Supporting Information for

Electron Regulation Enabled Selective Lithium Deposition for Stable Anode of Lithium-Metal Batteries

Junling Guo,[a] Shupeng Zhao, [a] He Yang, [a] Fengxiang Zhang*[a] and Jinping Liu*[b]

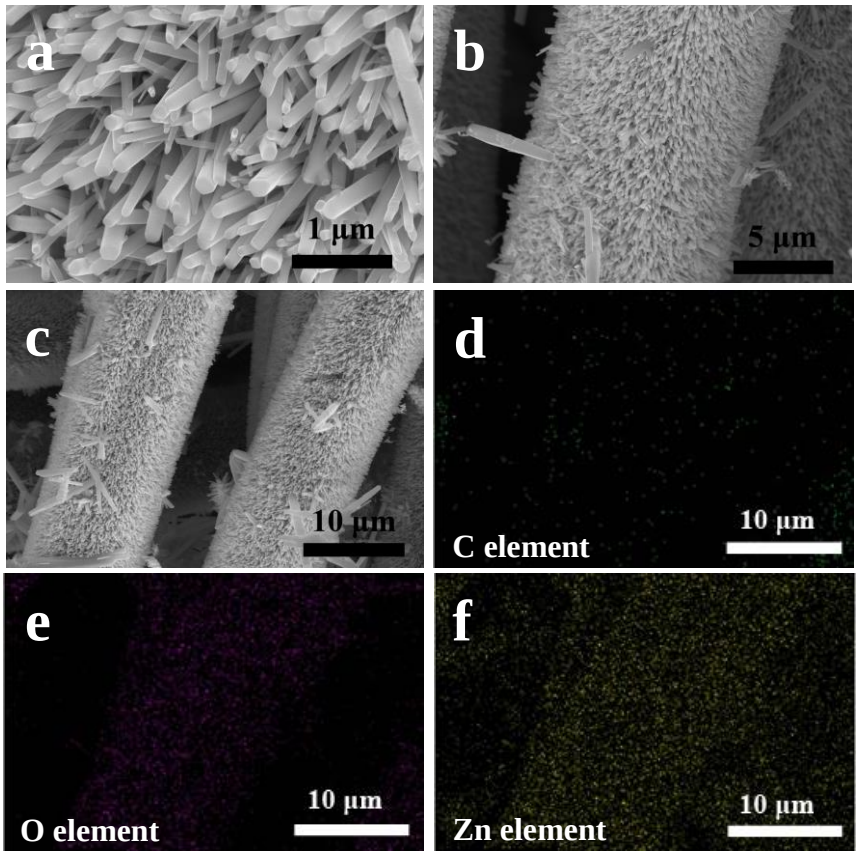

Figure S1. The SEM (a-c) and EDX (d-f) images of the ZnO array on carbon cloth.

[a] *State Key Laboratory of Fine Chemicals and School of Petroleum and Chemical Engineering, Dalian University of Technology, 2 Dagong Road, Liaodongwan New District, Panjin 124221, P. R. China.*
**E-mail: zhangfx@dlut.edu.cn*

[b] *School of Chemistry, Chemical Engineering and Life Science and State Key Laboratory of Advanced Technology for Materials Synthesis and Processing, Wuhan University of Technology, Wuhan 430070, P. R. China.*
**E-mail: liujp@whut.edu.cn*

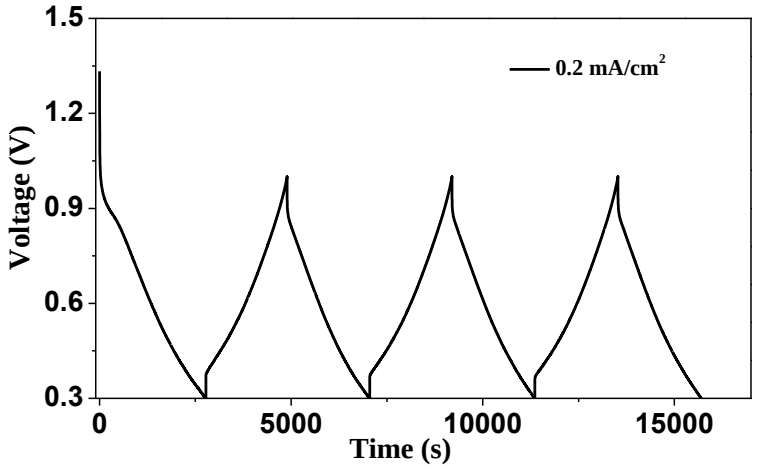

Figure S2. Discharge-charge curves of the TCA electrode for SEI formation.

