Supporting Information

Ultra-thin Polymer Electrolyte Based on Single-Helical-Structured Agarose for High Performance Solid-State Lithium Batteries

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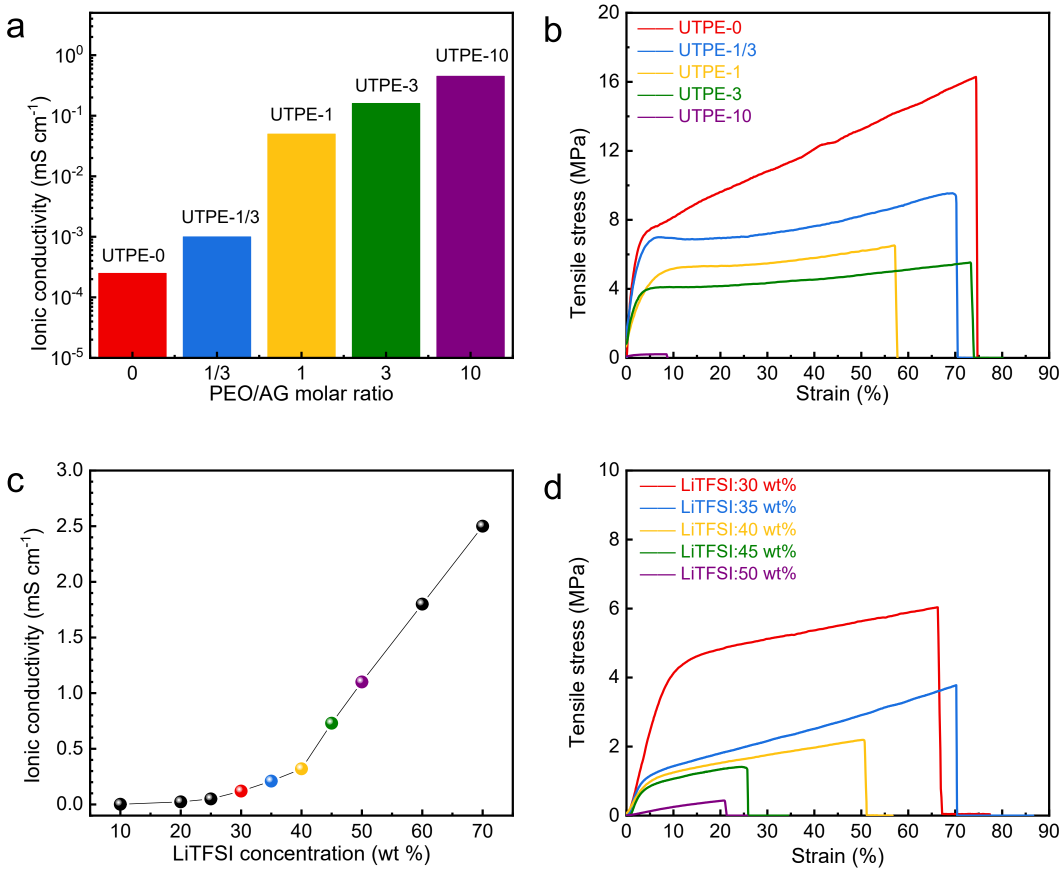

Fig. S1. (a) Ionic conductivity of UTPEs with different molar ratio of PEO/AG at room temperature (LiTFSI concentration: 30 wt%); (b) Stress-strain curves of UTPEs with different molar ratio of PEO/AG (LiTFSI concentration: 30 wt%); (c) Ionic conductivity of UTPEs with different concentrations of LiTFSI at room temperature (PEO/AG molar ratio: 3); (d) Stress-strain curves of UTPEs with different concentrations of LiTFSI (PEO/AG molar ratio: 3).

