Synthesis and characterization of solid polysiloxane electrolyte for energy storage devices

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Developing an all-solid-state lithium ion battery for energy devices is an ideal method to ensure safety. Efforts have been made to find the proper electrolyte for this kind of battery. Among various solid electrolytes, solid polymer electrolyte is most attractive due to its flexibility that can be laminated and produced on a large scale compared to inorganic solid electrolyte[1]. In particular, polysiloxane based electrolytes demonstrate a favorable application prospect in lithium ion batteries[2]. Batteries based on polysiloxane electrolyte have relatively good cycling performance at room temperature and 60 ^{o}C[3]. However, the ionic conductivity of this electrolyte is relatively low, which limits the application of the battery at lower temperatures. In order to improve the ionic conductivity of the electrolyte, a new type of polysiloxane has been developed by a hydrosilylation reaction, consisting of two kinds of side chains. One of them contains R-C-O-R, which provides Li^{+} conducting passages. The other contains a cyclic carbonate group, which promotes lithium salt dissociation. The polysiloxane structure is confirmed by nuclear magnetic resonance and Fourier transform infrared spectroscopy. A thin film of the electrolyte is prepared using the solution casting technique. The effects of different proportions of the two kinds of side chains on the ionic conductivity are studied. Electrochemical stability window, mechanical strength and thermal stability are measured respectively by linear sweep voltammogram, stress-strain tests and differential scanning calorimeter-thermo gravimetric analyzer. Afterwards, the lithium salt content in electrolyte is optimized. The electrolyte having the highest ionic conductivity is selected as a possible candidate for the lithium ion battery.

References

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