

ADVANCED FUNCTIONAL MATERIALS

Supporting Information

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Carbonyl- β -Cyclodextrin as a Novel Binder for Sulfur
Composite Cathodes in Rechargeable Lithium Batteries

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Supplementary Information

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Cyclic voltammogram measurements

C- β -CD and Polyvinylidene fluoride (PVDF) are insulators and conductive carbon Super P was used to improve their conductivity. C- β -CD gel powder was mixed with Super P at the weight ratio of 1:1 by using water as dispersant. PVDF dissolved in N-methylpyrrolidone (NMP) was also mixed with Super P at the weight ratio of PVDF : Super P = 1:1. The slurry was magnetically stirred for 4 hours at room temperature, and pasted on stainless steel foil as current collector, and then dried under vacuum at

120 °C for 6 hours. The coin-type 2016 cells were assembled in a glove box filled with the high purity argon, with lithium foils as anodes, Cellgard 2400 microporous membranes as separators. Traditional liquid electrolyte EC/DMC 1M LiPF₆ or ionic liquid PP13 0.5M LiTFSI (Shanghai Cheng Jie Chemical) was used as electrolyte.

Cyclic voltammograms were measured by CH1604b (CH Instruments) using the electrode containing binder as working electrode, lithium metal as reference electrode, and counter electrode as well, with the voltage range of 0 - 5.0 V and the rate of 0.1 mV/S.

Morphologies of cathode with PTFE binder

The morphologies of fresh and cycled cathodes were measured through scanning electron microscopy (SEM, JEOL JSM-7401F).

Effect of current collectors

Cathodes were prepared by mixing 80 wt% of sulfur composite material, 10 wt% acetylene black, and 10 wt% C-β-CD binder with water as dispersant. The slurry was magnetically stirred for 4 hours at room temperature, and then pasted on Al foil, Ni foam, Cu foil. Cathodes with load ca. 3 mg cm⁻² were dried under vacuum at 80 °C for 2 hours. The coin-type 2016 cells were assembled in a glove box filled with the high purity argon, with lithium foils as anodes, Cellgard 2400 microporous membranes as separators and EC/DMC 1M LiPF₆ as electrolytes (Zhangjiagang Guotai-Huarong New Chemical Materials). The electrochemical performances of the cells were measured galvanostatically by Land CT2001 battery test system (Wuhan Kingnuo Electronics), with the voltage ranges of 1.0 - 3.0 V at room temperature.

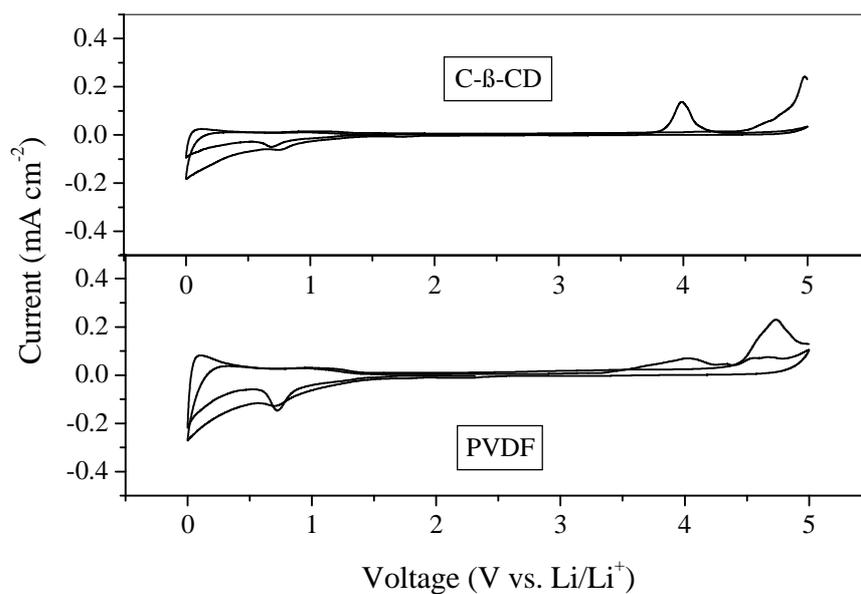


Figure S1 Cyclic voltammograms of C-β-CD and PVDF using EC/DMC 1M LiPF₆ as electrolyte.

The cathodic peak around 0.75 V derives from the lithium ion intercalate into conductive carbon Super P, and the anodic peak above 4 V mainly derive from the decomposition of the electrolyte.