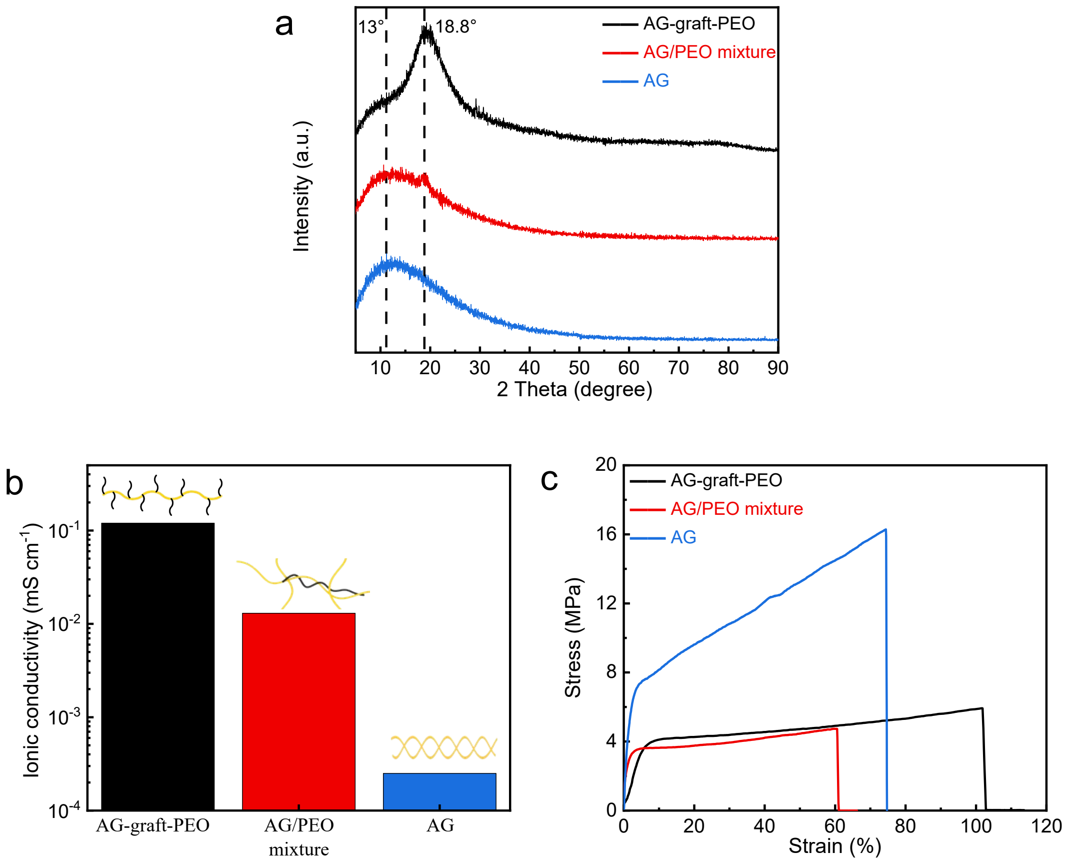

Fig. S2. (a) XRD pattern of AG-graft-PEO, AG/PEO-mixture and AG electrolytes; (b) Ionic conductivity of AG-graft-PEO, AG/PEO-mixture and AG electrolytes at room temperature; (c) Stress-strain curves of AG-graft-PEO, AG/PEO-mixture and AG electrolytes.

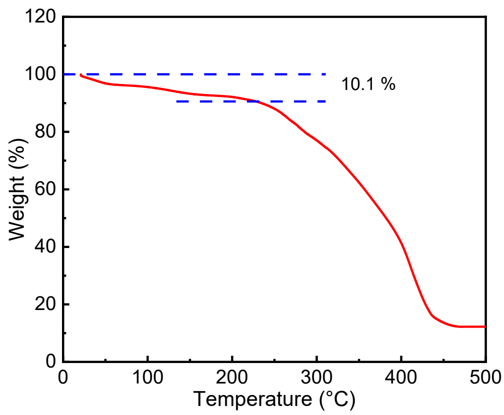

Fig. S3. Thermogravimetric curve of UTPE at a rate of 5 °C min^{-1}.

