Supporting Information

Building a Cycle-stable Sulfur Cathode by Tailoring Its Redox Reaction into a Solid-phase Conversion Mechanism

Feng He, Xiangjiang Wu, Jiangfeng Qian, Yuliang Cao, Hanxi Yang, Xinping Ai*, Dingguo Xia**

F. He, X. Wu, J. Qian, Prof. Y. Cao, Prof. H. Yang, Prof. X. Ai
Hubei Key Laboratory of Electrochemical Power Sources, College of Chemistry & Molecular Science, Wuhan University, Wuhan 430072, China
E-mail: jfqian@whu.edu.cn, xpai@whu.edu.cn

Prof. D. Xia
Beijing Key Laboratory of Theory and Technology for Advanced Batteries Materials, College of Engineering, Peking University, Beijing 100871, China
E-mail: dgxia@pku.edu.cn

*CORRESPONDING AUTHOR: E-mail: xpai@whu.edu.cn.

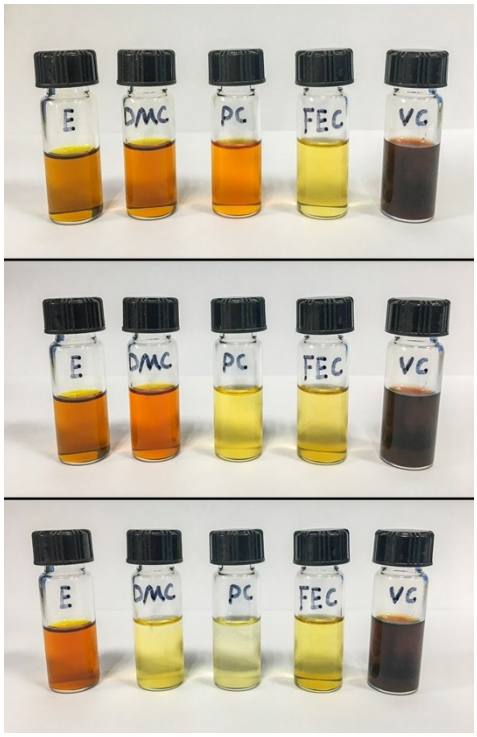

Figure S1. The changes in the colors and the amount of deposits with time when adding polysulfides solution into carbonate solvent of DMC, PC, FEC and VC, respectively. For a convenient comparison, the color changes of the DME solvent with addition of polysulfides solution are also displayed at the left-most column.