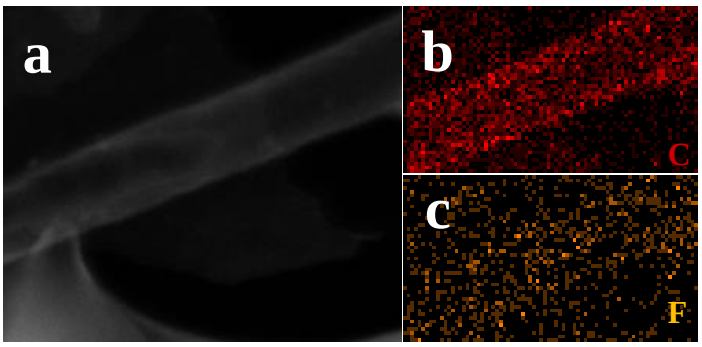

Figure S3. EDX mapping of TCA electrode after 3 cycles at 0.3 ~ 1 V for SEI formation: (a) Scanning Acquire image; (b) C element and (C) F element.

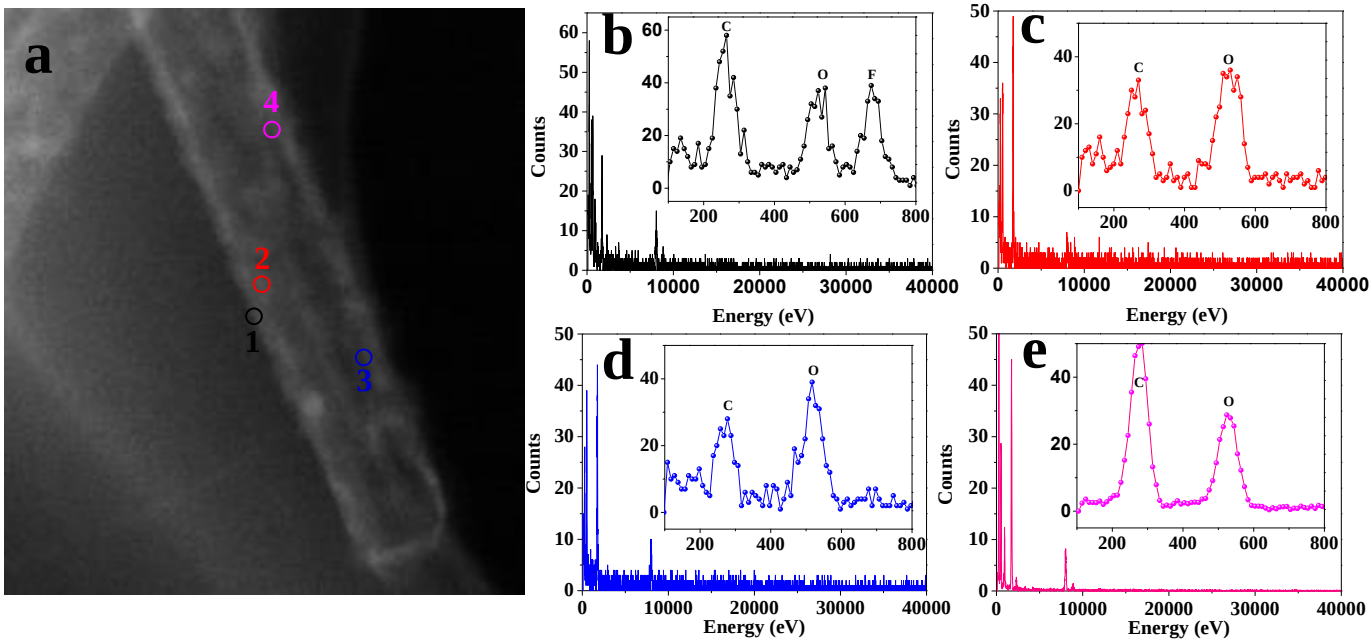

Figure S4. EDX of TCA electrode after infiltration in the electrolyte for 5h at different points: (a) Scanning Acquire image; (b) point 1, corresponding to position on the outer surface; (c-e) points 2-4 corresponding to different positions on the inner surface.

