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ELECTRONIC SUPPORTING INFORMATION

Long-chain fluorocarbon driven hybrid solid polymer electrolyte for lithium metal battery

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Additional figures and tables

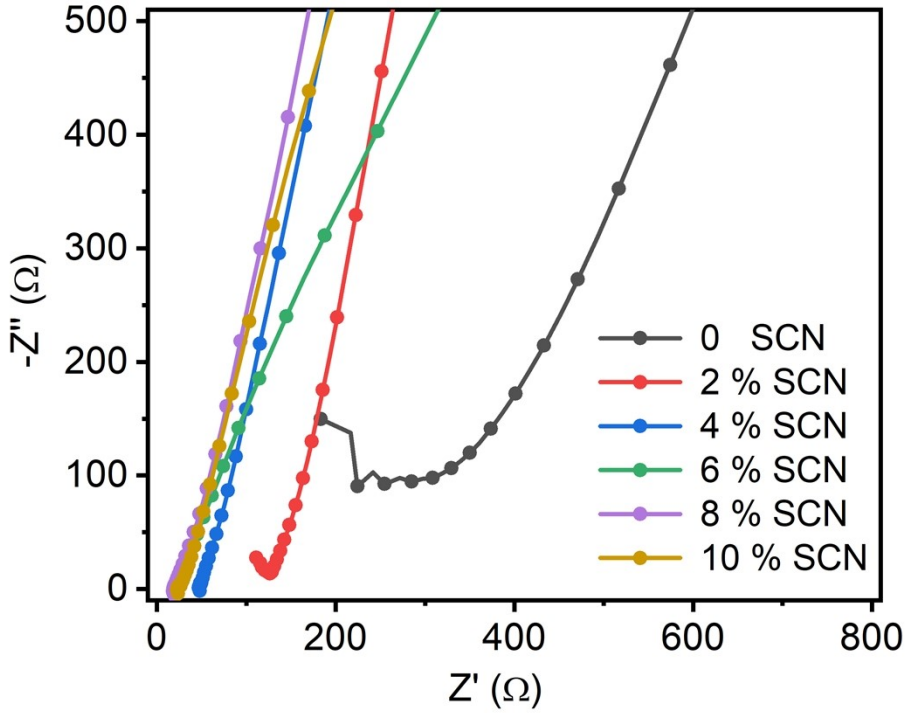

Fig. S1. Nyquist plots of P(DFMA-*co*-MMA)-xSCN-LiTFSI electrolyte membranes at 25 °C, which were prepared with various contents of SCN in P(DFMA-*co*-MMA).