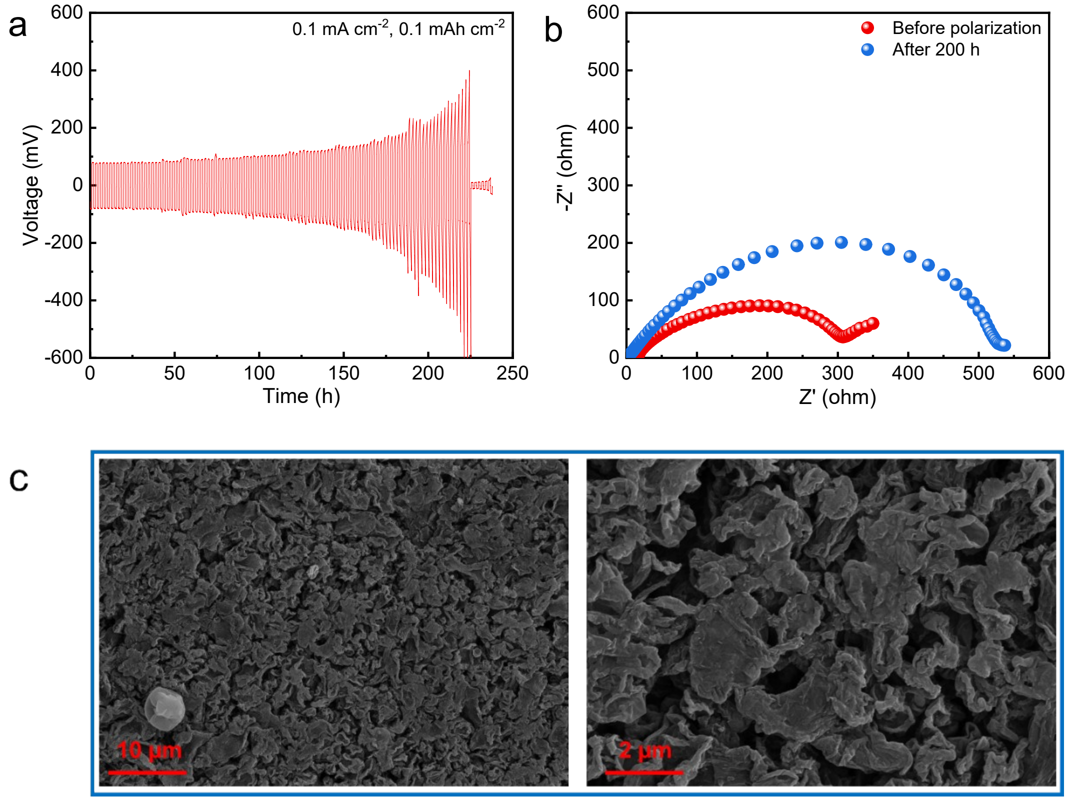

Fig. S4. (a) Galvanostatic Li plating/stripping profiles of Li symmetric cell with AG/PEO mixture electrolyte at room temperature (0.1 mAh cm^{-1}); (b) Alternating current impedance profiles of Li symmetric cell with AG/PEO mixture electrolyte at different cycles; (c) SEM images of the Li anode from Li symmetric cell with AG/PEO mixture electrolyte operating for 240 h at a current density of 0.1 mAh cm^{-1}.

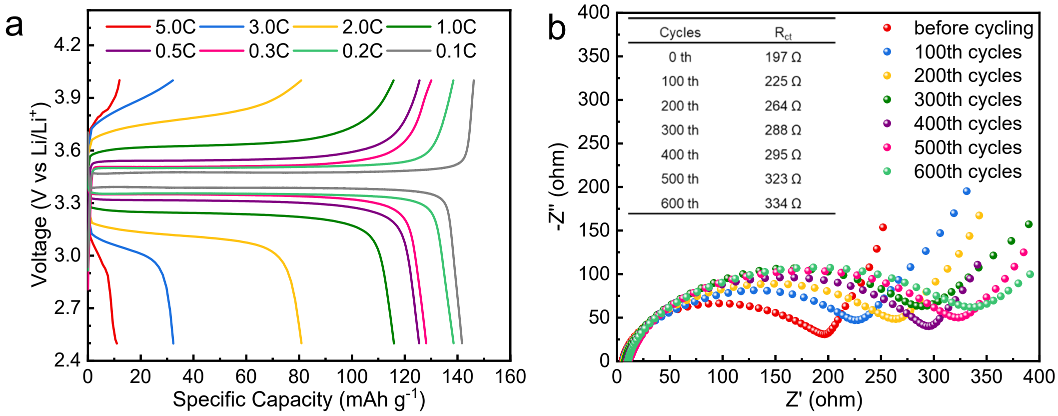

Fig. S5. (a) Voltage profiles of Li||LFP cell with 72 μm-thick UTPE at different charging/discharging rates at room temperature (2.5-4.0 V); (b) Electrochemical impedance spectra of LFP||Li cell with 72 μm-thick UTPE after different cycles.

