Li^+ transport properties in poly(oxetane) electrolytes having nitrile groups

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Polymer electrolytes (PEs) have attracted much attention as more safety material to conventional liquid electrolytes in the lithium ion secondary batteries (LIBs). We prepared two-type poly(oxetane) derivatives having nitrile groups and used as a matrix polymer for PEs.

Poly(3-(2-cyanoethoxymethyl)-3-ethyloxetane), PCEO and poly(3-(2-cyanoethoxymethyl)-oxetane), PCHO were synthesized as shown in Fig. 1. Lithium bis(trifluoromethane sulfonyl)amide, LiTFSA and polymers dissolved into tetrahydrofuran and the PEs were prepared by casting of the solution. The resulted PEs are described as $PCEO_aLiTFSA$ and $PCHO_aLiTFSA$ respectively (a= repeating unit/ LiTFSA (40, 30, 20, 10, 5, and 3)).

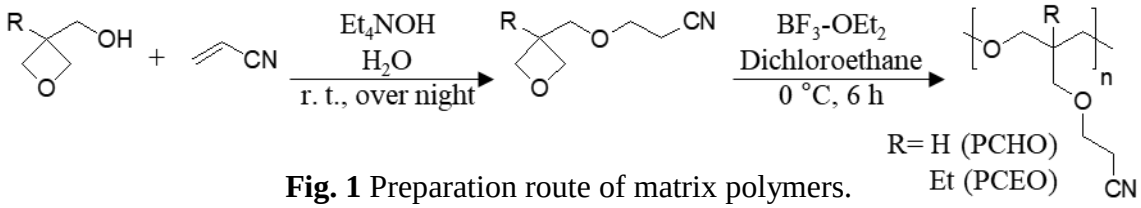

Fig. 1 Preparation route of matrix polymers.

Fig. 2(a) shows salt concentration dependence of glass transition temperature (T_g) for the PEs. Typical polyether, PEO-based electrolytes show elevation of T_g with increase in salt concentration with formation of pseudo cross-link of polymer chains through Li^+. The PCHO-based PEs showed similar behavior of PEO-based PEs. The PCEO-based PEs did not show such behavior. This is a reason of higher conductivity for the PCEO-based PEs with high salt concentration than that for PCHO-based electrolytes as shown in Fig. 2(b). The other properties and performance of the two-type PEs were also compared by using Raman spectroscopy, transference number measurements, and electrochemical techniques.

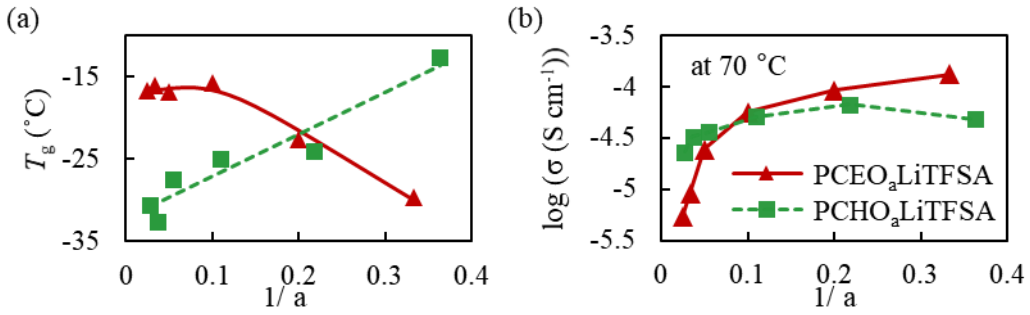

Fig. 2 Salt concentration dependence of (a) T_g and (b) σ of PEs.

References:

[1] R. Sai, K. Ueno, K. Fujii, Y. Nakano, N. Shigaki and H. Tsutsumi, Phys. Chem. Chem. Phys. 19 (2017) 5185-5194.

[2] R. Sai, K. Ueno, K. Fujii, Y. Nakano, H. Tsutsumi, RSC Adv. 7 (2017) 37975-37982.