

Characteristics of Li/S Battery Using PVdF Polymer Electrolytes with Controlled Micropores

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In recent years, there has been an increasing demand for rechargeable batteries with high specific energy for electronic applications, such as cellular phone, notebook computer and camcorder. The lithium-sulfur battery has many attractive properties. It has a theoretical specific capacity of 1675 mAh/g of sulfur and a theoretical specific energy of 2600 Wh/kg. The lithium-sulfur battery can also be cost-effective and environmentally benign due to the active material, sulfur. The lithium-sulfur battery system has been intensively studied and developed to increase the specific capacity and cycling efficiency, but the rapid capacity fade with the repeated charge-discharge process gives rise to a serious problem at the moment.

In this work microporous polymer electrolytes have been prepared by soaking the microporous films in liquid electrolytes and applied to the lithium/sulfur secondary cell. Microporous P(VdF-co-HFP) membranes were prepared by phase inversion method. Their porous structure was controlled by extracting NMP with a mixture of water and methanol. Porous structure of the membranes was observed to be different with SEM. Ionic conductivity of the polymer electrolytes was measured by impedance and was found to be as high as 10^{-3} S/cm. The microporous polymer electrolyte optimized in this work displayed a uniform pore size, high ionic conductivity, low interfacial resistance(Fig.1), and no change of the ionic conductivity with storage time(Fig.2).

Lithium/sulfur cells composed of lithium anode and sulfur cathode were assembled and their electrochemical performances were evaluated. The capacity fade during charge-discharge at room temperature was occurred, and the polysulfides, the reduction products of sulfur, were observed to diffuse out to the polymer electrolyte. The color of polymer electrolyte changed to dark brown and was directly observed using a digital camera. The size of polymer electrolyte was therefore reduced to decrease the problems associated with diffusing out to the electrolyte phase, and the lithium/sulfur cell with polymer electrolyte of smaller size showed better cycling efficiency.

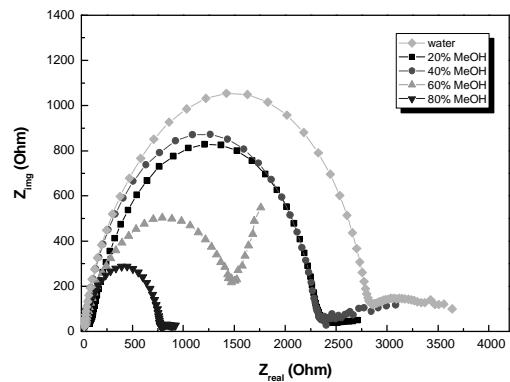


Fig.1. Nyquist plots for interfacial resistance between lithium and polymer electrolyte

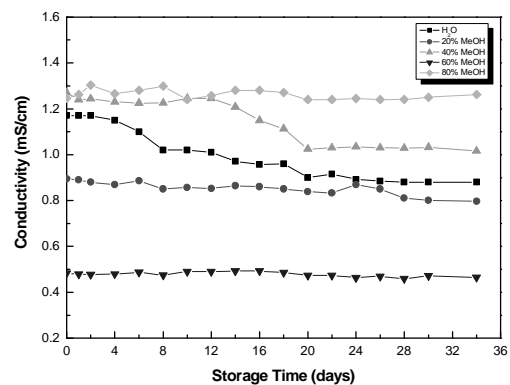


Fig.2. Ionic conductivity of polymer electrolyte with storage time

References

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