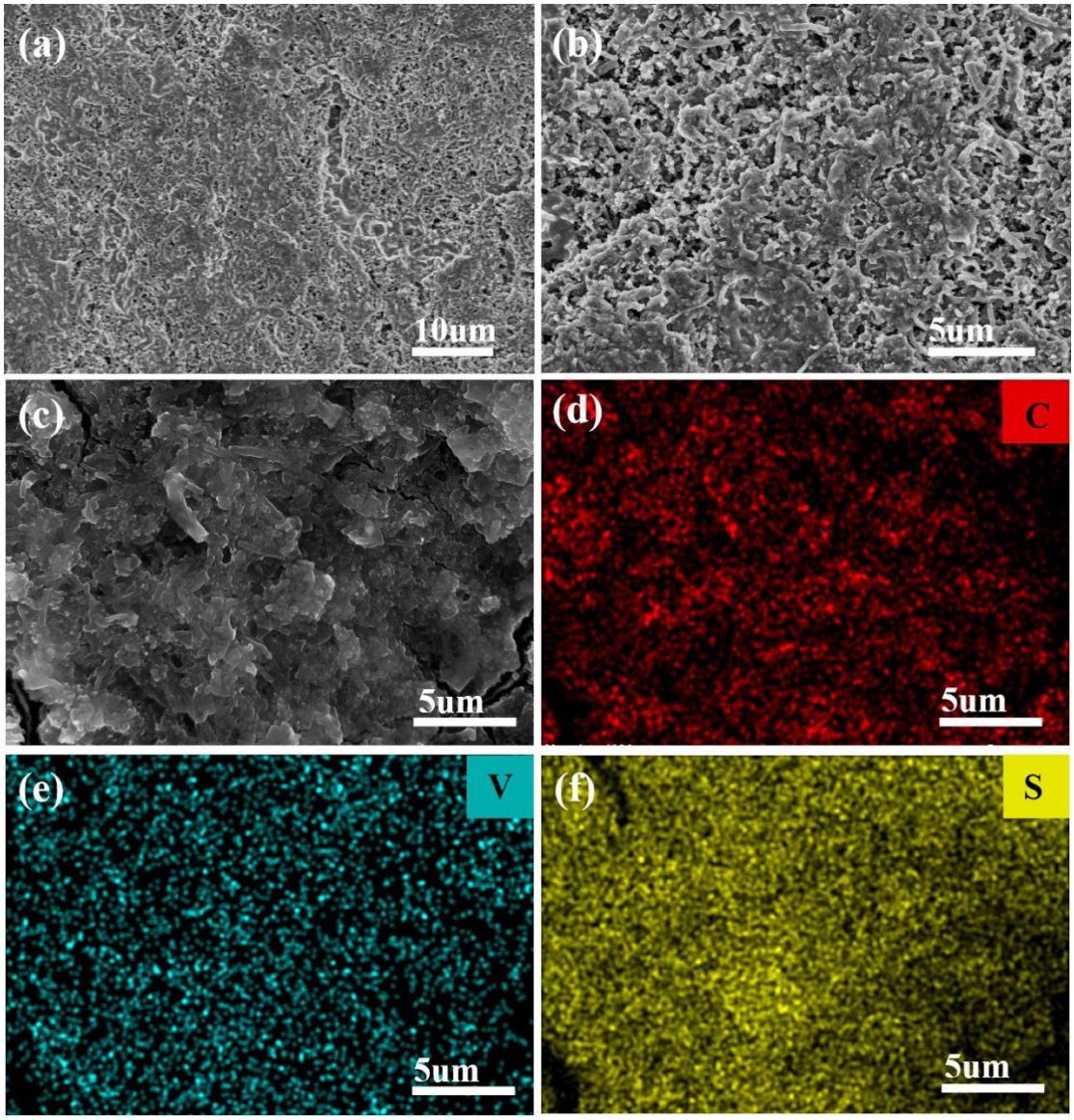

Figure S13. (a-c) SEM images and corresponding (d) C, (e) V (f) S elemental mapping images of CNFs-VS_4 functional separator after cycling.

