

1 **Supplementary Material: Pore filled solid electrolytes with high ionic conduction**
2 **and electrochemical stability for lithium sulfur battery**

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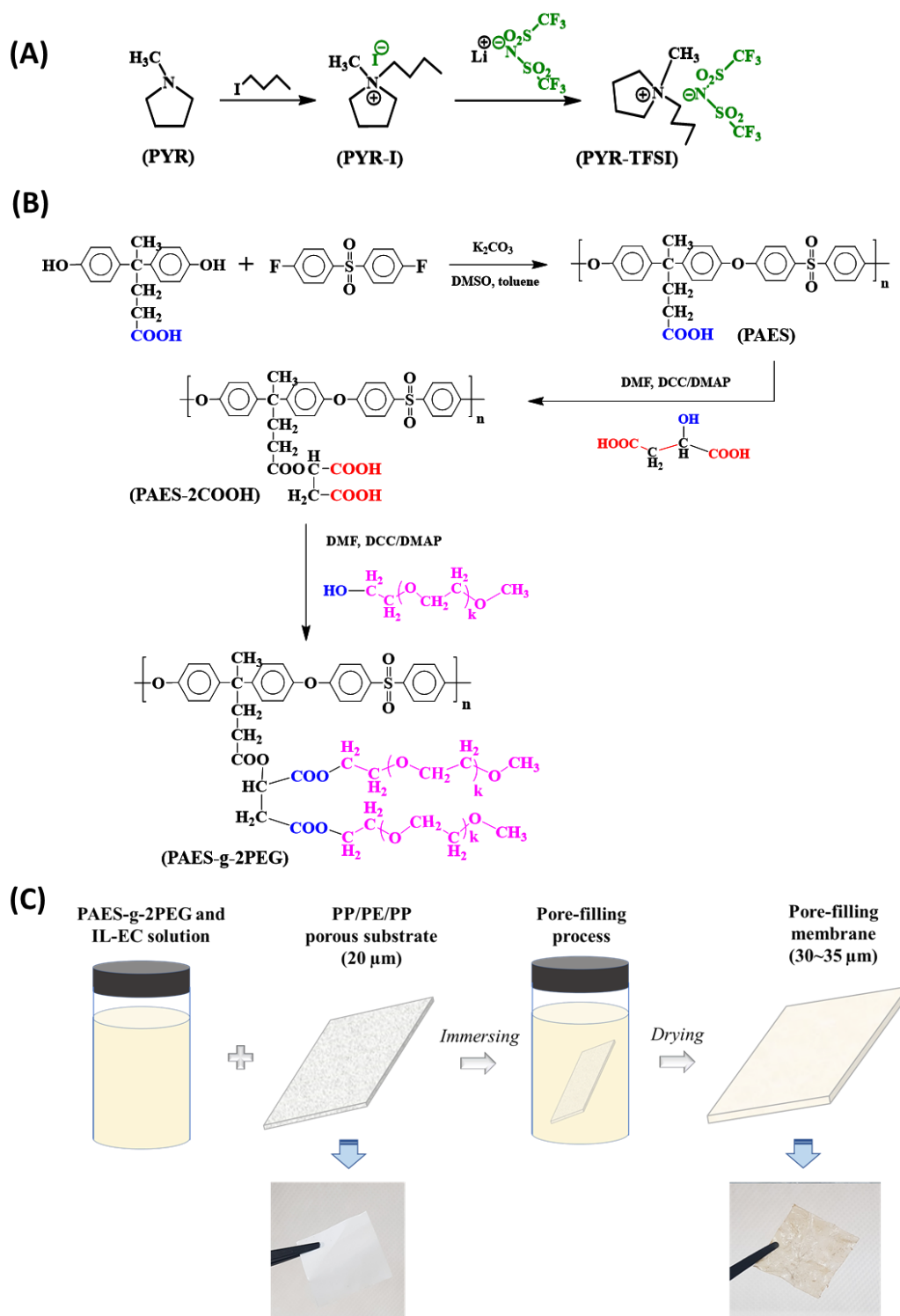
