Supplemental Information

A High Performance Lithium-Sulfur Battery Enabled by Fish-Scale Porous Carbon/Sulfur Composite and Symmetric Fluorinated Diethoxyethane Electrolyte

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1. NMR Spectroscopy Characterization of TFEE

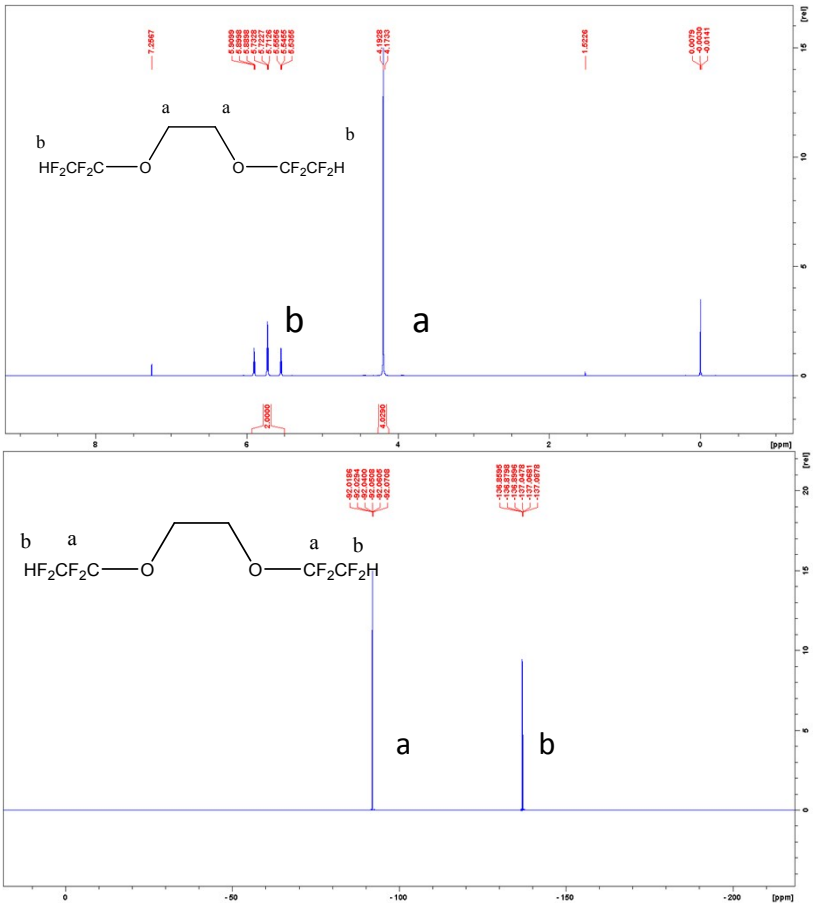

Figure S1. ^{1}H (top) and ^{19}F-NMR (bottom) spectra of 1,2-bis(1,1,2,2-tetrafluoroethoxy) ethane.