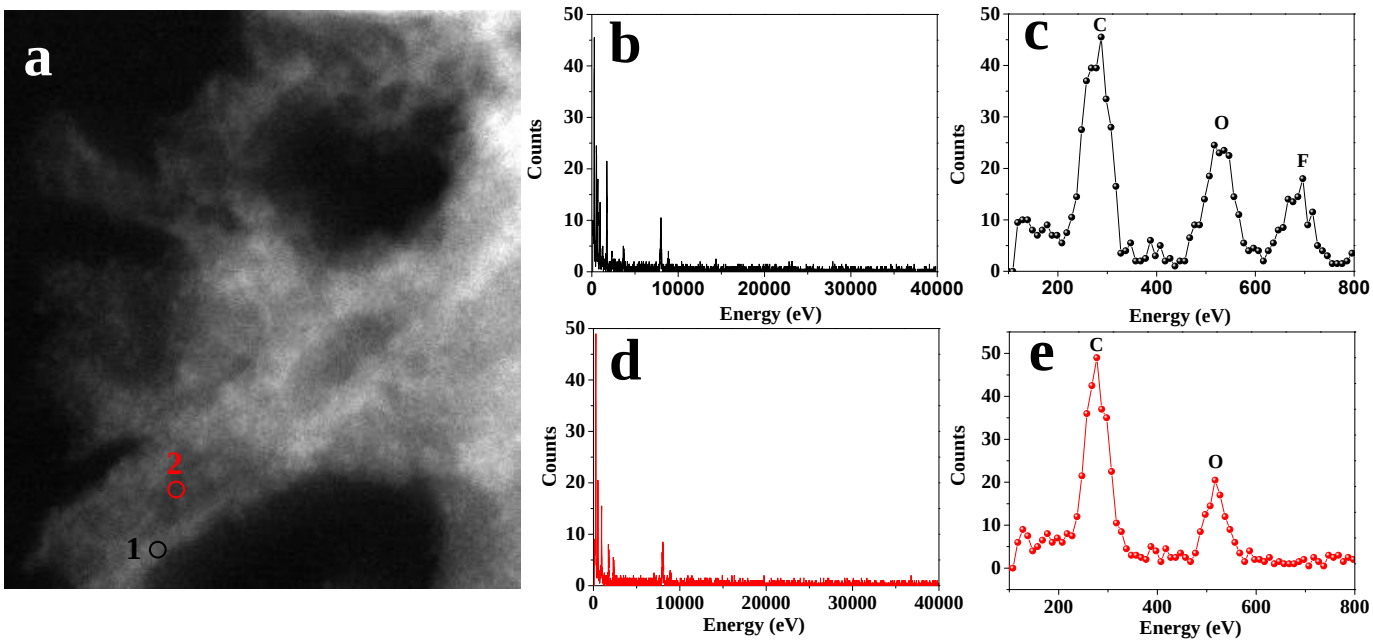

Figure S5. EDX of TCA electrode after 3 cycles at 0.3 ~1 V at different points: (a) scanning Acquire image; (b-c) point 1, corresponding to a position on the outer surface; (d-e) point 2, corresponding to a position on the inner surface.

