Supporting Information

Nanostructured block copolymer single-ion conductors for low-temperature, high-voltage and fast charging lithium-metal batteries

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Supporting Experimental Information

The lithium concentration (C_{Li}, meq Li^+ per g of electrolyte) in the dried ionomer films was obtained determined from both ^{19}F NMR spectra and acid-base titration of the ionomers in their acidic form as described elsewhere[1]. The molecular mass (Mw, Mn) and polydispersity index (Ip) were determined by size exclusion chromatography coupled multi-angle laser light scattering (SEC-MALLS) with differential refractometer SOPARES RI2000 coupled to a multi-angles light scattering detector WYATT DAWN EOS at 690 nm by using 2xPLgel-Mixed-D as a column. The elution solvent was 0.1 M solution of $NaNO_3$ in dimethylformamide (Alfa Aesar-HPLC grade 99.7%), with flow rate of 1 mL/min. Injection of the sample solution was carried through the polypropylene filter of 0.2 μm.

Table S1. Li concentration and molecular weights of copolymer samples

Sample	**C_{Li} ,** ***(meq. Li^+ g^{-1})*** ***(NMR)***	**C_{Li} ,** ***(meq. Li^+ g^{-1})*** **(titration)**	**M_n** ***(kg mol^{-1})***	**M_w** ***(kg mol^{-1})***	**I_p**
SI05-05	1.02	1.00 ± 0.02	150	396	2.6
SI10-05	1.18	1.15 ± 0.03	165	362	2.2
SI15-05	1.28	1.25 ± 0.04	126	408	3.2

For testing the electrochemical stability window of the electrolytes, linear sweep voltammetry (LSV) was performed with a VMP3 potentiostat (Biologic) at 0.1 mV s^{-1} in two-electrode 2032 coin cells. For the anodic sweep, a platinum (Pt) foil (Ø = 6 mm) was used as working electrode (WE) and a lithium foil (Ø = 12 mm) as combined counter (CE). For the cathodic sweep, a nickel (Ni) foil (Ø = 12 mm) was used as WE and a lithium foil was used as CE.

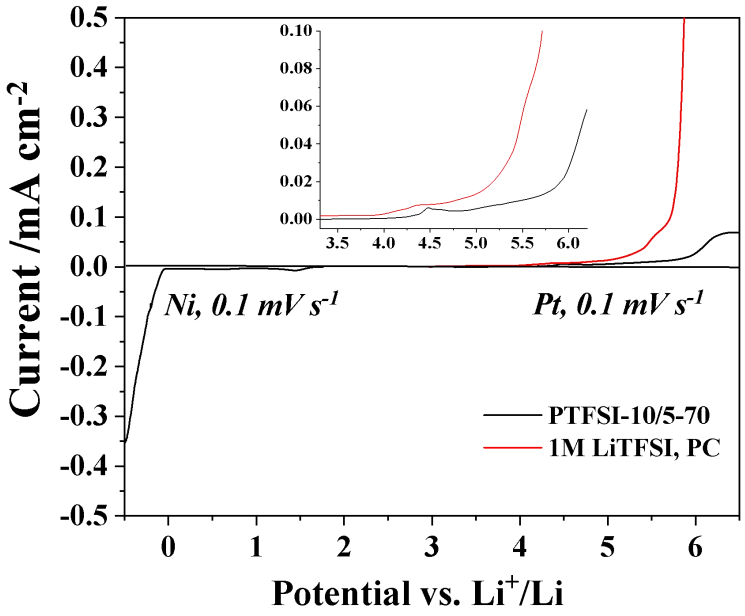

Figure S1. Electrochemical stability window of PTFSI-10/5-70 compared with 1M LiTFSI in PC for the anodic scan; inset: magnification of the onset of the current evolution at elevated potentials.