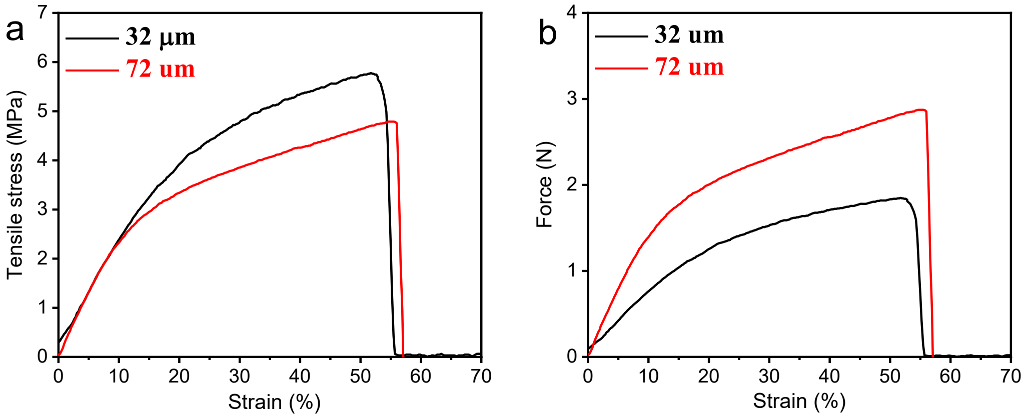

Fig. S6. (a) Stress-strain curves of 32 μm-thick and 72 μm-thick UTPE (b) Force-strain curves of 32 μm-thick and 72 μm-thick UTPE.

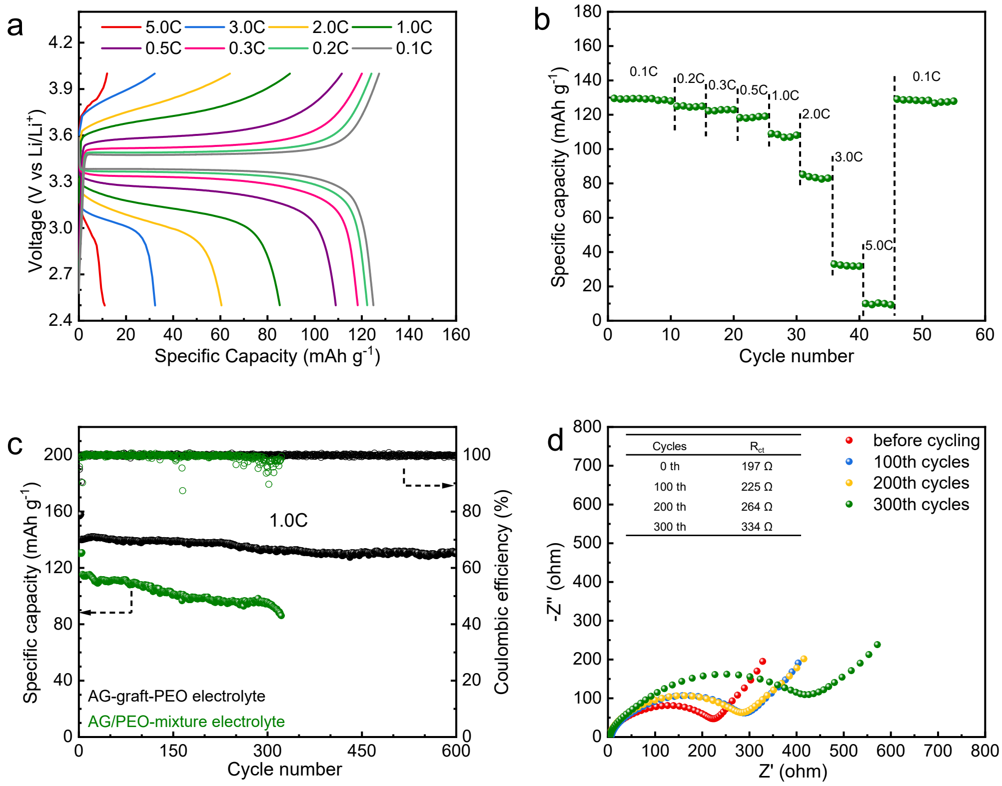

Fig. S7. (a) Rate performance of Li||LFP cells with 32 μm-thick AG/PEO/LiTFSI mixture electrolyte at room temperature; (b) Voltage profiles of Li||LFP cell with 32 μm-thick AG/PEO/LiTFSI mixture electrolyte at different charging/discharging rates at room temperature (2.5-4.0 V); (c) Discharge specific capacity and Coulombic efficiency of Li||LFP cells with AG-grafted-PEO and AG/PEO/LiTFSI mixture ultra-thin electrolytes at room temperature (1.0 C); (d) Electrochemical impedance spectra of LFP||Li cell with 32 μm-thick AG/PEO/LiTFSI mixture electrolyte after different cycles.

Table S1. The electrochemical performance of Li batteries using different solid electrolytes.