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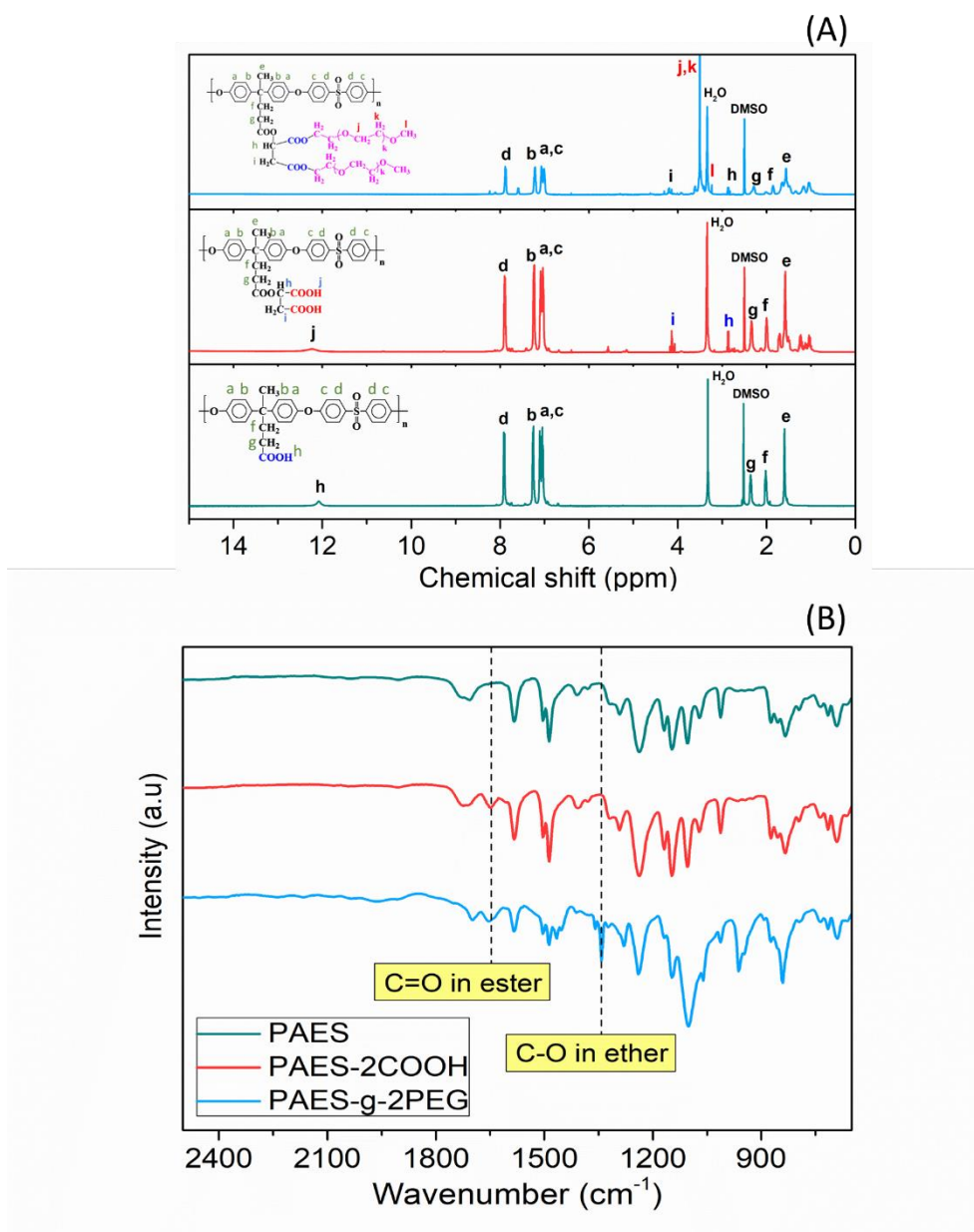
31 **Supplementary Figure 1.** Graphical scheme of (A) PYR-TFSI ionic liquid; (B) PAES-
 32 g-2PEG copolymer; and (C) preparation of the pore-filling membrane.

