A capsule-type gelled polymer electrolyte for rechargeable lithium batteries

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Differential scanning calorimetry (DSC) measurements were performed on a calorimeter (DSC Q10, PerkinElmer, USA) at 5 °C min^{-1} under a nitrogen atmosphere. The crystallinity (X_c) was calculated using Eq. (1) and the melting enthalpy (ΔH_f) obtained from the DSC curves:

$$X_c = \frac{\Delta H_f}{\Delta H_{100}} \times 100\% \qquad (1)$$

where ΔH_{100} is the crystalline melting enthalpy of perfectly crystalline PVDF (104.7 J g^{-1}).[S1]

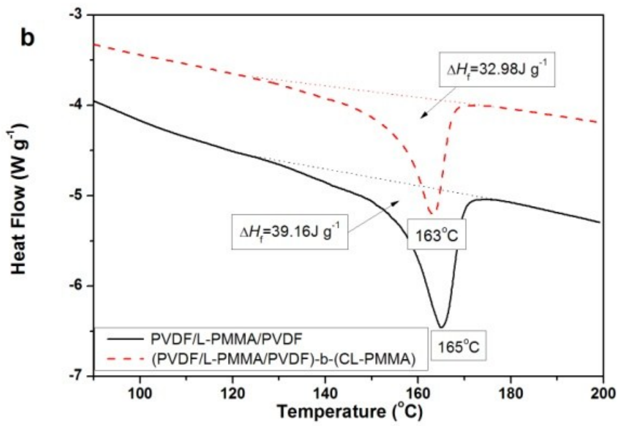

Figure S1. DSC curves of the trilayer and blended fibrous membranes.

The mechanical properties of the fibrous membranes were investigated using a tensile tester (RG2000-100, Shenzhen Reger Instruments Co., Ltd., China) with rectangular specimens (length: 100 mm; width: 10 mm; thickness: ~30 μm). All tests were performed at 28 ^{o}C with a speed of 1 mm min^{-1}.

Figure S2 presents the relationship of the breaking elongation and tensile strength of the membranes. It is found that the elongation at break and the maximum stress are 72.6%, and 6.4 MPa for the trilayer fibrous membrane, respectively. The corresponding values are 81.4% and 8.4 MPa for the blended fibrous membrane. It is clear the mechanical performance of the blended fibrous membrane was improved.

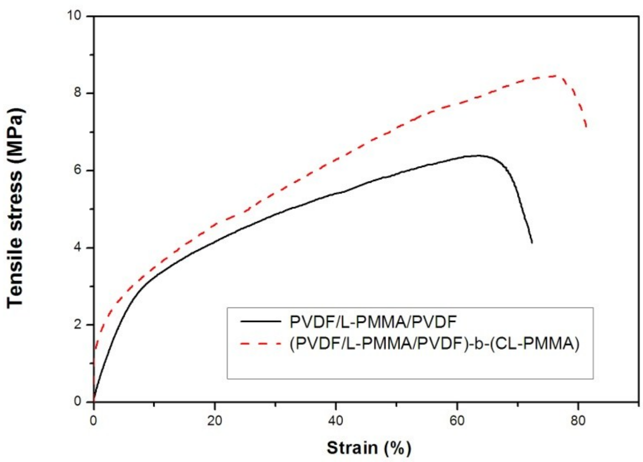

Figure S2. Stress-strain curves of the fibrous membranes

Table S1. Comparison of ionic conductivity, rate capability and cyclability of the various ionic liquid-based polymer electrolyte