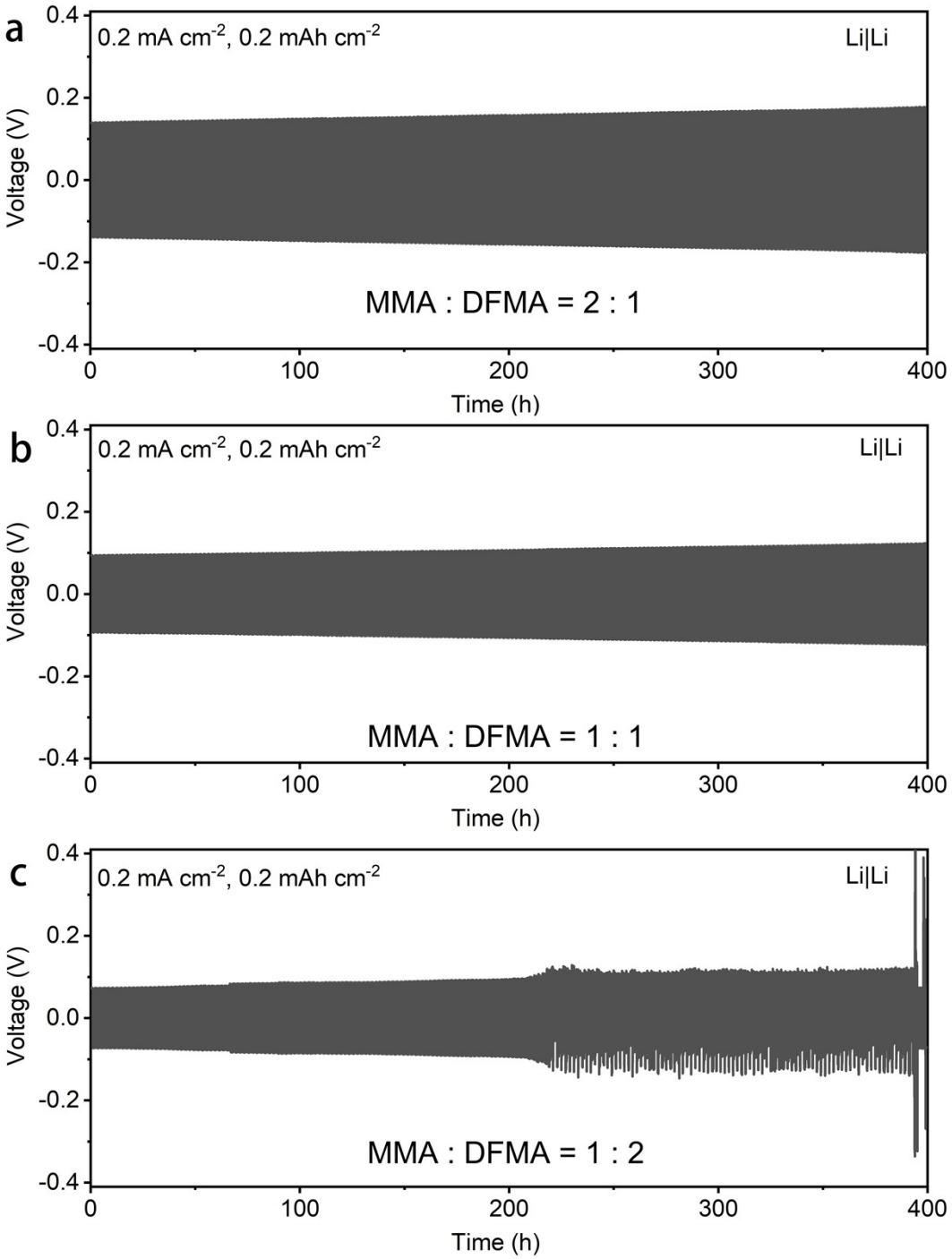

Fig. S2. The 200 cycles of Li symmetric cells with different ratios of DFMA and MMA.