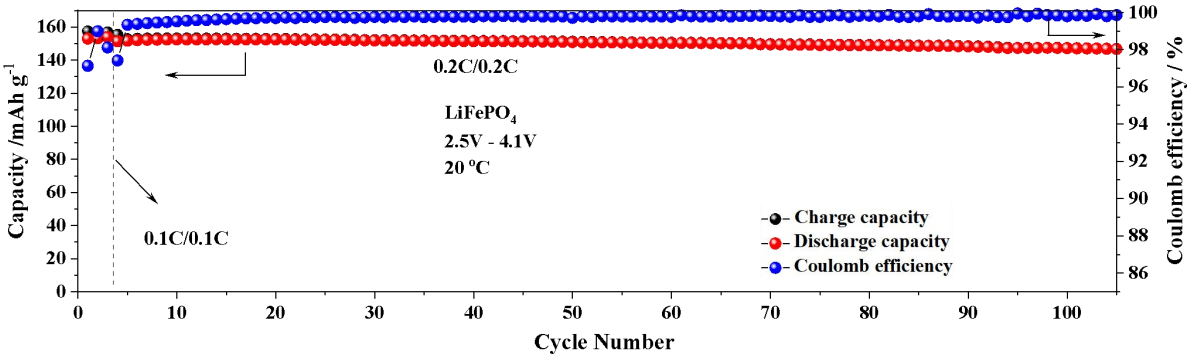

Figure S2. Cycling stability of a Li‖LFP cell at 20 °C with PTFSI-10/5-70 as the electrolyte (cut-off voltages: 2.5 V and 4.1 V).

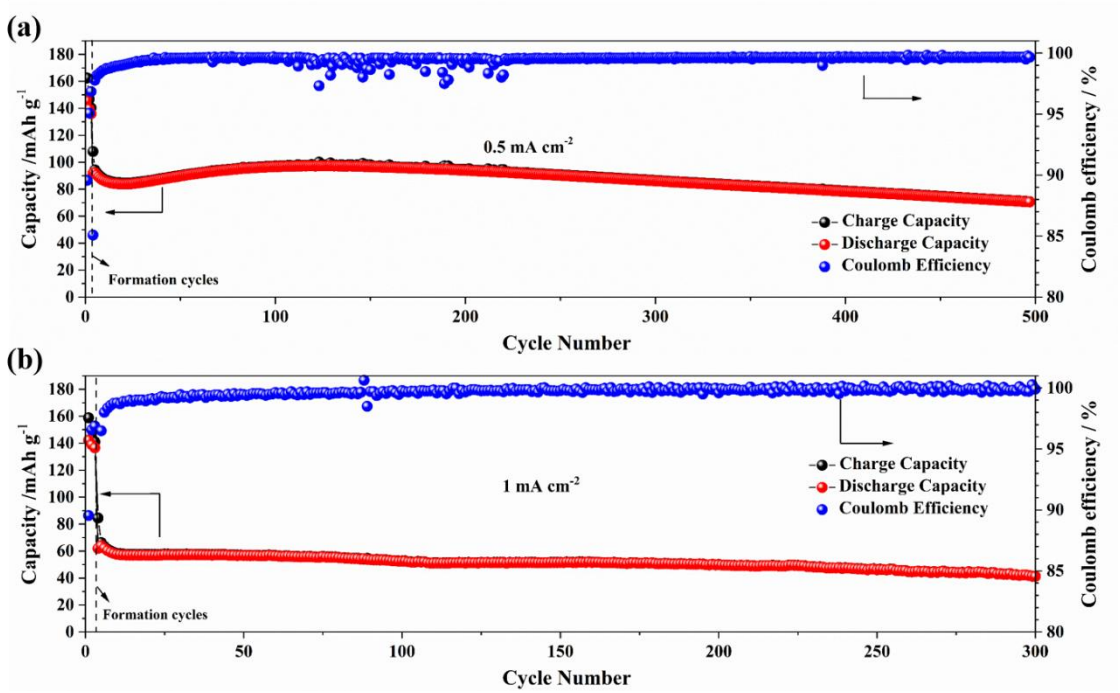

Figure S3. Cycling stability of a Li‖NMC_{111} cells at 20 °C with PTFSI-10/5-70 as the electrolyte (cut-off voltages: 2.8 V and 4.2 V).