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38 **Supplementary Figure 2.** (A) NMR spectra and (B) FTIR spectra of PAES, PAES-
 39 2COOH, and PAES-g-2PEG.

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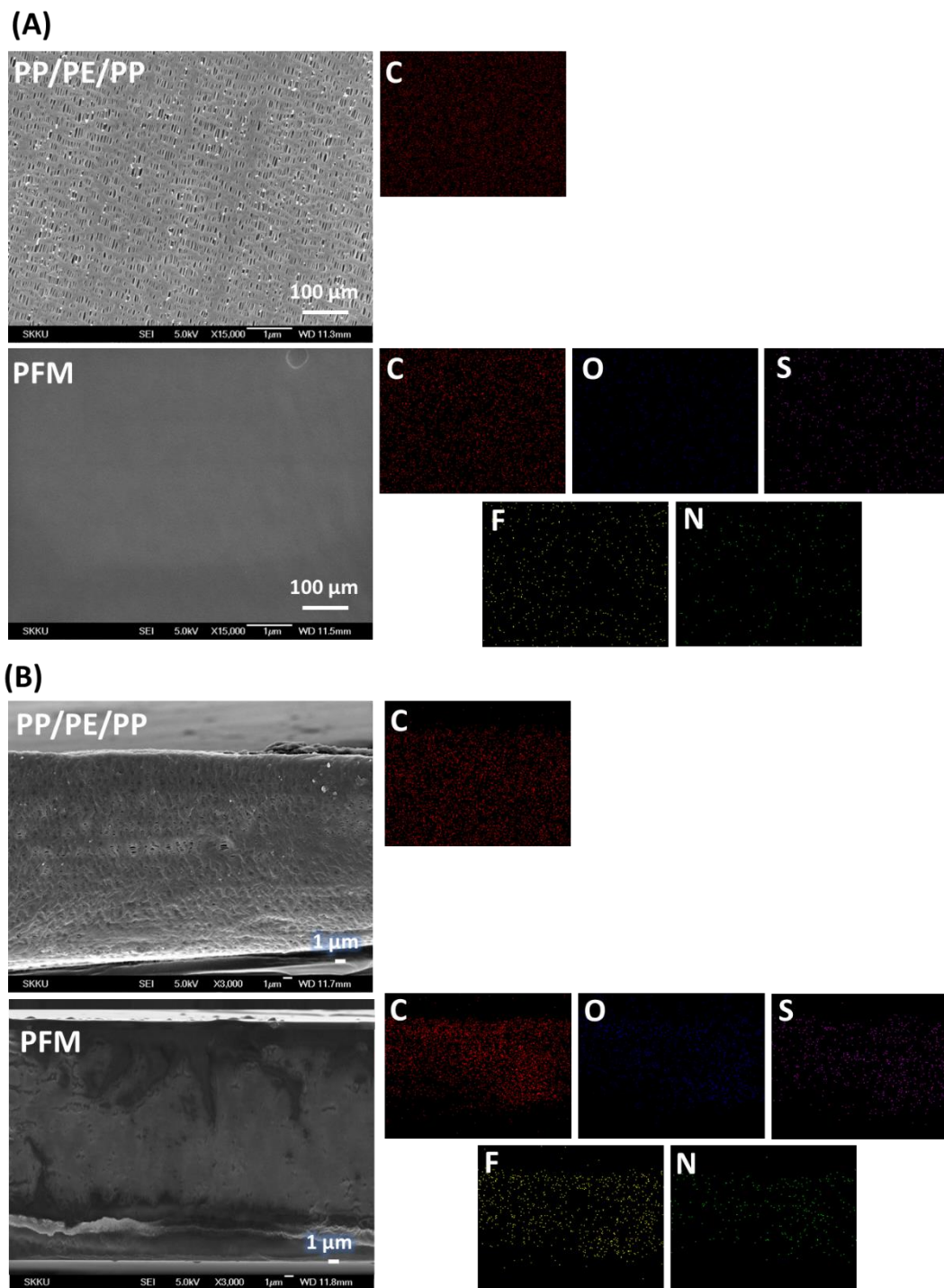
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50 **Supplementary Figure 3.** FESEM images with EDS mapping of PP/PE/PP and pore-
51 filing membranes at (A) surface and (B) cross-section.