2. Cyclic Voltammograms of Li-S Cells with Fluorinated and Baseline Electrolytes

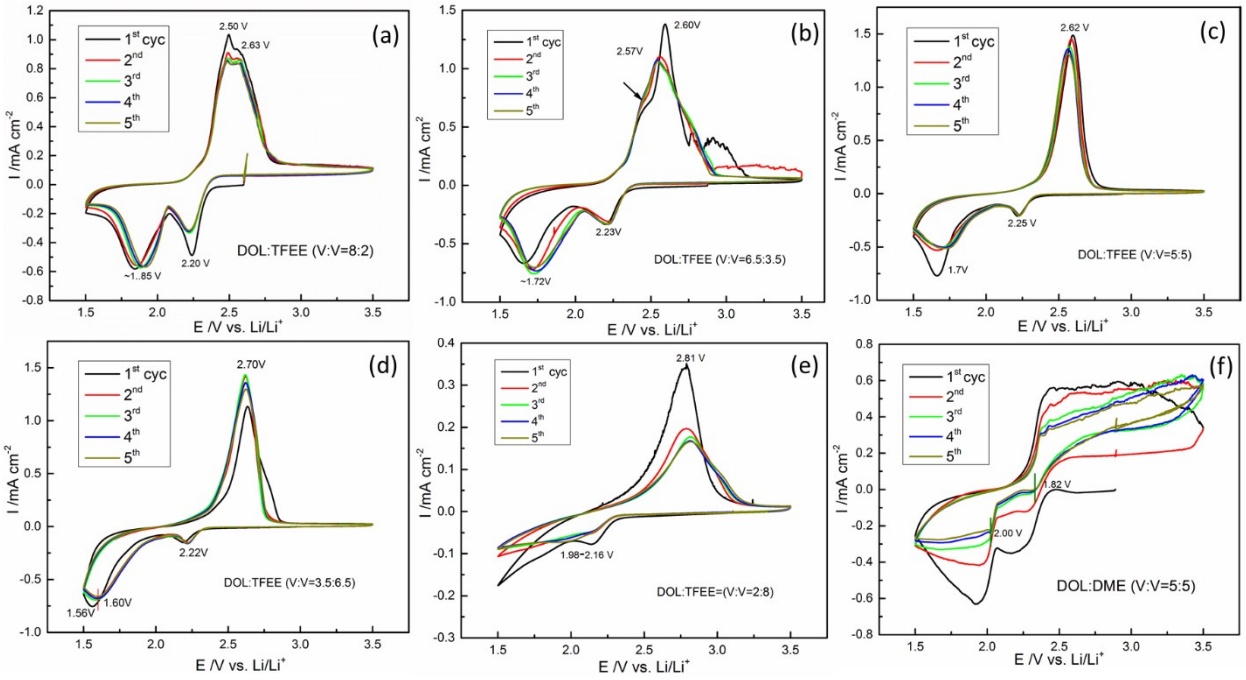

Figure S2. Cyclic voltammetry of the Li-S cells with electrolyte (a) 1.0 M LiTFSI DOL/TFEE (8/2), (b) 7/3, (c) 5/5, (d) 4/6, (e) 2/8, and (f) baseline 1.0 M LiTFSI DOL/DME (5/5) electrolyte. (All ratios are volumetric rations).

3. Lithium Polysulfides Dissolution in Electrolytes

Coin cells were disassembled in the first discharge cycle at various depth of discharge (DOD) 15%, 25%, 45%, 85% and 100%. The coin cell parts (electrodes, separator and stainless spacers) were rinsed by 10 mL DME solvent to harvest the electrolyte.

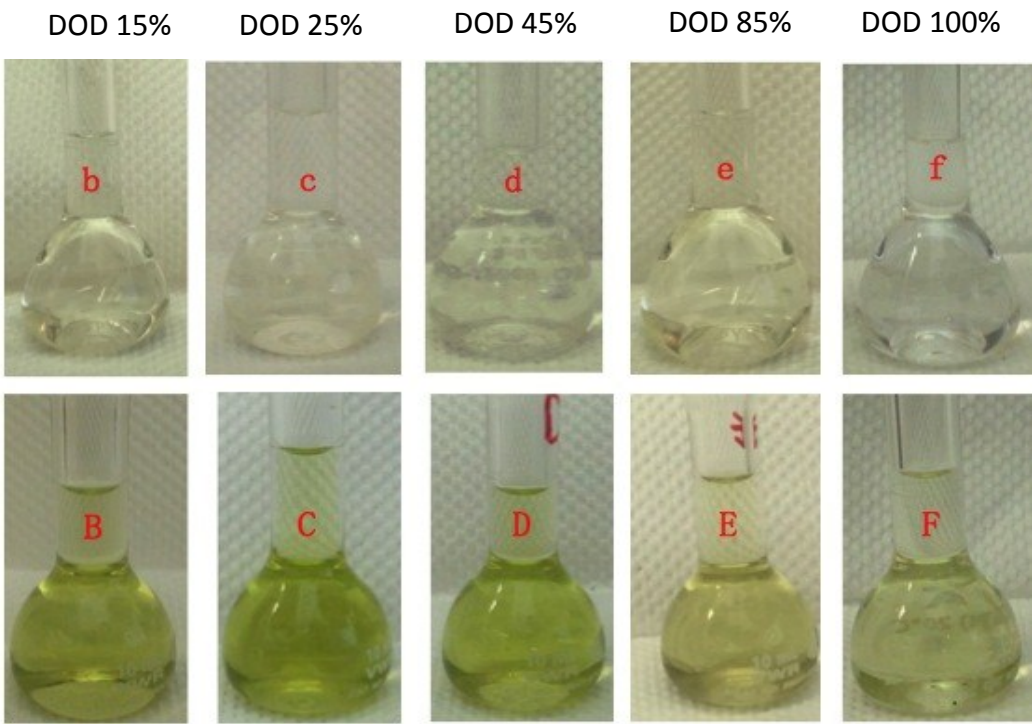

Figure S3. Harvested electrolyte from coin cells at DOD stage of 15%, 25%, 45%, 85% and 100% diluted with DOL solvent. Top figures from b to f: 1.0 M LiTFSI DOL/TFEE (5/5) electrolyte; Bottom figures from B to F: 1.0 M LiTFSI DOL/DME (5/5) electrolyte.