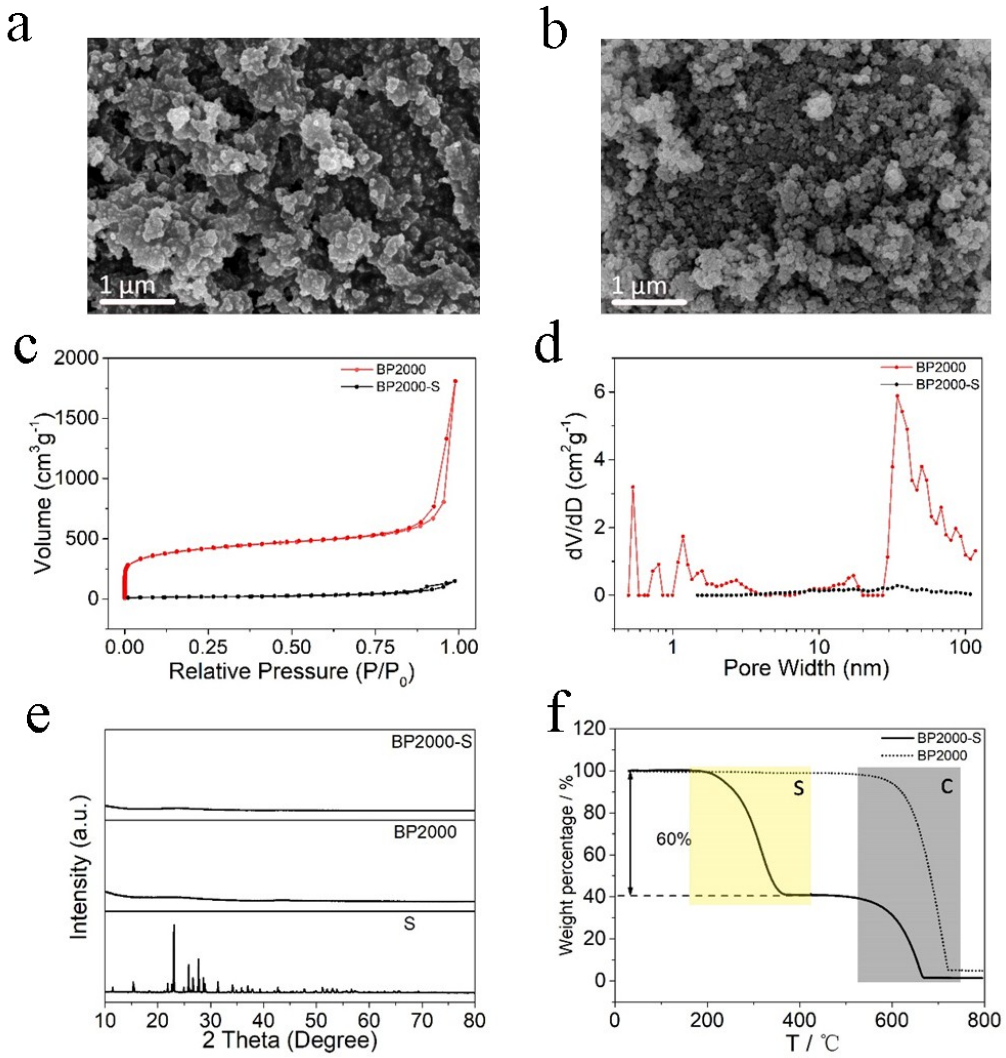

Figure S2. The morphological and structural characterizations of the carbon powder before and after sulfur impregnation. a, SEM image of BP2000 matrix; b. SEM image of S/C composite; c. N_2 adsorption-desorption curves; d. Pore distribution; e. XRD patterns; f. TGA curves.

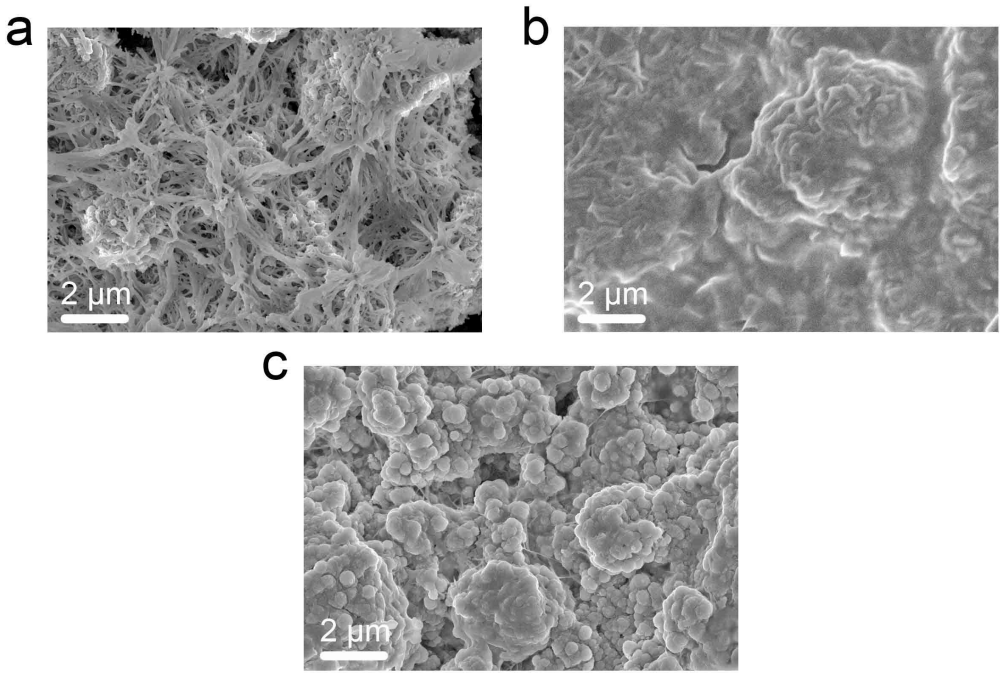

Figure S3. SEM images of the S/C cathode after cycled for 30 cycles in a. 1 mol L^{-1} LiTFSI + DME/DOL/DMC (v/v/v =5:5:1); b. 1 mol L^{-1} LiTFSI + DME/DOL/PC (v/v/v =5:5:1); c. 1 mol L^{-1} LiTFSI + DME/DOL/FEC (v/v/v =5:5:1), respectively.

