# Electronic Supplementary Material

# Fabricating ion-conducting channel in SU-8 matrix for high-performance patternable polymer electrolytes

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## Experimental section

### Materials

SU-8 2014 (Micro Chem), poly(ethylene oxide) (PEO, Mw=600,000, Aladin), bis(trifluoromethane)sulfonimide lithium salt (LiTFSI, >99.9%, Aladin), anhydrous Acetonitrile (ACN, >99.8%, Aladin), propylene glycol monomethyl ether acetate, (PGMEA, >99.7%, Jianghuamem).

### Preparation of Electrode

Amorphous silicon (a-Si) was deposited by DC magnetron sputtering (PD-280, Wuhan PDVACUUM) onto copper foils with a thickness of 50 μm. PSU-8 was spin-coated and fabricated onto a-Si films with 1.44 μm thick. $LiFePO_4$ (LFP) is chosen as the cathode material. LFP, Super P and polyvinylidene fluoride (PVDF) are mixed evenly in N-methyl-2-pyrrolidone (NMP) at a mass ratio of 8:1:1 to form a uniform slurry, and then coated on a clean aluminum foil. Then the mixture is dried at 70 °C in a vacuum oven for 12 h.

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**The measurement of ionic conductivity**

The bulk resistance (Rb) of polymer electrolytes was obtained from the EIS. The ionic conductivity was calculated from Equation (S1):

$$\sigma = \frac{L}{R_b S} \qquad (1)$$

where Rb is the bulk resistance of polymer electrolytes, L is the thickness of the polymer electrolytes and S is the area of polymer electrolytes.

**The computational formula of the activation energies (Ea)**

The Ea of polymer electrolytes in Figure 3b was calculated by Arrhenius relation from Equation (S2):

$$\sigma = A\,exp\left(-\frac{Ea}{kT}\right) \qquad (2)$$

Where σ is ionic conductivity of polymer electrolytes, A is pre-exponential factor, Ea is activation energy, k is Boltzmann constant, and T is temperature of testing process.