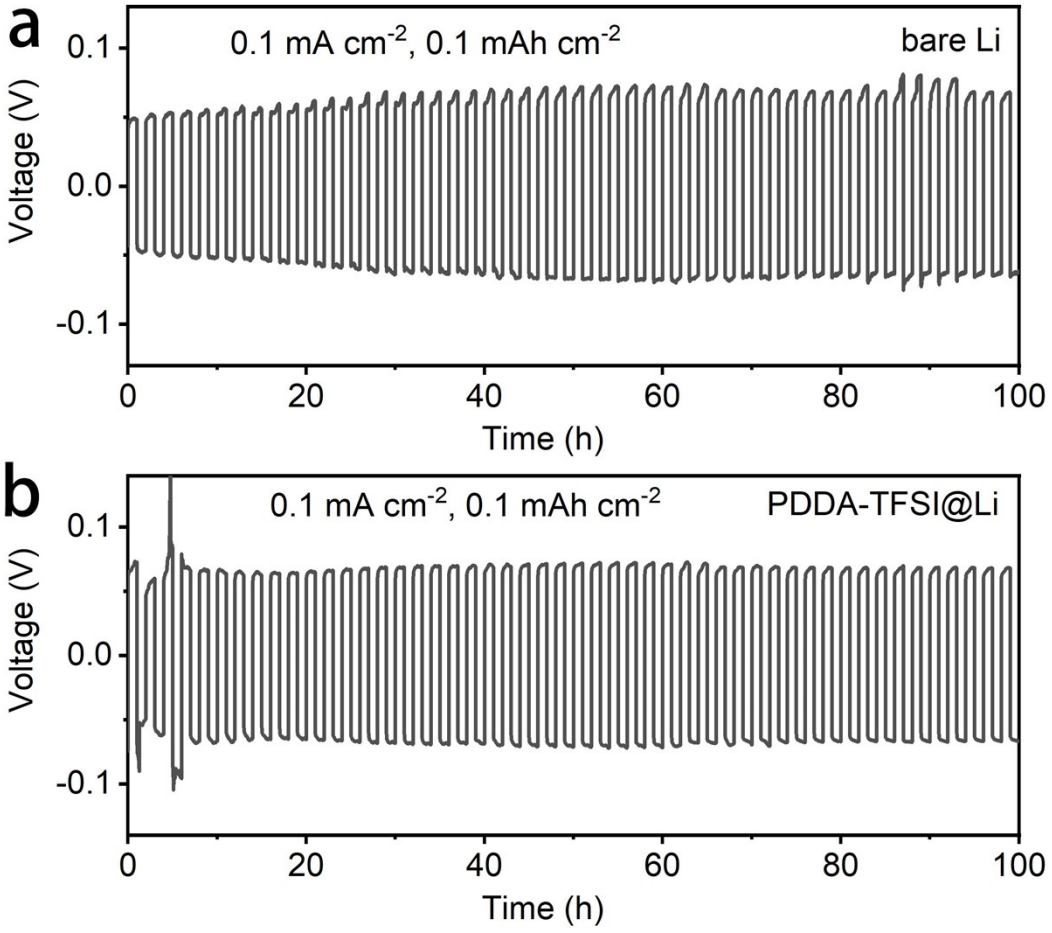

Fig. S3. The 50 cycles of (a) bare Li and (b) PDDA-TFSI@Li symmetric cells with LFSPE.

Table S1. Performance parameter and the application in the lithium battery of solid polymer electrolytes with SCN additives. (In some studies, succinonitrile is abbreviated as SN)

Solid electrolytes	Ionic conductivity (S cm^{-1})	Electrochemical windows	Battery configuration	Refs.
LFSPE	6.78×10^{-4} (25 °C)	4.713 V	LCO/LFP/ NCM811	This work
PSF-PEO_{35} +LiTFSI+SCN	1.6×10^{-4} (25 °C)	4.2 V	LFP	1
PIL-SCN-PCE	6.54×10^{-4} (25 °C)	5.4 V	LFP	2
C-PCE	2.1×10^{-4} (25 °C)	4.5 V	$Li_4Ti_5O_{12}$	3
PEO-SCN	1.9×10^{-4} (25 °C)	4.7 V	LFP	4
SN-SPE	4.6×10^{-4} (25 °C)	4.6 V	LFP	5
PEO/PVDF/$LiClO_4$/ SN	2.8×10^{-5} (25 °C)	4.5 V	LFP	6
PEO–SN_{25}–$LiTFSI_{10}$–GF	2.85×10^{-4} (25 °C)	5.5 V	LFP	7
PEO–SN–LiTFSI	3.38×10^{-4} (25 °C)	4.8 V	LFP	8
PIPCE	~3.1×10^{-4} (30 °C)	4.97 V	NCM532	9
TXE-SN-LiDFOB	1.14×10^{-4} (30 °C)	4.5 V	LCO	10
SN-PC-PEGDGE	1.4×10^{-5} (25 °C)	-	-	11
CPE-SCN	2.57×10^{-4} (30 °C)	4.7 V	LFP/NCM111	12
DLPE	1.54×10^{-4} (20 °C)	5 V	LFP/NCM811	13
PVA/PAN/SN/LATP/LiTFSI	1.13×10^{-4} (25 °C)	5.1 V	LFP	14
SPI-LAGP-SPI	1.4×10^{-4} (25 °C)	4.8 V	$LiNi_{0.8}Co_{0.15}Al_{0.05}O_2$	15
PEM-PEG3A	3.41×10^{-4} (21 °C)	4.5 V	LFP	16
PPC-SCN	2.18×10^{-4} (25 °C)	4.7 V	LFP	17
PCL/SN/PAN	4×10^{-4} (25 °C)	4.5 V	LFP	18
N-PCPE	5.7×10^{-4} (25 °C)	>2.7 V	LCO	19
PEO-SN	1.19×10^{-4} (25 °C)	5 V	NCM811	20
PEO/LiTFSI/SN/ LAO	1.36×10^{-5} (30 °C)	5.2 V	LFP	21
PSSE	2.5×10^{-4} (25 °C)	4.63 V	LTO@VG/LFP	22
SPE-14-15	1.26×10^{-4} (30 °C)	4.9 V	LFP	23

Table S2. Performance parameter and the application in the lithium battery of solid hybrid polymer electrolyte.

