

Supporting Information

Improving the stability of an organic battery with ionic liquid-based polymer electrolyte

*Jae-Kwang Kim,^{*a} Aleksandar Matic,^a Jou-Hyoun Ahn,^b and Per Jacobsson^{*a}*

^a *Department of Applied Physics, Chalmers University of Technology, 412 96 Göteborg, Sweden.*

^b *Department of Chemical & Biological Engineering and Engineering Research Institute, Gyeongsang National University, 900, Gajwa-dong, Jinju 660-701, Korea*

* Corresponding author: jaekwang@chalmers.se (J.-K. Kim), pjacob@chalmers.se (P. Jacobsson)

Experimental

Preparation of electrospun polymer membrane

The fibrous membrane of poly(vinylidene fluoride-co-hexafluoropropylene) {P(VdF-HFP)} was prepared by electrospinning method at room temperature. P(VdF-HFP) (Kynar Flex 2801, $M_w = 4.77 \times 10^5$, Elf Atochem) was vacuum dried at 60 °C before use. The solvents, acetone and N,N-dimethylacetamide (DMAc) (HPLC grades, Aldrich), were used as received. P(VdF-HFP) solution of 17 wt.% in acetone/DMAc (7:3 wt. ratio) was fed through a capillary using a syringe pump (KD scientific, model 210) and an electric voltage of 18 kV was applied to the capillary with a power supply. A thin aluminum foil fixed on to a grounded stainless steel, drum-shaped current collector rotating at 120 rpm, was used to collect the charged polymer in the form of a membrane. The electrospun membrane was vacuum dried at 60 °C for 12 h before further use.

Evaluation of electrochemical properties

To prepare the PTMA cathode, PTMA powders, Super-P carbon black (Alfa) and poly(vinylidene fluoride) (PVdF, Aldrich) binder, with the weight ratio 50:40:10, were mixed with *N*-methyl-2-pyrrolidinone (NMP, Aldrich). The viscous slurry obtained was cast on aluminum foil and dried at 70 °C for 12h under vacuum. The resulting film was cut into circular discs of area 0.95 cm² and mass ~2.0 mg to use as cathodes. For evaluation of electrochemical properties, two-electrode 2035-coin cells were assembled with a lithium metal anode. Electrochemical performance tests were carried out in an automatic galvanostatic charge-discharge unit, Invium-n-stat battery cycler, between 3.0 and 4.0 V at room temperature. The experiments were carried out at different current density rates from 1 (0.12 mA cm⁻²) to 10 (1.2 mA cm⁻²) C-rate.

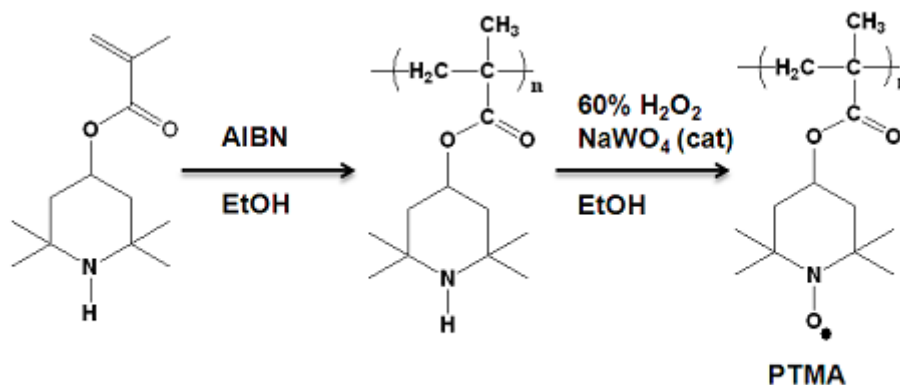


Fig. S1. Synthesis process of PTMA

PTMA was synthesized by the radical polymerization method. The synthesis steps followed are shown in Figure S1 and described in a previous study.¹ 2,2,6,6-tetramethylpiperidine methacrylate monomer was polymerized by first using 2,2'-azobisisobutyronitrile radical initiator and then oxidizing with H₂O₂ in the presence of NaWO₄ catalyst to obtain PTMA. Purity >95% (TLC), T_g ~76 °C, in 90% yield. ¹H-NMR (400 MHz, CDCl₃): H a : 1.18, H b : 1.20, H c : 1.87, H d : 5.23, H e : 5.98, H f : 5.61, H g : 1.87; IR (KBr) (cm⁻¹): 2983 (s), 2941 (s), 2368, 1728 (vs), 1471, 1366, 1172 (s), 1006, 981.

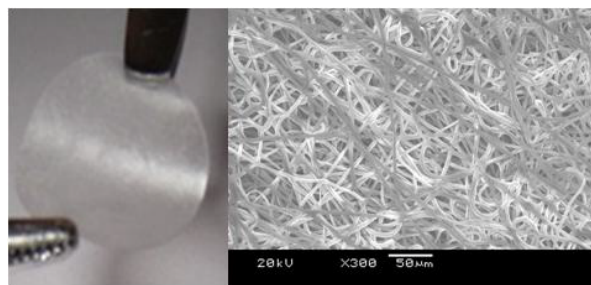


Fig. S2. Photograph of the 1M LiTFSI-Py₁₄TFSI based polymer electrolyte and SEM of electrospun P(VdF-HFP) matrix.

References

- (1) J.-K. Kim, G. Cheruvally, J.-W. Choi, J.-H. Ahn, S.-H. Lee, D.-S. Choi, and C.-E. Song, *Solid State Ionics*, 2007, **178**, 1546.