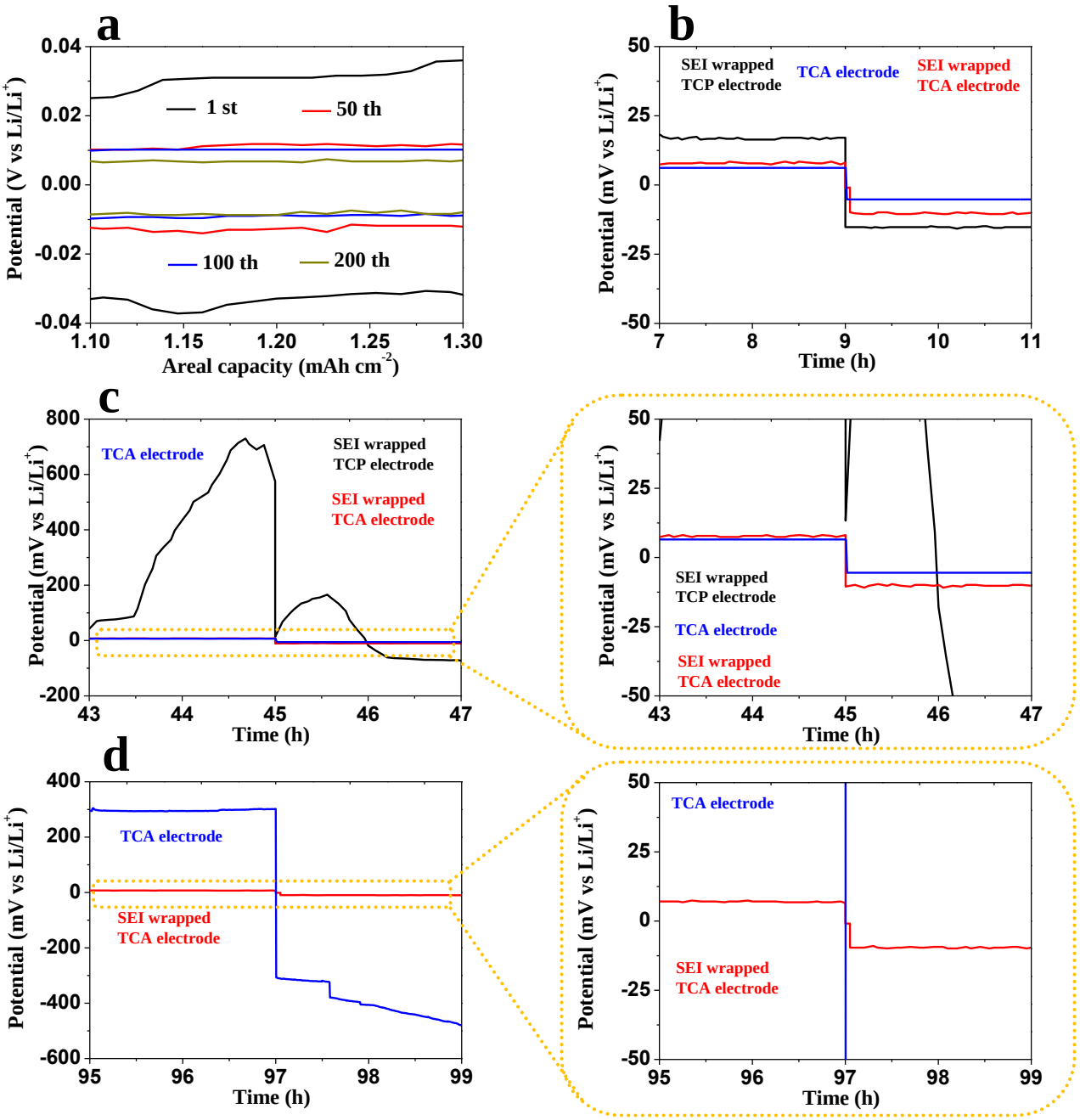

Figure S6. Enlarged charge-discharge curves of (a) the SEI wrapped TCA electrode at different cycles at 1 mA cm^2; (b-d) Li plating/stripping curves of different electrodes at 1 mA cm^{-2} for 2 mAh cm^{-2}.

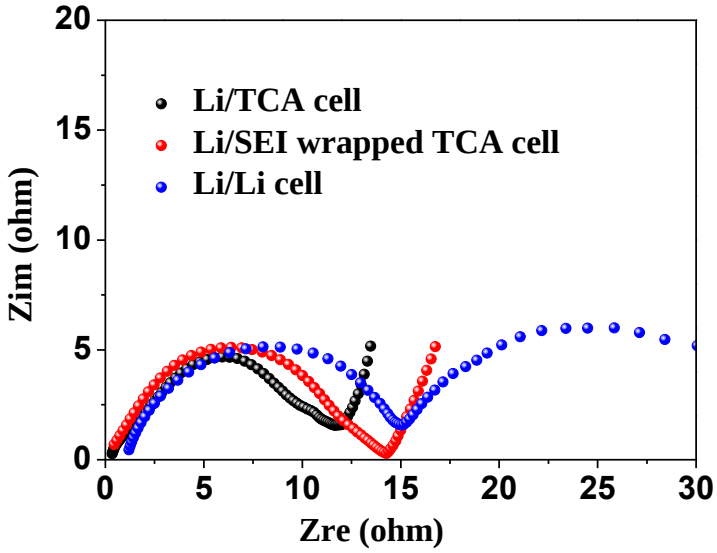

Figure S7. The nyquist plots of different cells without sulfur.

