A PMMA Gel Polymer Electrolyte for Lithium-sulfur Batteries

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Lithium-sulfur (Li-S) batteries are one of the most promising energy storage devices owing to their high energy density. The theoretical capacity of sulfur is 1675 mAh/g, and the energy density of Li-S batteries is 2600 Wh/kg. But the batteries suffer from fast capacity fading during cycling because of the shuttle effect and the formation of lithium dendrites. These also make the Li-S batteries unsafe to use in reality. Gel polymer electrolytes(GPE) can help improve the performance of Li-S batteries. Usually, gel polymer electrolytes consist of inert polymer and liquid electrolyte. They have relatively high ionic conductivity and safety.

In this work, methyl methacrylate (MMA) and the liquid electrolyte consists of 1 M lithiumbis (trifluoromethane sulfonimide) (LiTFSI) in a 1,3-dioxolane (DOL) and 1,2-dimethoxyethane (DME) solution (1:1 ratio in volume) were mixed before used. The mixture were heated to form the gel polymer electrolyte samples. The ionic conductivity decreases with the increasing content of PMMA. It is 10^{-3} S/cm with 40% PMMA in the GPE. The tests of ionic conductivity at different temperatures indicate that the ionic conductivity increases with the elevation of temperature. According to the relationship between ionic conductivity and temperature, the activation energy of different samples increases with the increasing content of PMMA. It indicates that PMMA affects the ionization of the electrolyte.

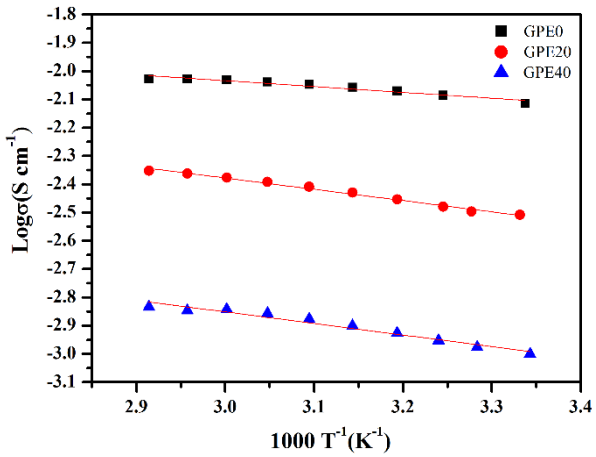

Figure 1 Dependence of conductivity on the reciprocal of temperature for the gel electrolyte

References:

[1] Peramunage D, Licht S. Science, 1993, 261(5124): 1029.
[2] Jeon B H, Yeon J H, Kim K M, et al. Journal of Power Sources, 2002,109: 89.