Composition	Thickness (μm)	RT ionic conductivity (S cm^{-1})	Electrochemical performance in LFP‖Li cell at RT	Reference
AG-graft-PEO electrolyte	32	1.2×10^{-4}	131 mA h g^{-1} (1.0 C, 600 cycles)	This work
Crosslinked-PEGDE on cellulose	30	8.9×10^{-5}	95 mA h g^{-1} (0.1 C, 100 cycles)	[1]
PEO electrolyte on PE separator	7.5	3.7×10^{-5}	108 mA h g^{-1} (0.1 C, 50 cycles)	[2]
PEO electrolyte on PI film	8.5	2.3×10^{-4}	100 mA h g^{-1} (0.5 C, 60 cycles)	[3]
LLZTO/PTEE/SN electrolyte	100	1.2×10^{-4}	135 mA h g^{-1} (0.2 C, 200 cycles)	[4]
LPS/PEG-Ti electrolyte	20	1.6×10^{-4}	103 mA h g^{-1} (0.05 C, 8 cycles)	[5]
Crosslinked IL-PVDF electrolyte	32	8.8×10^{-4}	129 mA h g^{-1} (1.0 C, 200 cycles)	[6]

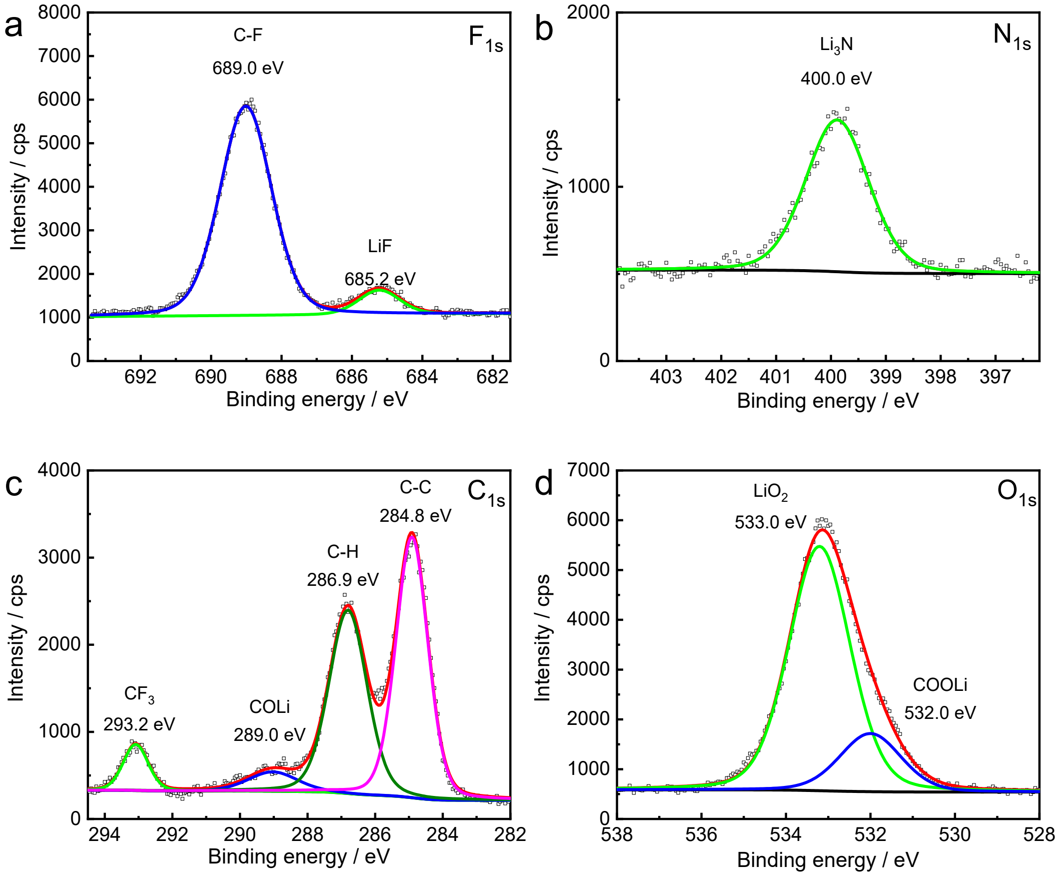

Fig. S8. XPS spectra of Li anode in LFP||Li cell with 32 μm-thick UTPE after 600th cycles: (a)F1s; (b)N1s; (c)C1s; (d) O1s

References

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