Composite Polymer Electrolyte based on Liquid Crystalline Copolymer with High-temperature Stability and Bendability for All-solid-state Lithium-ion Batteries

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In this study, a novel composite polymer electrolyte consist of 8-arm block liquid crystalline copolymer (8-PEG-MALC), 8-arm poly(ethylene glycol) (8-PEG), polyethylene (glycol) diacrylate (PEGDA) and bistrifluoromethanesulfonimide lithium salt (LiTFSI) was prepared successfully. The branching 8-PEG ensure high ionic conductivity of the all solid state polymer, crosslinking agent PEGDA endow good mechanical property, and 8-arm block liquid crystalline copolymer with a birefringent mesogens to tune the morphology of the composite polymer electrolytes. The polymer electrolytes can form a transparent and flexible film with nanoscale microphase separation structure, which creating well-defined ion conducting channels. The electrochemical properties of composite polymer electrolytes are analyzed and the highest ionic conductivity reaches $6.2 \times 10^{-5} \text{ S cm}^{-1}$ at room temperature after annealed from fixed temperature. It also displays high temperature stability up to 150°C , which is higher than traditional electrolytes. More intriguingly, the assembled $\text{LiFePO}_4/\text{Li}$ cells using the composite polymer electrolytes exhibit good charge/discharge cycles at 95°C . The good electrochemical properties, temperature stability and bendability of the composite polymer electrolytes indicate it potentially as a very promising material for all-solid-state flexible lithium ion batteries.

Keywords: self-assemble; composite polymer electrolytes; bendability; lithium-ion batteries

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