Supporting Information

Suppressing Dissolution of Polysulfides with Cosolvent Fluorinated

Diether towards High-performance Lithium Sulfur Batteries

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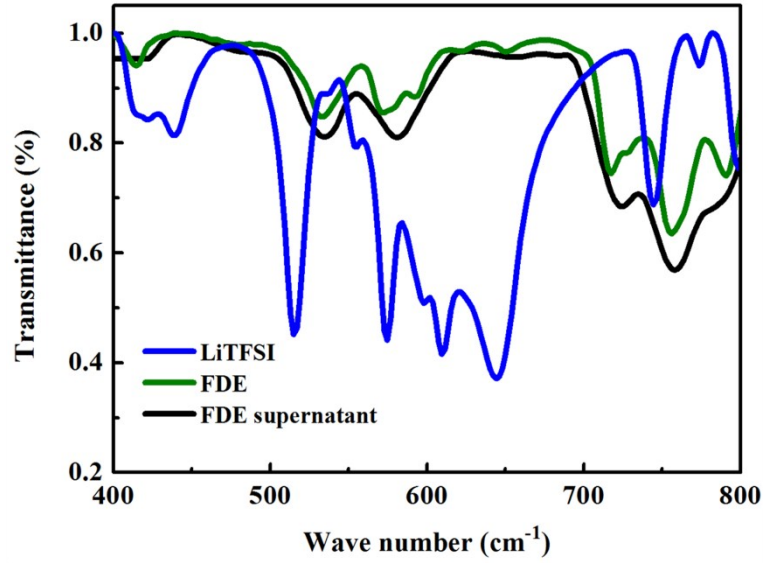*Corresponding author E-mail addresses: qianrong@mail.sic.ac.cn and zywen@mail.sic.ac.cn

Figure S1. Fourier transform infrared spectra of LiTFSI, fluorinated diether (FDE), and the supernatant of the LiTFSI/FDE mixture.
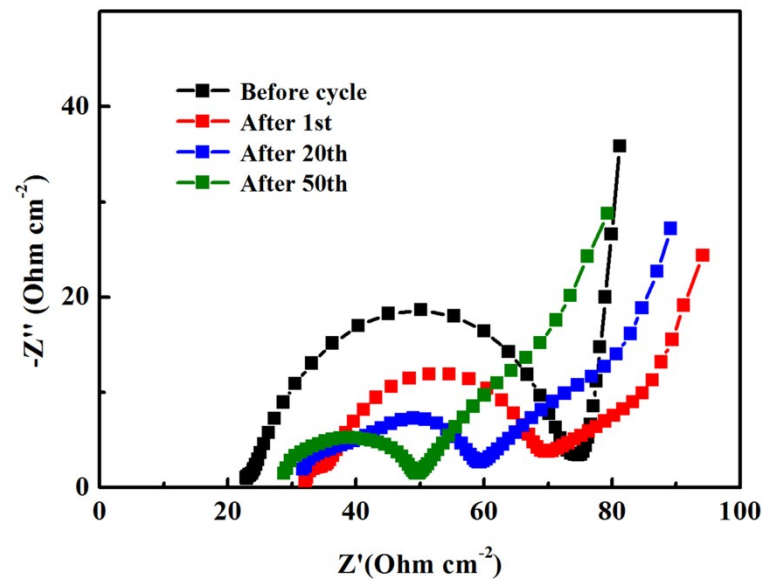

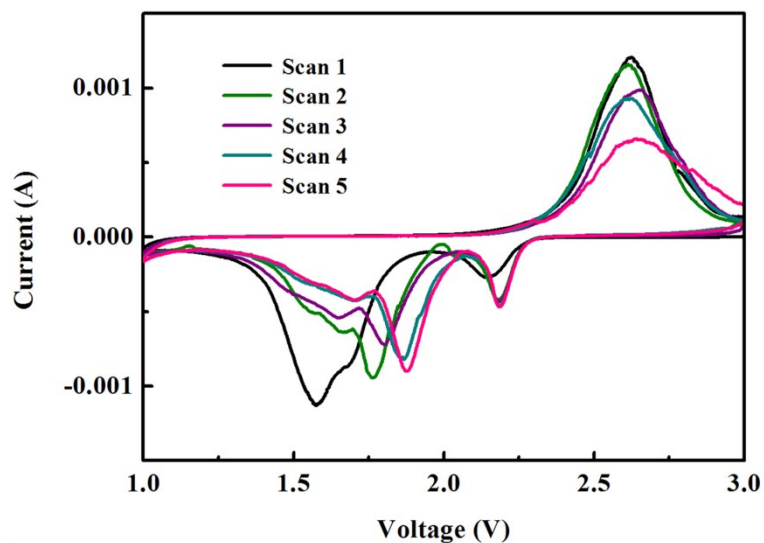**Figure S2.** EIS analysis of 80% FDE electrolytes at different cycles after fully charged.