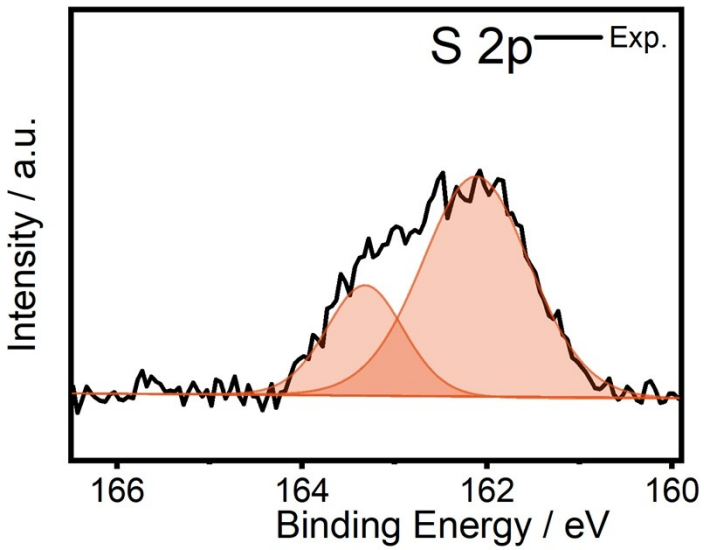

Figure S4. S 2p XPS spectra of the S/C cathode after first discharge in VC co-solvent electrolyte.

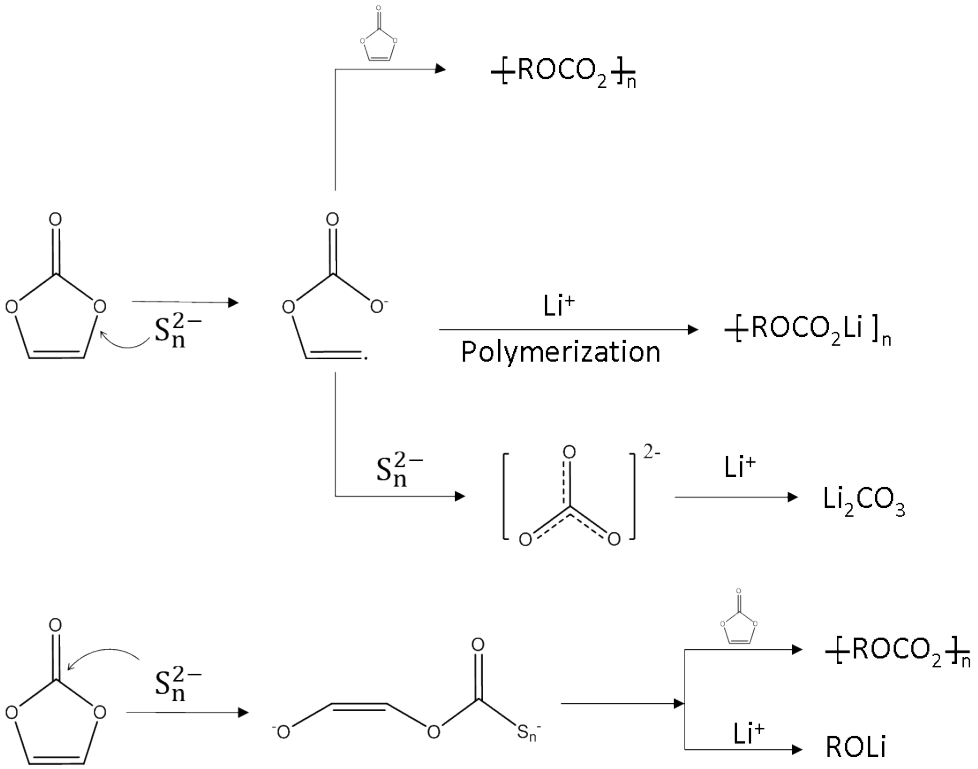

Figure S5. The reaction mechanism of VC molecules with polysulfides.