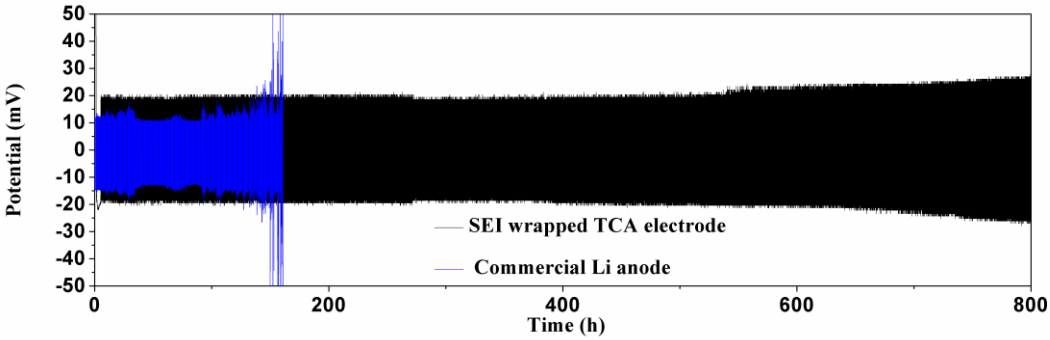

Figure S8. Li plating/stripping behavior of different electrodes at 5 mA cm^{-2} for 2 mAh cm^{-2}.