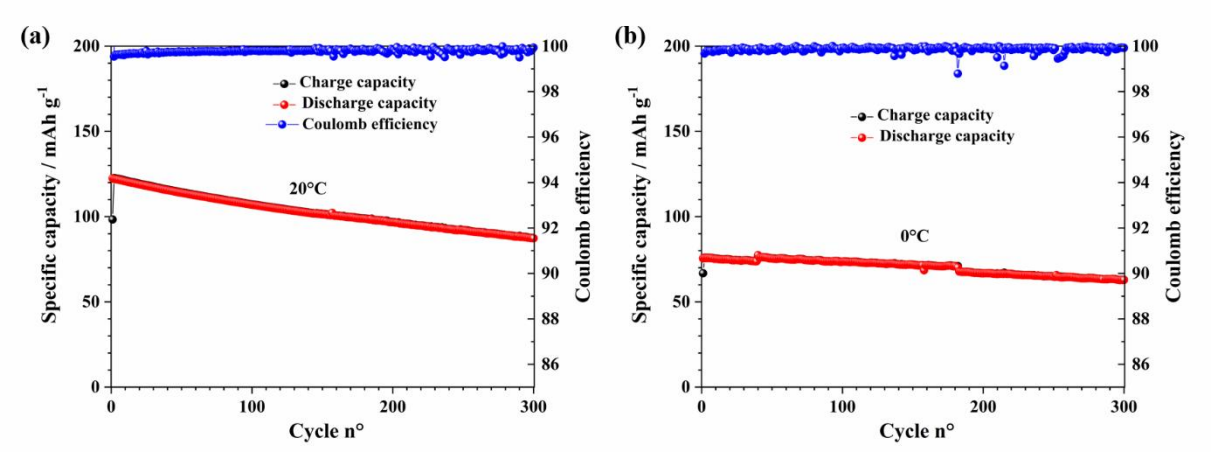

Figure S4. Cycling stability of Li‖NMC_{622} cells at 0.5C after the rate capability tests at (a) 20 °C and (b) 0 °C (cut-off voltages: 2.8 V and 4.2 V).

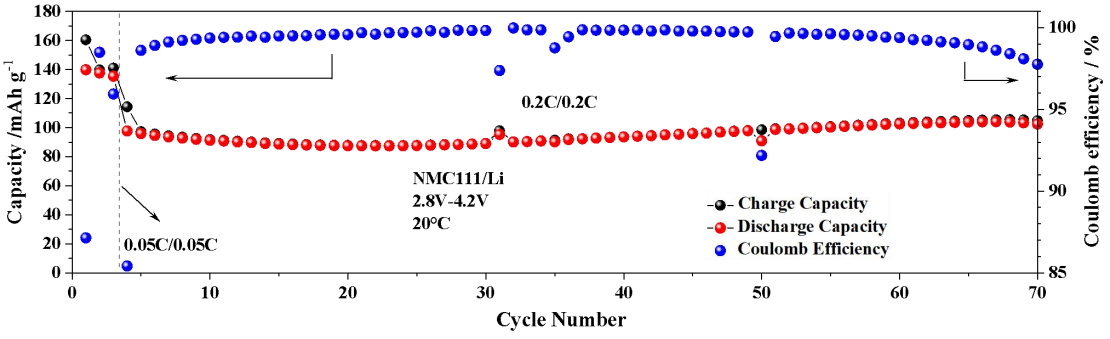

Figure S5. Cycling stability of a Li‖NMC_{111} cell at 20 °C using PTFSI-10/5 with 70 wt% adiponitrile as the electrolyte (cut-off voltages: 2.8 V and 4.2 V).

Bibliography

1. L. Assumma, C. Iojoiu, R. Mercier, S. Lyonnard, H. D. Nguyen and E. Planes, J. Polym. *Sci Part Polym Chem* 2015;53:1941-56.