Appendix A. Supplementary data

Table 1. The Comparison of performances of GPEs obtained by different preparation processes.

Preparation Process	GPE composition (polymer/electrolyte)	Ionic conductivity S/cm	Electrochemical stability window	Li/LFP cell capacity(1st, mAhg^{-1})	ref
Immersion method	PVDF-HFP/ lg_{13}TFSI-LiTFSI	3.16×10^{-4}	5.3 V (vs. Li/Li+)	142(0.1C)	31
Solution casting method	PVDF-HFP/ PYR_{14}TFSI-LiTFSI	4×10^{-4}	5V (vs. Li/Li^{+})	123(0.1C)	32
Initiate polymerization	PVDF-HFP/ lg_{13}TFSI	1.17×10^{-4}	5.1 V (vs. Li/Li^{+})	140(0.1C)	33
Situ polymerization	(BEMA-PEGMA) /PY_{1201}TFSI	10^{-3}	4.5 V (vs. Li/Li^{+})	85(0.1C)	34

Table 1 reports the performance of different GPEs prepared by different preparation processes. In general, all GPEs have wide electrochemical stability window (ESW), The electrochemical stability window of the first three GPEs exceed 5V which is high enough for the GPE to be combined with most cathode material in lithium batteries. And most of the Li/LFP battery which used GPE owns a high initial discharge capacity. In addition, polymer electrolytes based on ionic liquids offer high ionic conductivity (with a range of 10^{-4} to10^{-3} S/cm at 25 ℃), which usually higher than solid polymer electrolyte(SPE). However, there is still room for the improvement of ionic conductivity of GPEs.

In this work we obtained micro-porous polymer membrane by adopting solvent casting method, in which hairy micro-porouses serve as rapid migration channels to Li^{+} and thus providing high ionic conductivity.

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