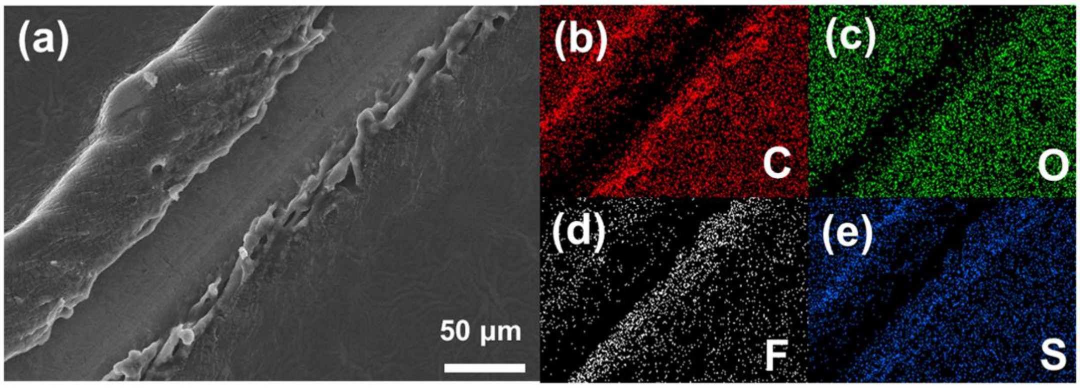



**Figure S1** SEM image (a) and Energy Dispersive Spectrometer image (b-e) of PSU-8.

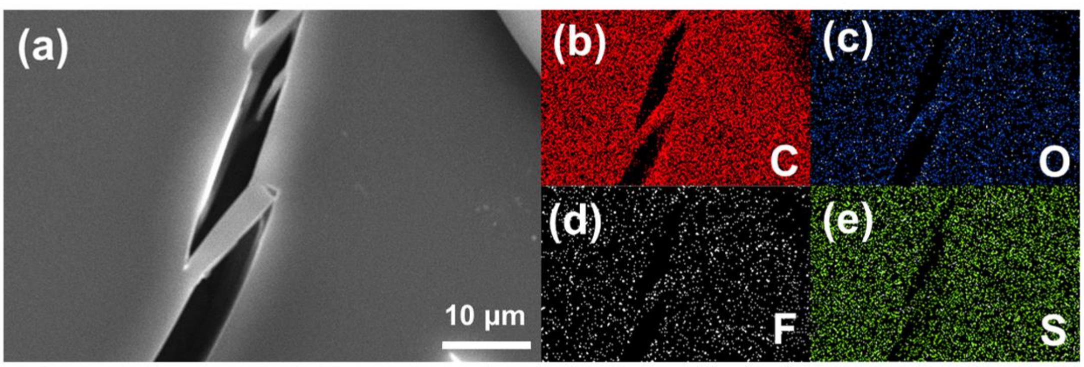



**Figure S2** SEM image (a) and Energy Dispersive Spectrometer image (b-e) of SU-8.

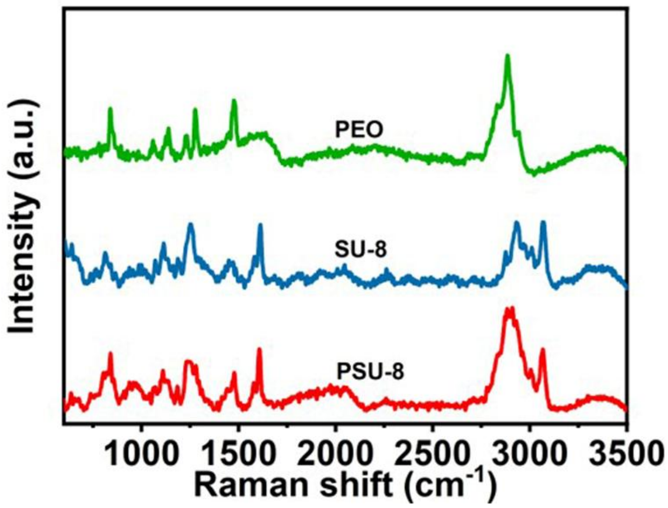



**Figure S3** Raman spectra of PEO, SU-8 and PSU-8.

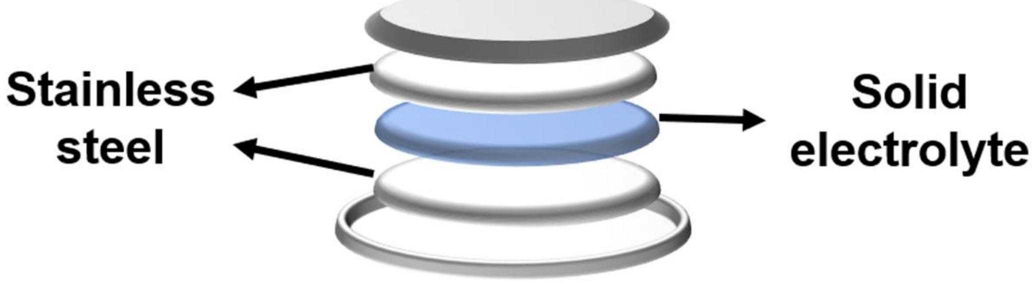



**Figure S4** Schematic illustration of SS|PSU-8|SS half-cells**.**

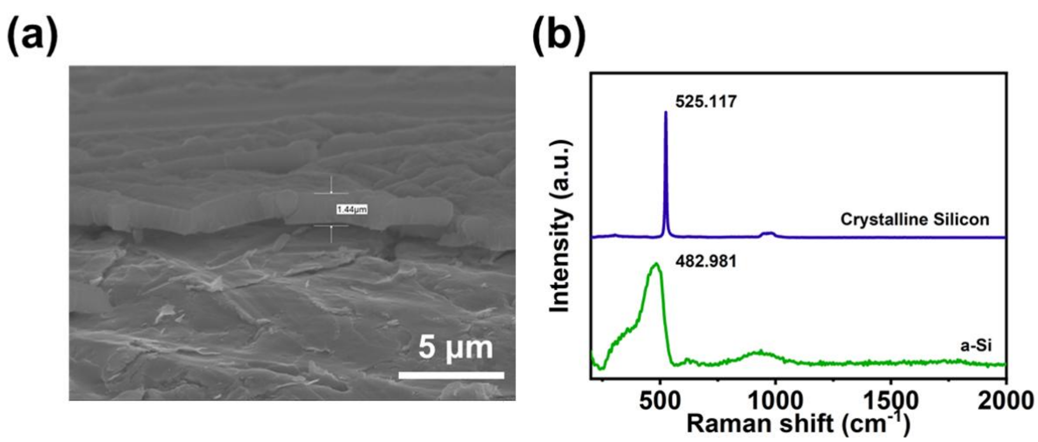
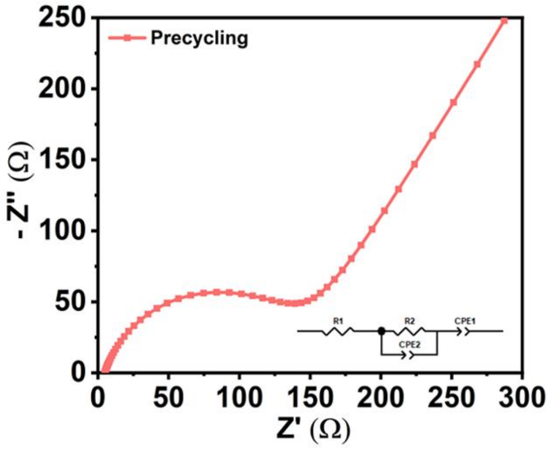
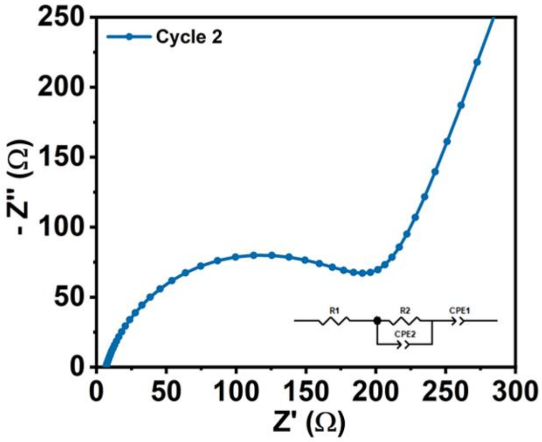



**Figure S5** (a) Cross-sectional SEM image of a-Si film. (b) Raman spectra of crystalline silicon and a-Si.




| Element | Value |
|---|---|
| R1 | 4.696 |
| R2 | 132.1 |
| CPE2-T | 8.5253E -6 |
| CPE2-P | 0.81012 |
| CPE1-T | 0.00048846 |
| CPE2-P | 0.65371 |

**Figure S6** The fit curve of impedance spectroscopy and fitted values of a-Si|PSU-8|Li half-cells for precycling.




| Element | Value |
|---|---|
| R1 | 6.728 |
| R2 | 193.5 |
| CPE2-T | 4.3158E -6 |
| CPE2-P | 0.81382 |
| CPE1-T | 0.00013346 |
| CPE2-P | 0.78576 |

**Figure S7** The fit curve of impedance spectroscopy and fitted values of a-Si|PSU-8|Li half-cells for the second cycle.