Membrane	Electrolyte component	Electrolyte uptake (%)	Ionic conductivity (S cm^{-1})	Rate capability (Discharge capacity at various rates) (mAh g^{-1})	Cyclability (Capacity retention after n cycles) (%)	Ref.
PAN/PMMA fibers	1M LiTFSI in $PYR_{14}TFSI$+PEGDME	480%	3.6×10^{-3}	139 (0.1C) 134 (0.2C) 120 (0.5C) 101 (1C)	92% (0.2 C, 50 cycles)	S2
P(VdF-HFP) fibers	0.5 M LiTFSI in BMITFSI	750%	2.3×10^{-3}	149 (0.1C) 132 (0.5C)	No data	S3
P(VdF-co-HFP) fibers	1 M LiTFSI in EMImTFSI	700%	4.5×10^{-3}	140 (0.1C)	95% (0.1 C, 25 cycles)	S4
P(VdF-HFP) fibers	0.5M LiTFSI in EMITFSI	No data	9.9×10^{-3}	164 (0.1C)	98.6% (0.1 C, 50 cycles)	S5
$BaTiO_3$/P(VdF-HFP) ibers	0.5 M LiTFSI in BMITFSI	750%	5.2×10^{-3}	165.8 (0.1C)	98.6% (0.1 C, 20 cycles)	S6
P(VdF-HFP) fibers	1M LiTFSI in $PY_{14}TFSI$	No data	$<1.0\times 10^{-3}$	143 (0.1C) 115 (1C)	92% (0.1 C, 55 cycles)	S7
PVDF-HFP fibers	PMIMTFSI/LiTFSI	No data	1.2×10^{-3}	151.6 (0.1 C)	96.2% (0.1 C,50 cycles)	S8
SiO_2/PVDF-HFP fibers	0.5 M LiTFSI in BMITFSI	400%	4.3×10^{-3}	169 (0.1 C)	94.4% (0.1 C,80 cycles)	S9
CL-PMMA blended PVDF/L-PMMA/PVDF fibers	0.8M LiTFSI in EMITFSI	296%	1.18×10^{-3}	151 (0.1C) 138(0.2C) 124 (0.5C) 110 (1C) 102 (2C)	97% (0.1C, 50 cycles)	This work

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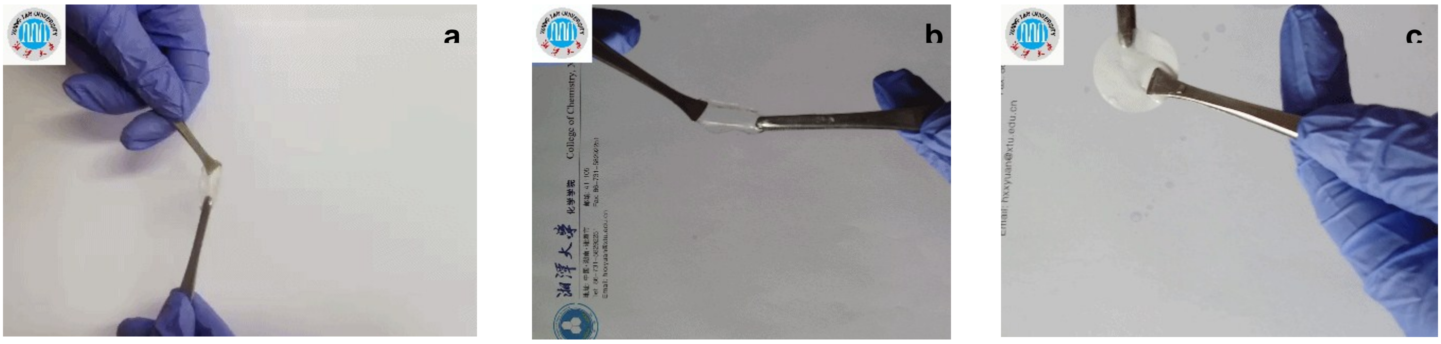

Gif. format images of the CGPE (a), TGPE (b) and Celgard porous membrane after soaked in the LiTFSI/EMITFSI electrolyte (c) during streched.

From the images, we can see that during stretched, the CGPE membrane appeared elastic, i.e. it was elongated without rupture; while the TGPE membrane was broken. Obviously, the Celgard porous membrane showed poor wetting capability when it was immersed in the electrolyte of LiTFSI/EMITFSI in spite of good mechanical strength.