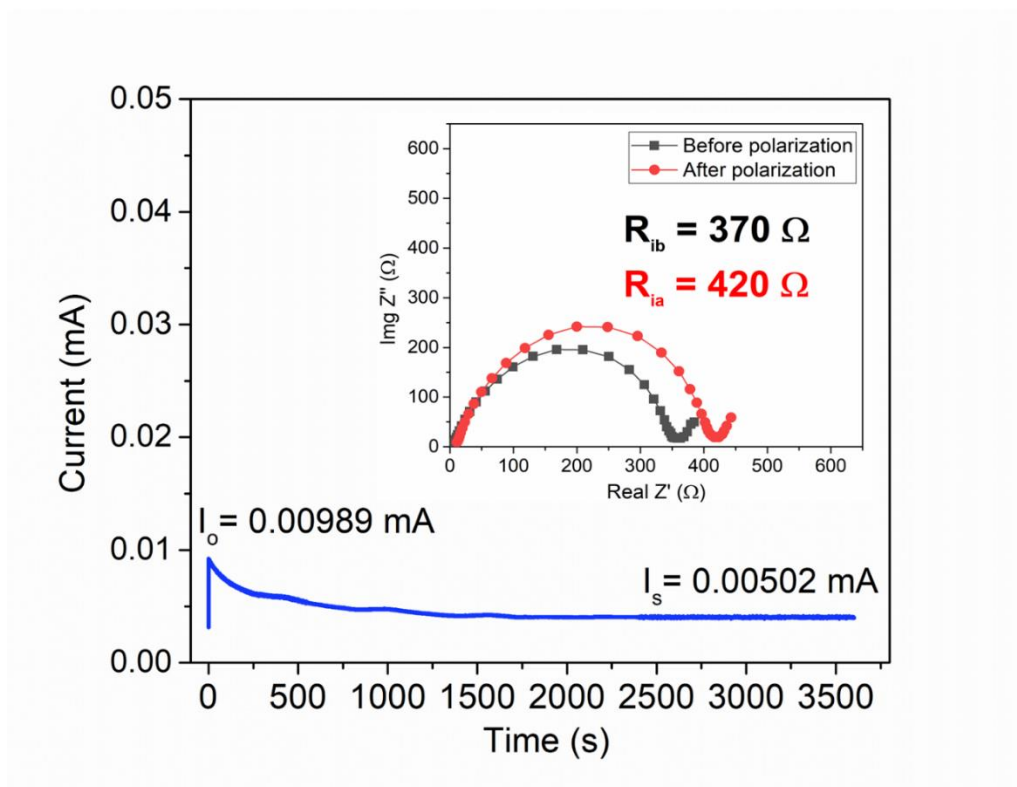
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58 **Supplementary Figure 4.** CA profile and impedance plot before and after CA test.

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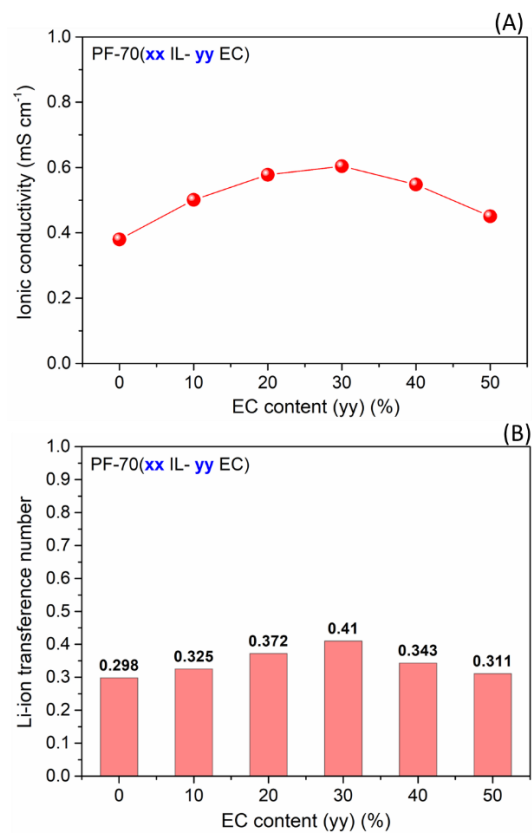
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78 **Supplementary Figure 5.** Effect of EC content on (A) ionic conductivity and (B) Li-
79 transference number of pore-filling membrane.