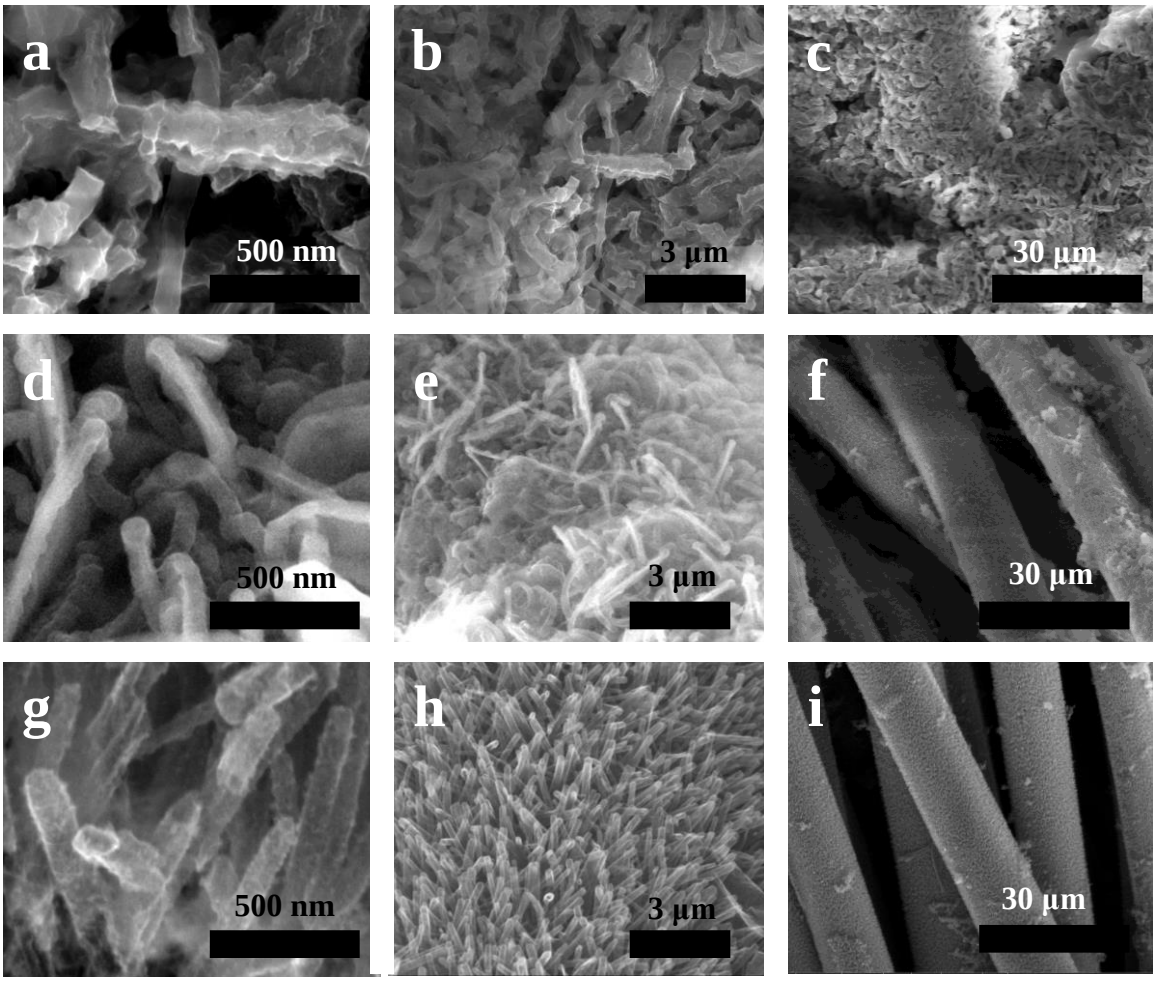

Figure S9. The SEM images of different electrodes after cycling: (a-c) SEI wrapped TCP electrode; (d-f) TCA electrode and (g-i) SEI wrapped TCA electrode.

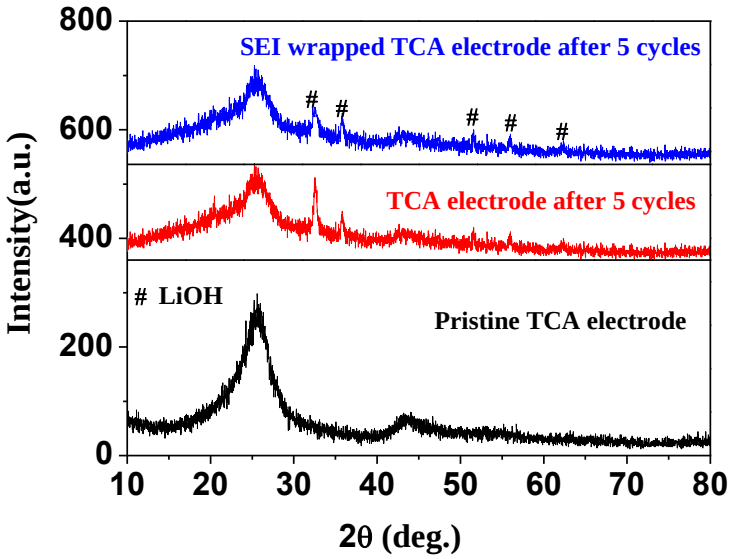

Figure S10. XRD of pristine TCA electrode, TCA electrode after 5 cycles and SEI wrapped TCA electrode after 5 cycles of charge-discharge operation.

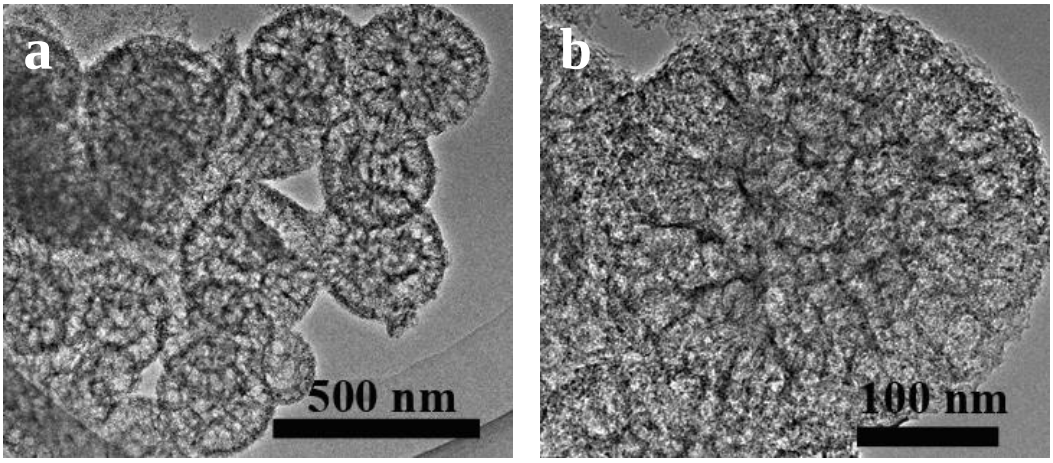

Figure S11. TEM images of porous carbon sphere/sulfur composite.