4. SEM/EDS of the Fish-Scale Porous Carbon/Sulfur Cathode

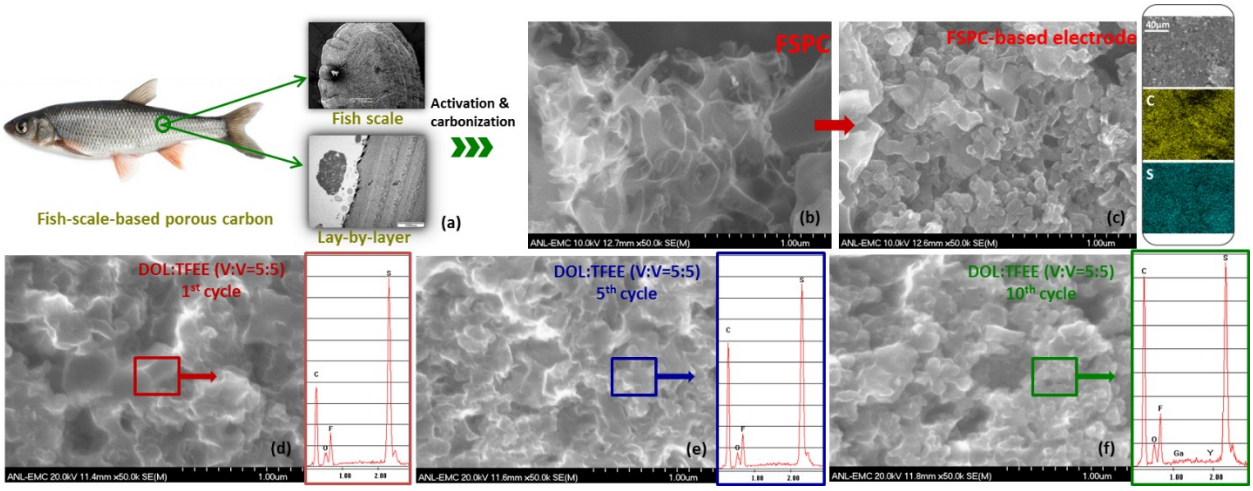

Figure S4. (a) Fish-scale porous carbon (FSPC) fabrication process and SEM image of (b) FSPC, (c) FSPC/sulfur composite electrode, (d) electrode after 1st cycle, (e) after 5th cycle, and (f) after

10th cycle with 1.0 M LiTFSI DOL/TFEE (5/5) electrolyte. C and S elemental mapping is shown adjacent to (c), EDS spectra for electrode after 1st, 5th and 10th were shown adjacent to (d), (e) and (f), respectively.

5. Sulfur Electrode Morphology after 100 Cycles

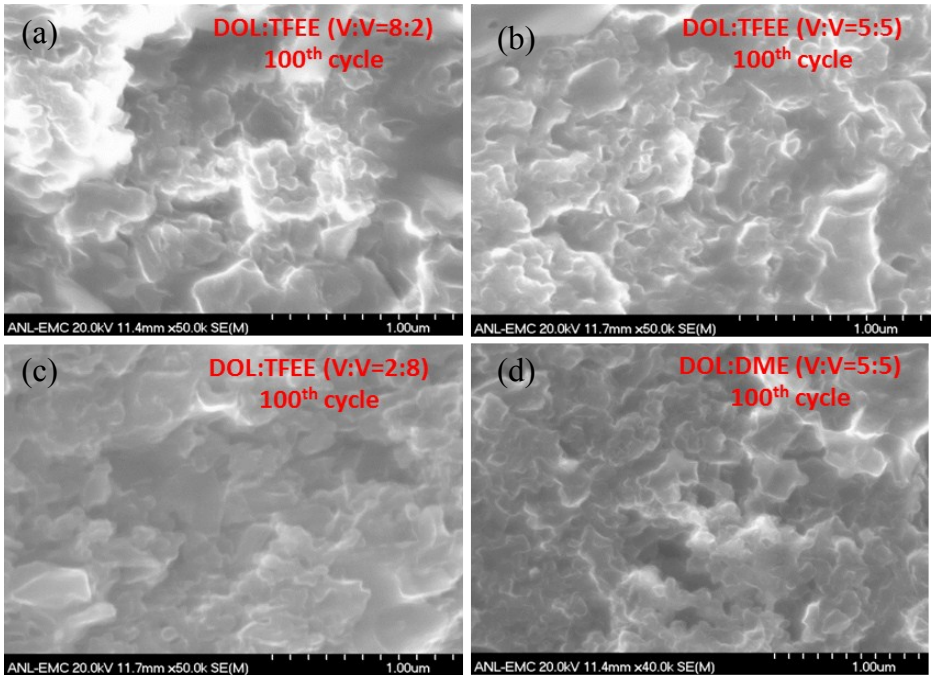

Figure S5. SEM image of FSPC/sulfur electrode after 100 cycles in different electrolytes. (a) 1.0 M LiTFSI DOL/TFEE (8/2), (b) 1.0 M LiTFSI DOL/TFEE (5/5), (c) 1.0 M LiTFSI DOL/TFEE (2/8), and (d) 1.0 M LiTFSI DOL/DME (5/5).

Table S1. **Fitted values for the equivalent circuit by simulation of impedance spectra**

Stage	$R_1(\Omega)$	R_2 (Ω)	CPE1
OCV	14.32	146.60	8.3595E-6
a	14.95	140.30	8.1405E-6
b	16.30	90.36	8.3621E-6
c	17.85	140.00	6.5119E-5
d	19.19	100.20	1.3384E-5
e	17.76	82.81	1.4332E-5
f	18.33	97.38	1.2624E-5
g	17.36	63.65	1.4324E-5
h	17.51	99.52	1.5147E-5