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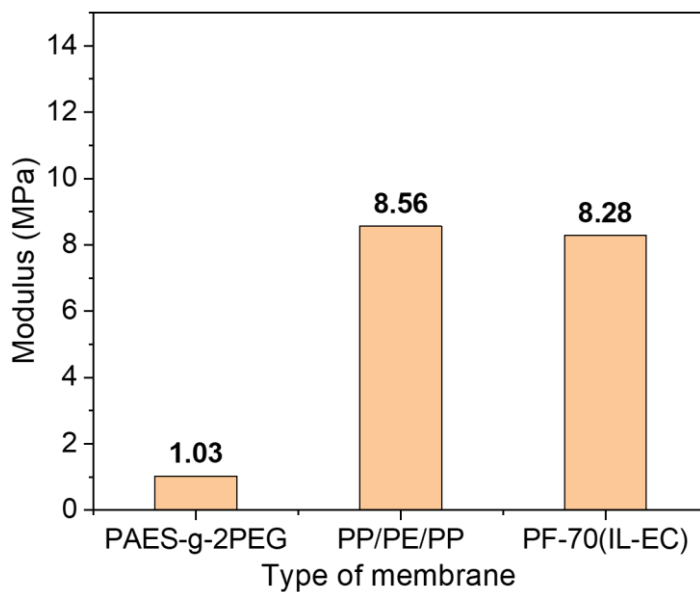
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97 **Supplementary Figure 6.** Modulus of PAES-g-2PEG, PP/PE/PP, and PL-70(IL-EC)
98 membranes.

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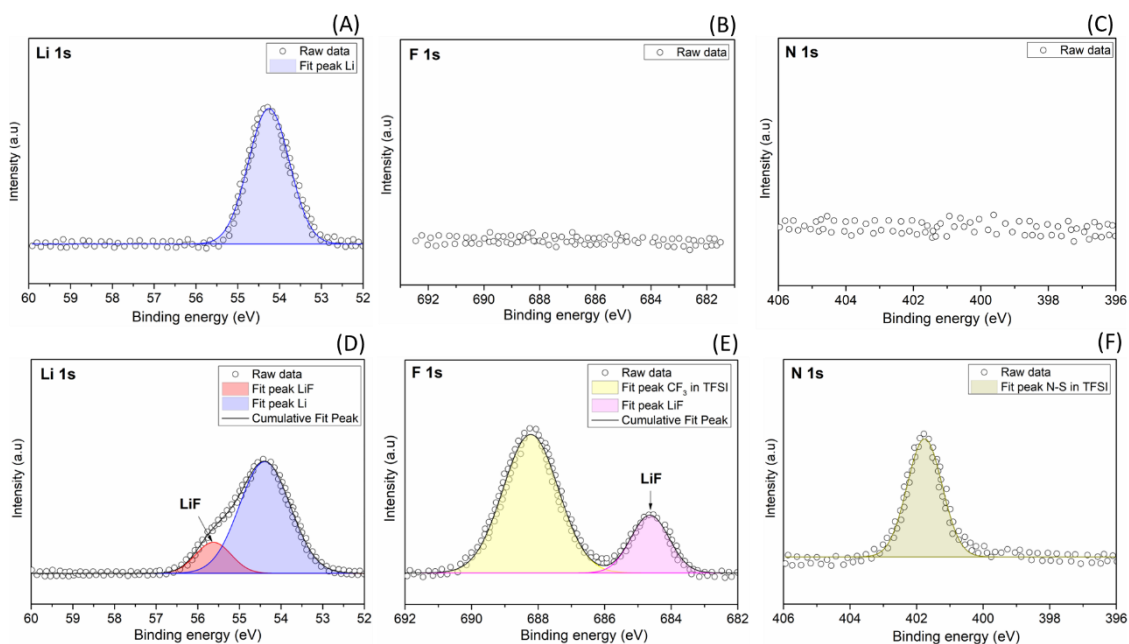
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108 **Supplementary Figure 7.** XPS spectra (Li 1s, F 1s, N 1s) and peak fit model for Li
109 anode of Li/PFM/Li cell (A-C) before and (D-F) after 500 h plating/stripping test.