Table S1. The performance comparison of our works with literature results

Strategies	Coulombic efficiency	Stable cycling performance	
		Current density	Voltage hysteresis (after 150 h)
Hollow carbon shells loaded with Au nanoparticles inside[23]	98% 300 cycles	/	/
Carbon nanofibers loaded with Ag nanoparticles[33]	98% 50 cycles	0.5 mA cm^{-2}	~22 mV
Covalently connected graphite microtubes[42]	~97% 100 cycles	1 mA cm^{-2}	24 mV
Artificial solid electrolyte interphase layer[18]	~98% 200 cycles	/	/
Nanodiamonds work as an electrolyte additive[11]	~96% 100 cycles	1 mA cm^{-2}	100 mV
Our work	98% 200 cycles.	1 mA cm^{-2}	~12 mV

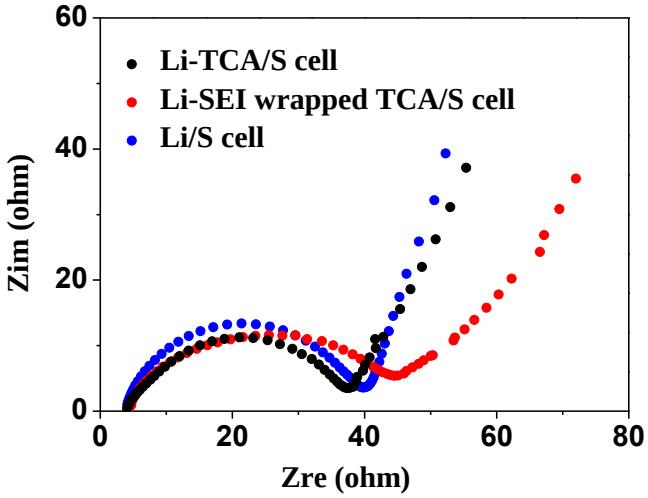

Figure S12. The nyquist plots of different sulfur cells.

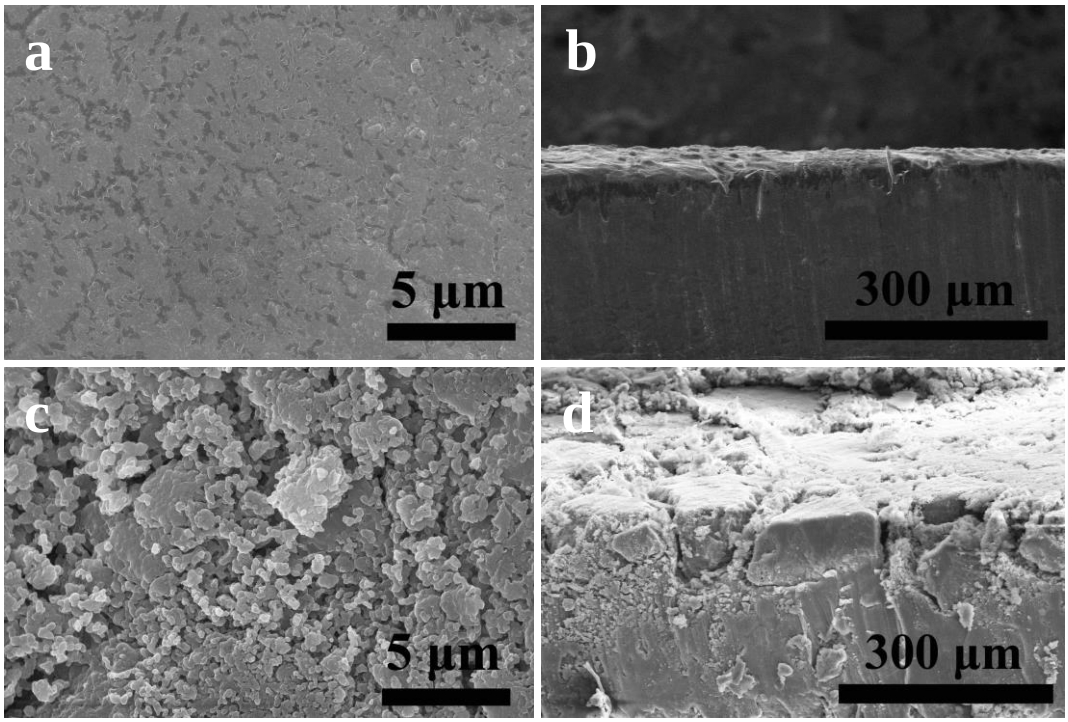

Figure S13. (a) Side-view and (b) top-view SEM images of the pristine Li metal anode; (c) side-view and (d) top-view SEM images of the Li metal anode after 100 cycles.

