Exceptionally stable polymer electrolyte for a lithium battery based on cross-linking by a residue-free process

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Highlights

- Synthesis of cross-linked copolymers of glycidyl methacrylate (GMA) as SPE.
- Synthesis poly (ethylene glycol) methyl methacrylate (PEGMA) as SPE.
- Fabrication of membranes by residue-free eco-friendly process.
- The Young Modulus of the membrane is as high as 1 GPa.
- Cell exhibits a good capacity (151 mAh g\textsuperscript{-1}) at C/6, 97% after 80 cycles.

Abstract

In this paper, we report the synthesis of cross-linked copolymers of glycidyl methacrylate (GMA) and poly (ethylene glycol) methyl methacrylate (PEGMA) for use as solid polymer electrolytes (SPE). The cross-linking is performed with volatile ethylene diamine, thus preventing the accumulation of undesirable precursors in the final membrane. The structure of the cross-linked polymer electrolyte was investigated by \textsuperscript{13}C solid NMR and its physical properties were examined by DSC, TGA and stress-strain tests. The ionic conductivities were determined by AC impedance, which showed that the SPEs have good conductivities (10\textsuperscript{-5} S cm\textsuperscript{-1}) at 80 °C. The highest capacity measured with these polymers was 151 mAh g\textsuperscript{-1} at C/6 and 80 °C for a LFP/SPE/Lithium battery. The retention capacity is high, at 97% after 80 cycles at different rates of cycling. The Young’s modulus of the membranes is as high as 1 GPa. The SEM images showed no evidence of lithium dendrites and no degradation after cycling. Therefore, the polymer is a good candidate for battery operation over a long time. Especially important is the ability of this polymer to prevent growth of dendrites on the Li-metal electrode.

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