Solid electrolytes	Ionic conductivity (S cm^{-1})	Electrochemical windows	Battery configuration	Refs.
LFSPE	6.78×10^{-4} (25 °C)	4.713 V	LCO/LFP/ NCM811	This work
(PEG-HDIt)/LiTFSI	6.51×10^{-5} (25 °C)	4.65 V	LFP/ $LiNi_{0.8}Co_{0.15}Al_{0.05}O_2$	24
PCL/LiTFSI	2.5×10^{-5} (25 °C)	4.6 V	$LiNi_{0.6}Co_{0.2}Mn_{0.2}O_2$	25
P(STFSILi)-PEO-P(STFSILi)	1.3×10^{-5} (60 °C)	5 V	LFP	26
PEO/LiTFSI	1.9×10^{-6} (25 °C)	-	-	27
PIL-PEO/LiTFSI	6.12×10^{-4} (55 °C)	5.44 V	LFP	28
PEO/LiTFSI-SNps	4.35×10^{-4} (30 °C)	5.18 V	LFP/LCO	29
SPEs with nanowires	6.05×10^{-5} (30 °C)	-	-	30
PEO-ta-POSS	1.2×10^{-3} (90 °C)	3.8 V	V_2O_5	31
PDADMA NTf_2/LiFSI/PVDF	2.64×10^{-4} (25 °C)	4.5 V	$LiNiMnCoO_2$/ $LiNi_{0.8}Co_{0.15}Al_{0.05}O_2$	32
PI/PEO/LiTFSI	2.3×10^{-4} (30 °C)	-	LFP	33
PEO-5% g-C_3N_4-LiTFSI	1.52×10^{-4} (60 °C)	4.7 V	LFP	34
PEO/LiTFSI/10% VS	2.9×10^{-5} (25 °C)	5.35 V	LFP	35
PEO-n-UIO-LiTFSI	1.3×10^{-4} (30 °C)	4.5 V	LFP	36
PEO-LiTFSI-1% Li_2S	2.52×10^{-4} (50 °C)	-	NCM811	37
PEO-VAVS-LiTFSI	1.89×10^{-4} (50 °C)	-	LFP	38
(PMHS-PEO)/LiTFSI	10^{-5} (25 °C)	5.2 V	LFP	39
(PEO-sulfur-PEGMA)/LiTFSI	2.13×10^{-4} (50 °C)	5.4 V	LFP	40

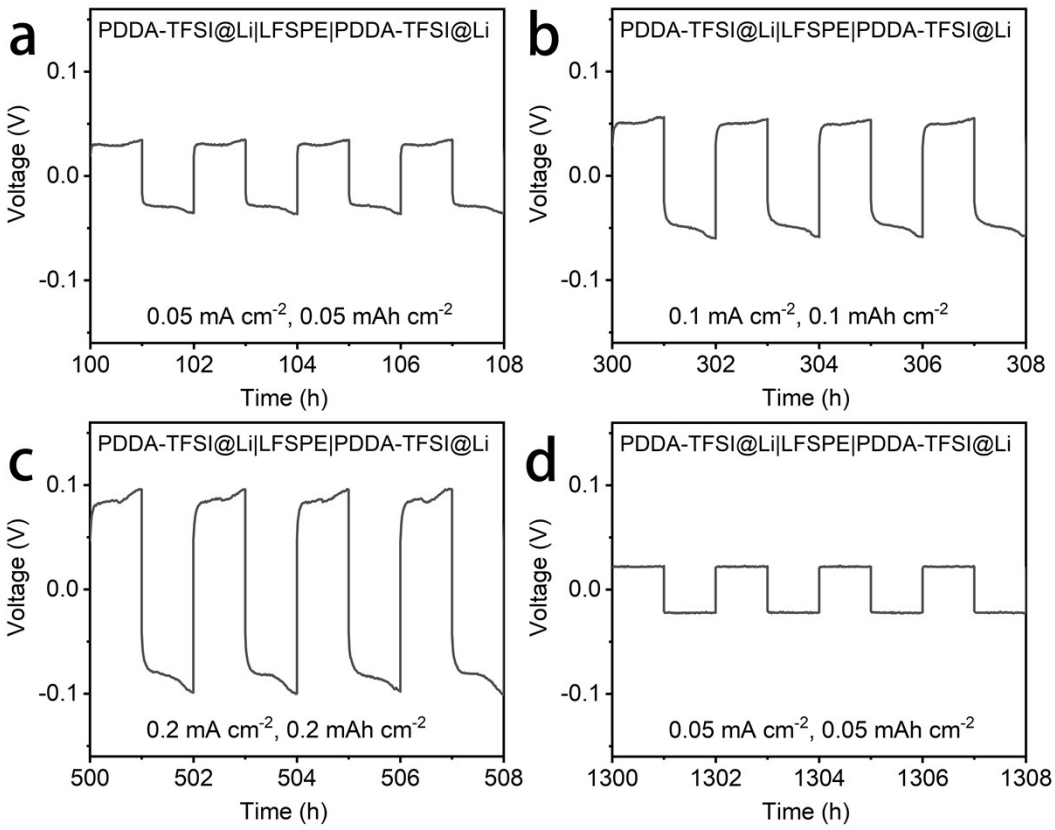

Fig. S4. Magnified areas of Li plating\stripping curves of the LFSPE symmetric cell at different current densities.