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129 **Supplementary Table 1. Comparison of ionic conductivity (σ), Li-ion transference**
 130 **number (t_{Li^+}), mechanical properties and electrochemical stability window (ESW)**
 131 **of PL-70((IL-EC) membrane with those of other electrolytes recently reported.^[1–12]**
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Electrolyte membranes	σ value (mS cm ⁻¹)	t_{Li^+}	Mechanical		ESW (V)	[Ref]
			properties			
			Stress (MPa)	Strain (%)		
PEO-aramic fiber ANF/ LLZO	1.36	0.5	0.6	1000	4.8	[1]
Pore-filled PL-70((IL-EC)	0.60	0.40	200	65.0	4.6	Our work
PEC-P(VDF-HDP)/LLZO	0.005	0.82	6.9	14.9	4.8	[2]
PPO/ (LATP+LiTFSI) composite	0.0002	0.22	1.78	30.0	4.6	[3]
PPO/ PEO/ PPO cross-linking	1.32	0.44	0.03	39.0	4.8	[4]
PEGPEA/ LiTFSI (PSPE)	0.0022	0.63	0.24	170	4.8	[5]
PEO/ (LLZTO + LiTFSI)	0.0677	0.10	0.30	55.0	4.78	[6]
(PTMEG+VBIM-TFSI)	0.0318	0.47	1.0	84.0	5.1	[7]
PVDF/ 10 wt.% LLZO composite	0.175	0.34	90.0	70.0	4.2	[8]
(PVDF+PEO)/LLZTO composite	0.324	0.45	6.0	40.0	4.8	[9]
(PVDF+PEO)/(LLZO + LiTFSI)	0.105	0.45	0.90	35.0	5.0	[10]
PEO/ CMC-Li@PI	0.0316	-	6.47	20.0	5.0	[11]
<i>Pore-filling</i> CNF/ (PEO+LLZO)	0.183	0.64	-	-	5.0	[12]

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142 **Supplementary Table 2. Comparison of the S/SPE/Li cell performance based on**
 143 **PAS-co-2PEG membrane with some other reports at various C-rates.** ^[13–21]

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Electrolyte membranes	Discharge capacity (mAh g ⁻¹)				[Ref]
	0.2C	0.5C	1.0C	2.0C	
PEO-Li ₄ (BH ₄) ₃ I/ SiO ₂ <i>composite</i>	950	817	613	583	[13]
PETT-DA/(PEO + PVDF-HFP)	910	766	624	543	[14]
<i>In-situ</i> S-DCBQ organosulfur	890	795	750	600	[15]
Pore-filled PL-70((IL-EC)	835.7	808.2	739.3	657.3	Our work
PETEA+divinyladipate/(DOL+TEGDME)	779	621	325	220	[16]
PEO/ (P ₂ S ₅ + LiTFSI) <i>gel electrolyte</i>	750	450	-	-	[17]
PEO/ Li _{1.3} Al _{0.3} Ti _{1.7} (PO ₄) ₃ / PEO (<i>LbL</i>)	692.9	428.4	362.3	-	[18]
PEO/ Li ₁₀ SnP ₂ S ₁₂ <i>composite electrolyte</i>	615	-	-	-	[19]
Polydopamine-coated Li ₆ PS ₅ Cl <i>solid</i>	552.8	226.4	-	-	[20]
PEO/TCM+ LiTFSI) <i>solid electrolyte</i>	450	300	-	-	[21]

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