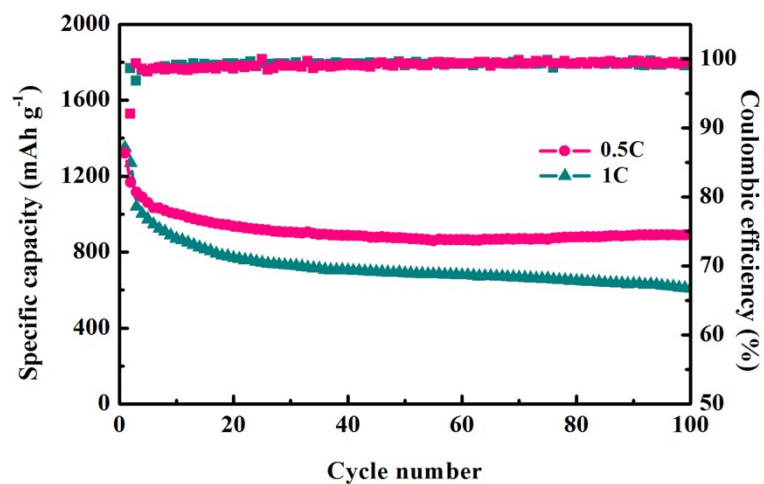**Figure S3.** Cyclic voltammogram profiles of 80% FDE electrolyte cell at scan rate of 0.2 mV s^{-1}.

Figure S4. Cycle performance and coulombic efficiency of 80% FDE electrolytes at different rate.
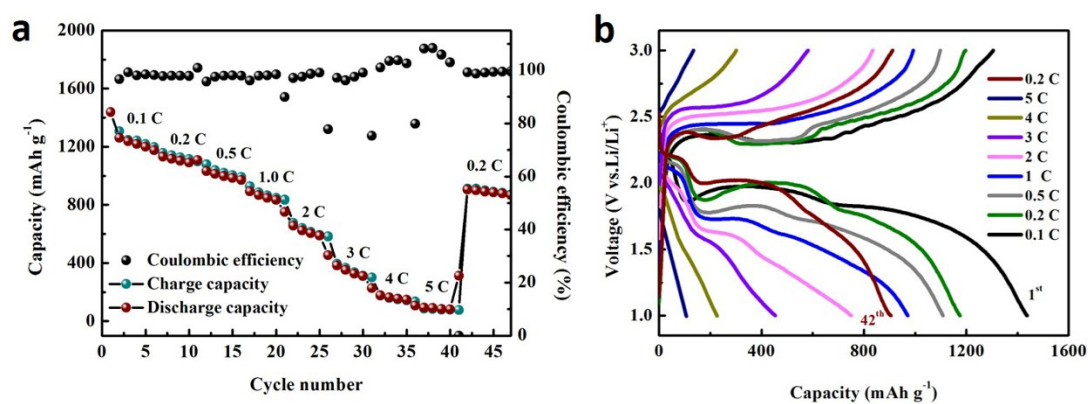