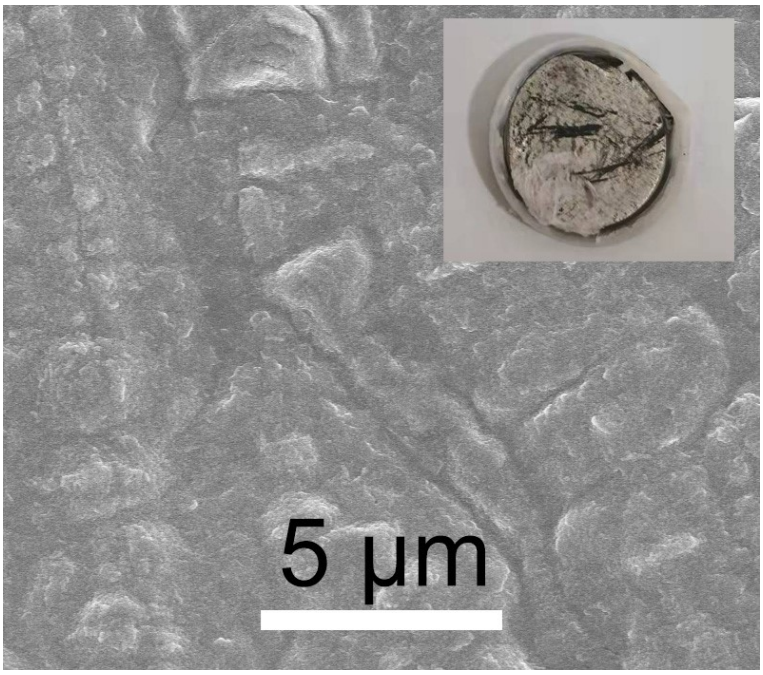

Fig. S5. SEM image and digital image of cycled PDDA-TFSI@Li electrode over 2000 h from LFSPE symmetric cell. The scratches on the surface are the result of artificial etching, indicating that even after the cyclic reaction, the coating can still effectively avoid the oxidation reaction of lithium metal exposed to the air. The white fibers on the surface prove that the electrolyte membrane in the battery is closely attached to the anode.

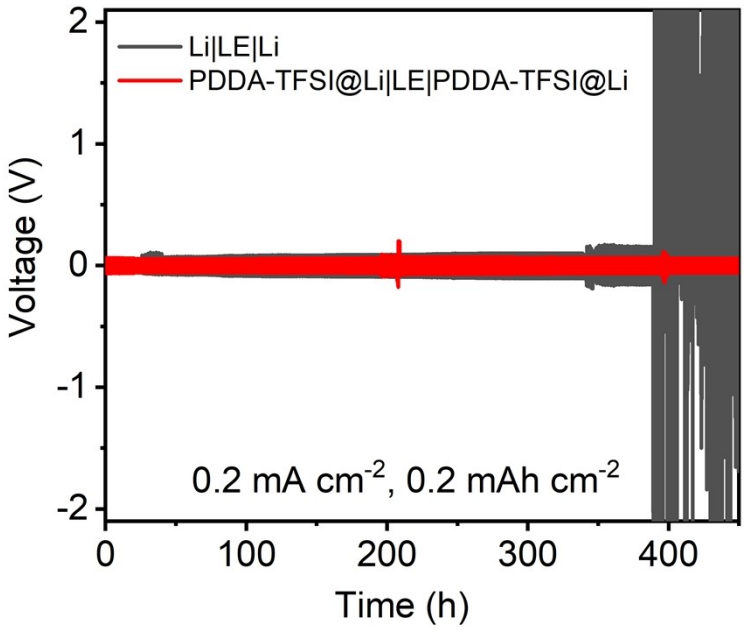

Fig. S6. The cycling performances of bare Li and PDDA-TFSI@Li symmetric cells with liquid electrolyte.

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