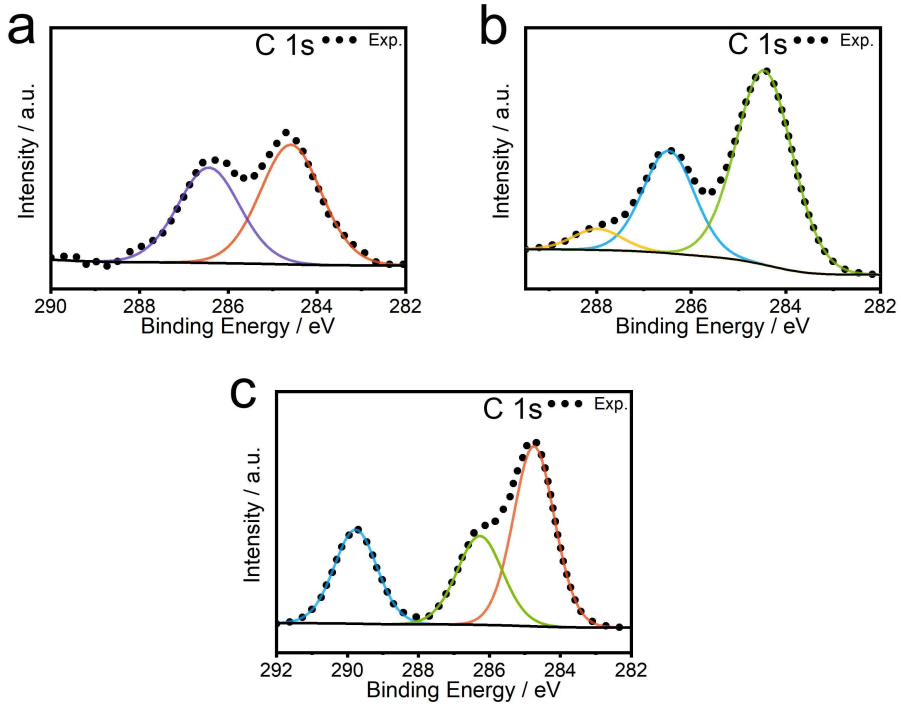

Figure S6. C 1s XPS spectra of the S/C cathode after first discharge in a. 1 mol L^{-1} LiTFSI + DME/DOL/DMC (v/v/v =5:5:1); b. 1 mol L^{-1} LiTFSI + DME/DOL/PC (v/v/v =5:5:1); c. 1 mol L^{-1} LiTFSI + DME/DOL/FEC (v/v/v =5:5:1).

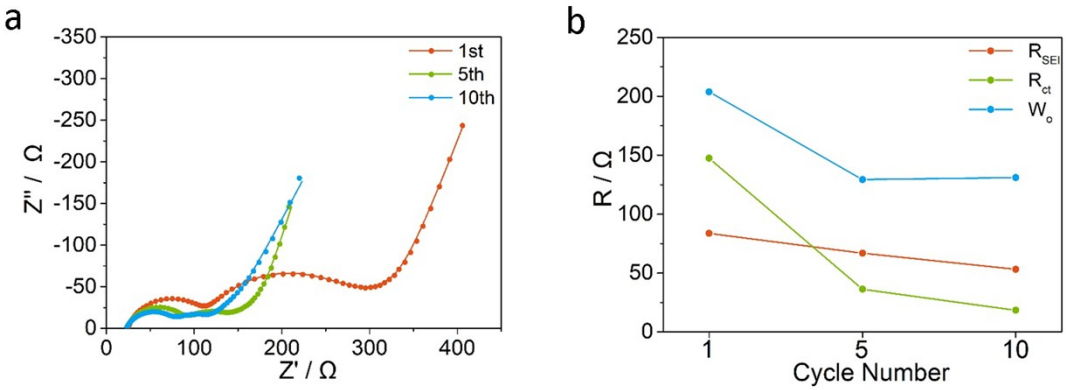

Figure S7. The electrochemical impedance spectra of S/C cathode at different cycles in VC co-solvent electrolyte (a) and (b) Fitted results of the charge-transfer resistance R_{ct}, the surface film resistance and Warburg impedance.