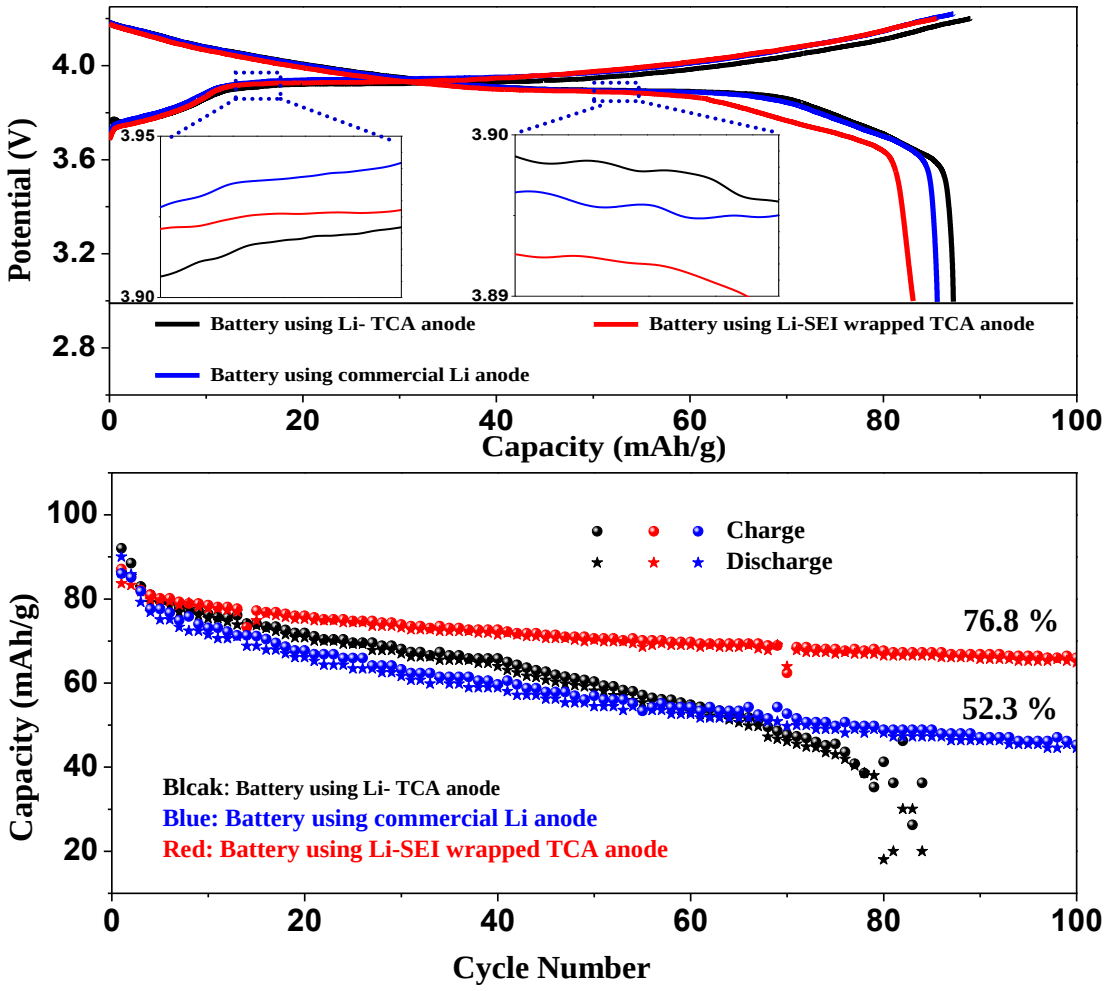

Figure S14. The electrochemical performance of different Li-$LiCoO_2$ batteries: (a) the first charge-discharge curves; (b) the cycle performance at 0.2 C.