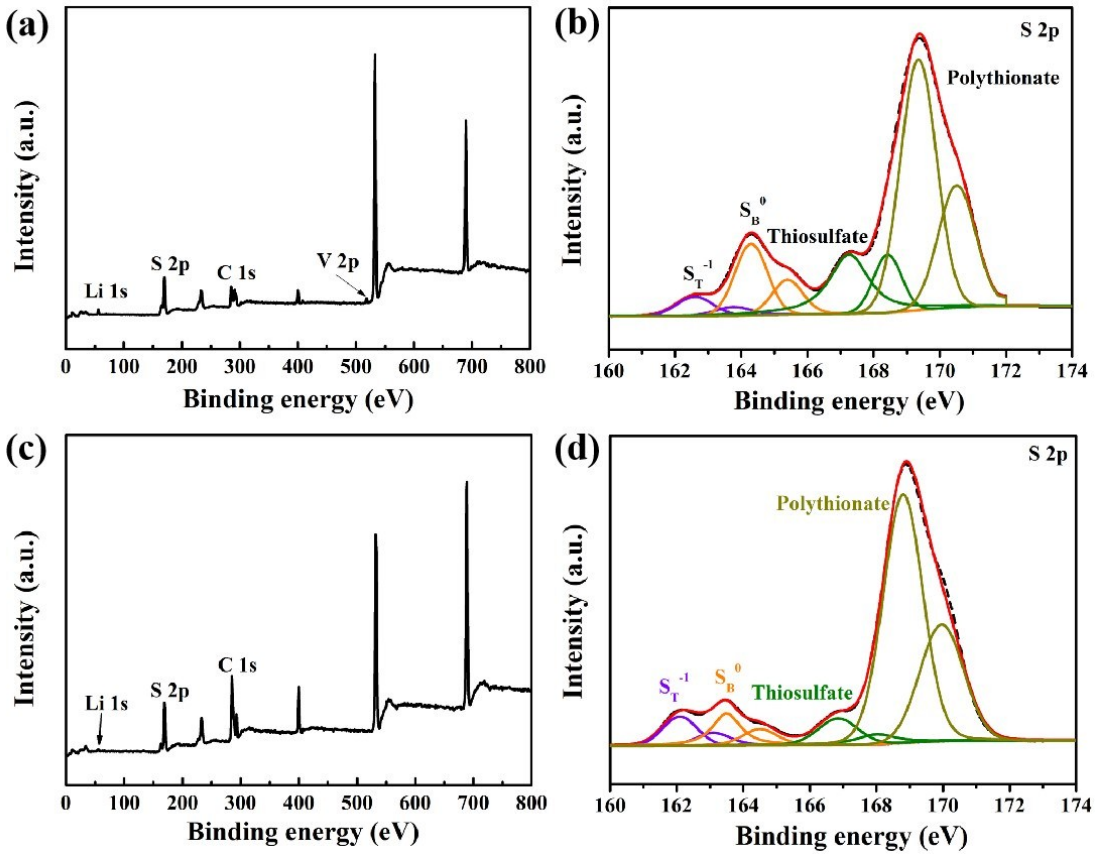

Figure S14. (a) XPS spectra and (b) S 2p spectrum of CNFs-VS_4 functional separator after cycling, (c) XPS spectra and (d) S 2p spectrum of CB/S cathode after cycling.

Reference

[S1] Y. Li, J. D.Zhu, R. W. Shi, M. Dirican, P. Zhu, C. Y. Yan, H. Jia, J. Zang, J. H. He, X. W. Zhang, Chem. Eng. J. 2018, **349**, 376-387.

[S2] Y. E. Miao, Y. P. Huang, L. S. Zhang, W. Fan, F. L. Lai, T. X. Liu, Nanoscale, 2015, **7**, 11093-11101.

[S3] Z. H. Wang, X. D. Wang, W. Sun, K. N. Sun, Electrochim. Acta, 2017, **252**, 127-137.

[S4] A. Y. Zhang, X. Fang, C. F. Shen, Y. H. Liu, I. G. Seo, Y. Q. Ma, L. Chen, P. Cottingham, C. W. Zhou, Nano Research, 2018, **11**, 3340-3352.

[S5] S. Z. Wang, H. Y. Chen, J. H. Liao, Q. Sun, F. P. Zhao, J. Luo, X. T. Luo, X. B. Niu, M. Q. Wu, R. Y. Li, X. L. Sun, ACS Energy Lett. 2019, **4**, 755-762.

[S6]H. W. Liang, W. J. Zhang, Y. N. Ma, X. Cao, Q. F. Guan, W. P. Xu, S. H. Yu, ACS Nano, 2011, **5**, 8148-8161.

[S7] P. Chen, H. W. Liang, X. H. Lv, H. Z. Zhu, H. B. Yao, S. H. Yu, ACS Nano, 2011, **5**, 5928-5935.