Figure S5. **a.** Rate performance of Li-S cell with 80% FDE electrolyte. **b.** Selected discharge-charge profiles at various current rate.
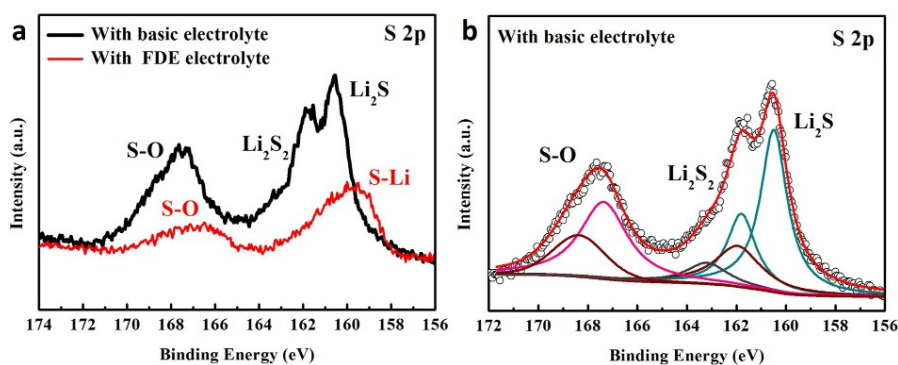
Figure S6. a. XPS spectra of S 2p of lithium anodes with different electrolytes after 20 cycles. **b.** Fitted S 2p spectra (Figure 1a. black curve).
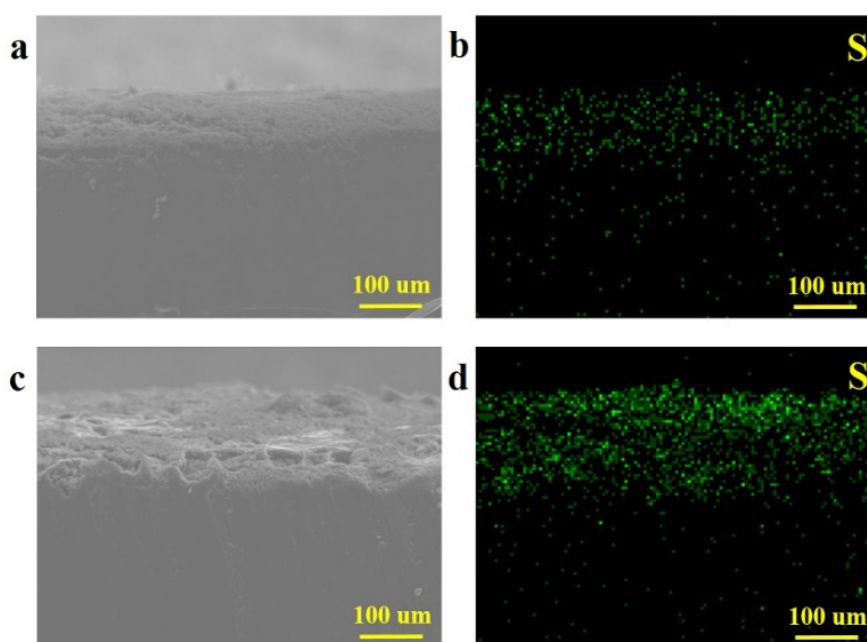

Figure S7. SEM image **(a)** and EDS map **(b)** of cross section for Li anode with 80% FDE electrolyte. SEM image **(c)** and EDS map **(d)** of cross section for Li anode with basic electrolyte.

Table S1. Mole numbers of Oxygen atom and Lithium ion in electrolyte (N_O and N_{Li+})

	Molecular weight (Mw)	Density (ρ, g/ml)	Formula for N_O and N_{Li+}	Mole numbers of Oxygen and Li⁺ (N_O, mol) (N_{Li+}, mol)
DOL	74.08	1.06	$N_O = \dfrac{V*\rho}{Mw}*2$	$0.0286V$
DME	90.12	0.867		$0.0192V$
Li⁺	—	—	$N_{Li+} = 10V*10^{-3}$	$0.01V$

(V is the volume of electrolyte, and Oxygen atom is from DOL/DME.)

Mole ratio (Li⁺: O) = 1: (2.89+1.92) = **1: 4.8**

In the 80% FDE system, the molar ratio of Li⁺ and oxygen atom of DOL/DME is about 1: 4.8. Because the coordination number of Li⁺ is about 4~5, most oxygen atom

from DOL/DME can be coordinated to the Li$^+$.

Table S2. Open circuit voltage (E) values of cells at different cycles and $\triangle$E.

Electrolytes	E_{10th}	E_{11th}	ΔE (E_{10th}-E_{11th})
Basic electrolyte	2.51 V	2.09 V	0.42 V
80% FDE electrolyte	2.30 V	2.12 V	0.18 V