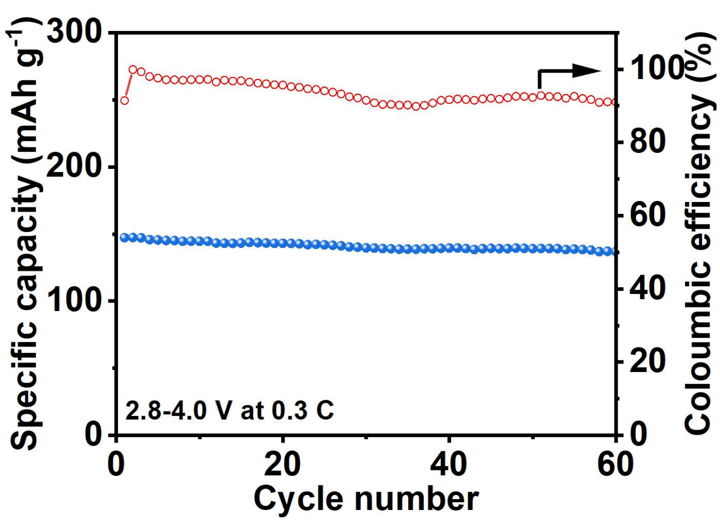


**Figure S8** The long-term cycle performance of the $LiFePO_4$|PSU-8|Li battery at a rate of 0.3 C.

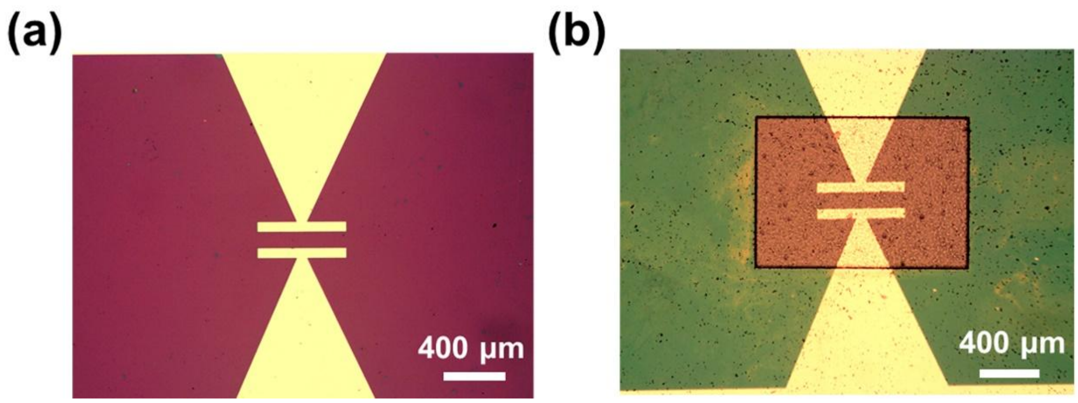



**Figure S9** (a) Optical image of Au electrodes. (b) Optical image of Au electrodes with PSU-8.

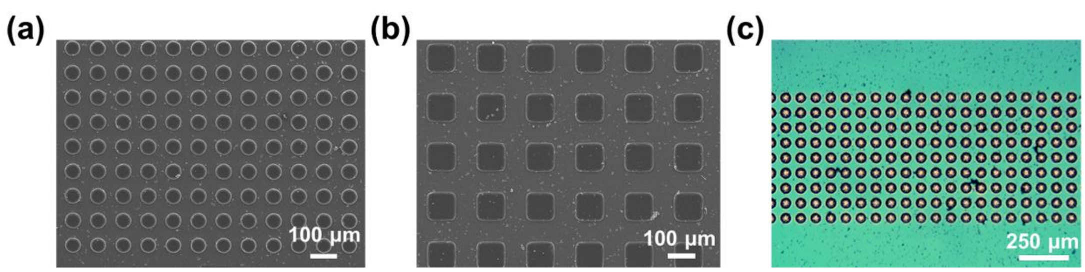



**Figure S10** (a) SEM image of PSU-8 with features: circular, 100 μm in diameter. (b) SEM image of PSU-8 with features: square, 100 μm in length. (c) Optical image of PSU-8 with features: circular, 50 μm in diameter.

**Table S1** The comparisons of this work and previous reports in different polymer electrolytes.

| Polymer electrolytes | Ionic conductivity ($S\ cm^{-1}$) | Elastic Modulus | Ref. |
|---|---|---|---|
| PSU-8 | $2.9 \times 10^{-4}$ | 1.52 GPa | This work |
| Crosslinked PEO/ $SiO_2$ aerogel network/ LiTFSI/SCN | ~ $6 \times 10^{-4}$ | 0.43 GPa | S1 |
| SU-8/$LiClO_4$ | $5.2 \times 10^{-5}$ | 4.2 GPa | S2 |
| Poly (propylene oxide)/ PEO-tethered $SiO_2$ /LiTFSI/PC | ~ $5 \times 10^{-3}$ | ~ 1.0 MPa | S3 |
| PEO/PEG/Octa-POSS/ LiTFSI | ~ $1.3 \times 10^{-5}$ (30 °C) | ~ 2.98 MPa | S4 |
| PEO / Vermiculite sheets/LiTFSI | $1.2 \times 10^{-3}$ (60 °C) | 35.4 MPa | S5 |

**Supplementary References**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