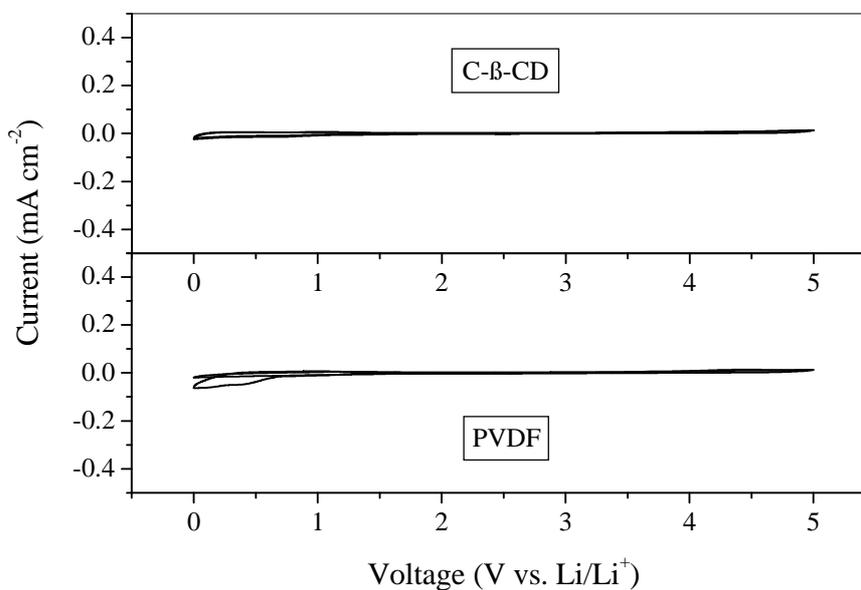


Figure S2 Cyclic voltammograms of C-β-CD and PVDF with ionic liquid of PP13 0.5M LiTFSI.

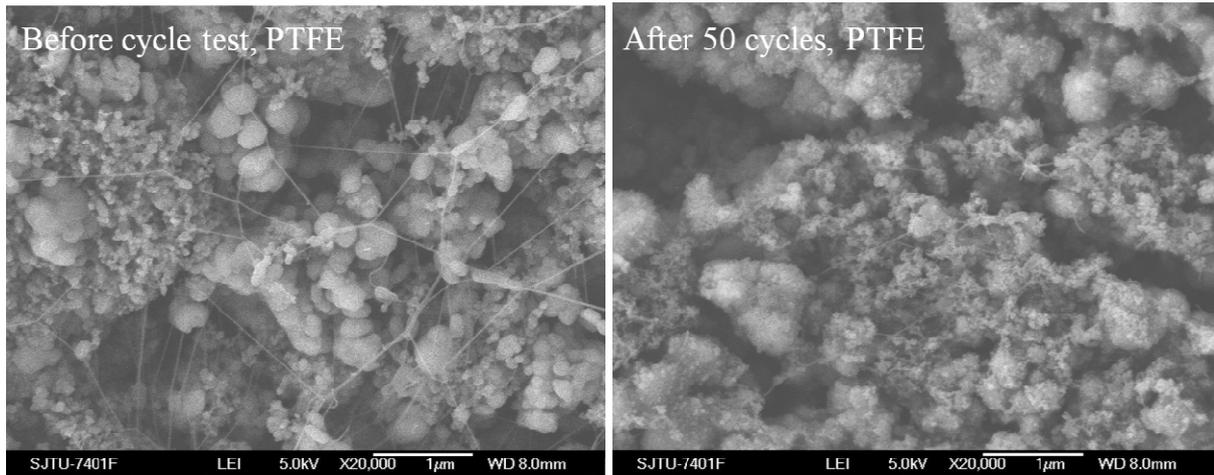


Figure S3 Morphology changes of the sulfur electrode with PTFE binder.

It is clear that PTFE forms nano fibers in the fresh electrode which bonding sulfur composite, Super P and current collector together. However, after 50 cycles, PTFE nano fibers were broken because sulfur cathode volume change during charge/discharge processes ^[45].

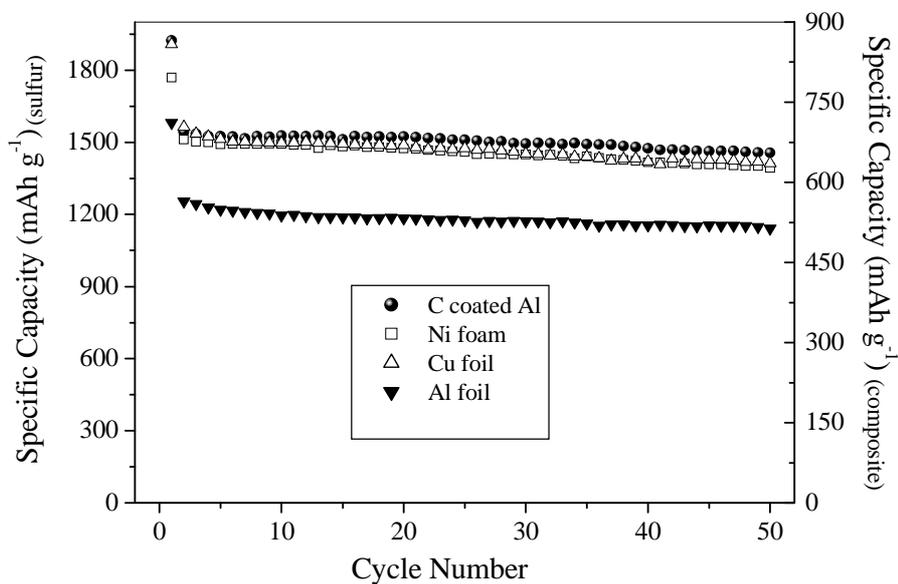


Figure S4 show the effect of current collectors including Ni foam, Cu and Al foils.

There is almost no different with various current collectors except for Al foil. Carbon coating can improve the contact between sulfur composite materials and Al current collector, which is very

important when using aqueous binder. Therefore the cathode on carbon coating Al current collector shows superior performance to pure Al foil.