

3D Network Polymer Blend Gel Electrolyte consist of PEO-LiX Complex and PS

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Electrolytes for lithium secondary battery have been studied. Good electrolytes can be obtained by means of current techniques, however, cost performance would be one of the most important issues. So electrolytes with low-cost materials and easy processes are required. We have proposed hot blending method to obtain the novel polymer matrix of gel electrolytes. The polymer matrix containing two kinds of polymers with different characteristics, PEO (Polyethylene Oxide) and PS (Polystyrene), were prepared and confirmed to have both ionic conduction and mechanical property.^[1,2,3] This gel polymer electrolyte has a good mechanical strength, while there are some possibility to loose the PEO phase with plasticizer from the PS matrix.

There are some reports on that PEO and lithium salt (LiX) forms a complex when LiX is added to PEO. The complex keeps high viscosity in spite of impregnation with plasticizer and improves lithium anode performance.^[4]

In this work, we made PEO-LiX-PS blend (PEO : PS = 48 : 52 by wt., O : Li = 6 : 1 by mol.) to apply PEO-LiX complex to the polymer blend gel electrolyte. PEO, LiBF₄ and PS were blended in the adequate condition to obtain a polymer matrix with PS phase and PEO-LiX complex phase. The blend was quenched in the liquid nitrogen and hot-pressed to form the film. The resultant film was impregnated with the plasticizer.

Ionic conductivity as a function of the concentration of the supporting electrolyte in the plasticizer was measured with ac impedance method. Ionic conductivity of PEO-LiBF₄-PS film was compared with that of PEO-PS film. Ionic conductivity of PEO-LiBF₄-PS film was wholly higher than that of PEO-PS film. Besides, the concentration of the supporting electrolyte with maximum ionic conductivity of PEO-LiBF₄-PS film was smaller than that of PEO-PS film.

Constant current charge-discharge test was acted to check on the lithium plating / stripping reaction and lithium-ion transportation in the bulk of the gel electrolyte. It showed constant cell voltage when constant current was applied. This result indicated that this new polymer gel electrolyte performed as an electrolyte for lithium metal battery.

References

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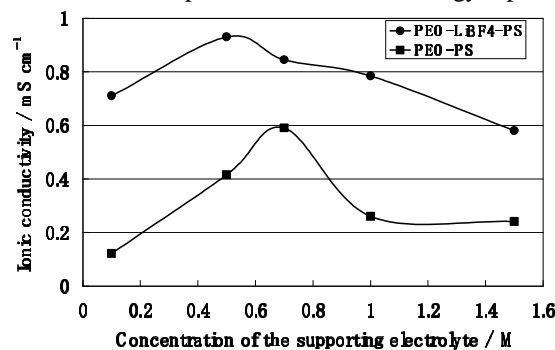


Fig. 1 Room temperature ionic conductivity of the polymer blend gel electrolyte as a function of the concentration of the supporting electrolyte in plasticizer. Plasticizer content is 50 wt%.

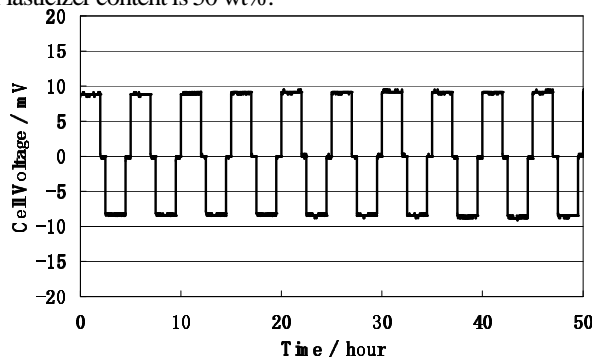


Fig. 2 Constant current charge-discharge test of Li / PEO-LiBF₄-PS gel / Li cell at 0.5 mA cm⁻². Plasticizer content is 80 wt%.