EFFECT OF ALUMINA FILLER ON SPHERULITE GROWTH AND ON IONIC CONDUCTIVITY OF $PEO_9(LICLO_4)$ AND AL_2O_3 COMPOSITE POLYMER ELECTROLYTE

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INTRODUCTION

Ionically conducting polymer-salt complexes were first described in early 1970's and the importance were quickly recognized, i.e. the potential of a flexible, plastic, ion transporting media, suitable for numerous electrochemical power sources such as rechargeable batteries, fuel cells, solar cells and super capacitors.

Solid polymer electrolytes are solid materials which consist of an ionic salt dissolved in a solid, coordinating polymeric solvent (Bruce 1983). Most of the polymers used as host materials for electrolytes are semi-crystalline polymers. These types of polymers consist of a crystalline phase and an amorphous phase. Increase in conductivity and ionic motion can be observed when the fraction of the crystalline phase decreases. This paper analyzes the effect of alumina filler on the spherulite growth and on the ionic conductivity of the composite polymer electrolyte.

METHODOLOGY

The composite polymer electrolytes were prepared by solvent casting method. The bulk electrical conductivity and morphological structure of the composite polymer electrolytes were determined by a.c. impedance spectroscopy and polarizing microscope respectively.

RESULTS AND DISCUSSION

Ionic Conductivity

For Al_2O_3 (weakly acidic, 5.8 nm pore size), the highest conductivity was obtained for the composition of 15 wt% alumina throughout the temperature range studied. For the system with Al_2O_3 having average grain size <10 microns the 5 wt % Al_2O_3 filler has shown the highest conductivity throughout the temperature range. For the 100 mesh size, α- Al_2O_3 filler the highest conductivity was achieved with addition of 5 wt% of filler.

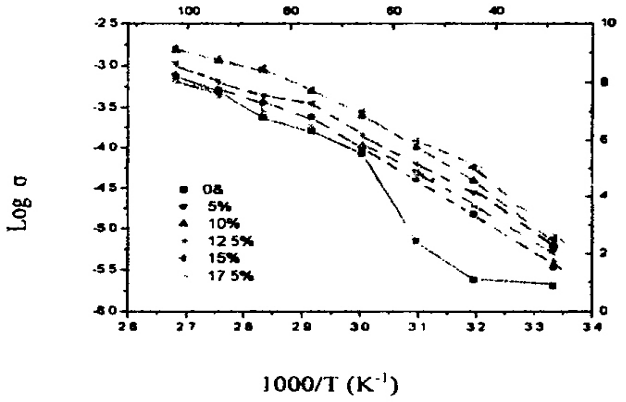


Figure 1

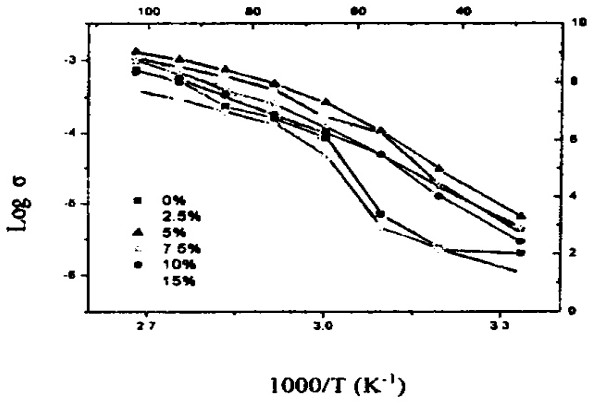


Figure 2

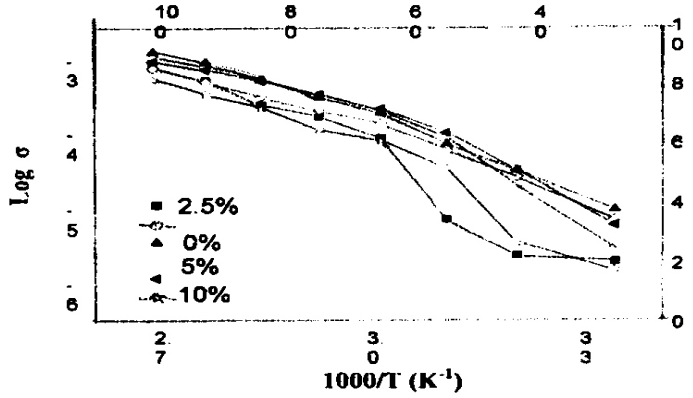


Figure 3

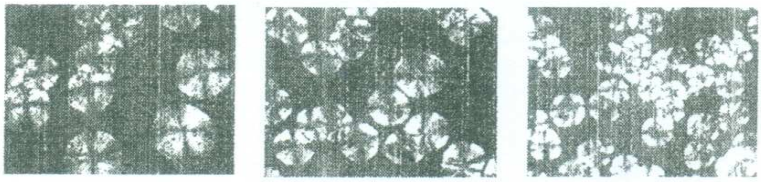
Variation of ionic conductivity with inverse temperature for the composite polymer electrolyte,

Figure 1 - $(PEO)_9LiClO_4+Al_2O_3$ with different wt% of nano-sized weakly acidic Al_2O_3 filler particles,

Figure 2 - $(PEO)_9LiClO_4+Al_2O_3$ with different wt% of Al_2O_3 having average particle size < 10 microns,

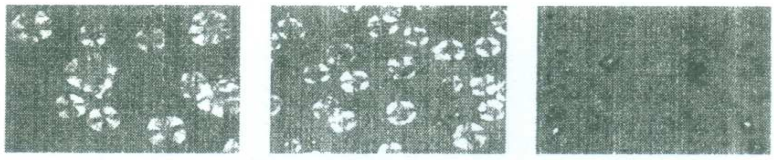
Figure 3 - $(PEO)_9LiClO_4+ Al_2O_3$ with different wt% of α- Al_2O_3 (100 mesh)

Polarization microscopy (POM)



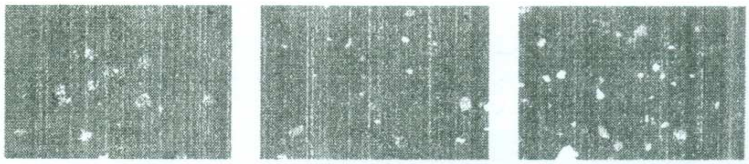
(a) (b) (c)

Figure 4 - POM images of $(PEO)_9LiClO_4$ containing (a) 5 wt% (b) 10 wt% (c) 15 wt% of Al_2O_3 particles having average grain size of <10 μm under the magnification of x600. The scale bar is same for all the images (100 μm)



(a) (b) (c)

Figure 5 - POM images of $(PEO)_9LiClO_4$ containing (a) 5 wt% (b) 10 wt% (c) 15 wt% of weakly acidic Al_2O_3 having pore size of 5.8 nm under the magnification of x600.The scale bar is same for all the images (100 μm)



(a) (b) (c)

Figure 6 - POM images of $(PEO)_9LiClO_4$ containing (a) 5 wt% (b) 10 wt% (c) 15 wt% of α-Al_2O_3 (100 mesh) under the magnification of x600. The scale bar is same for all the images (100 μm)

CONCLUSION

The highest conductivity was obtained for the system with 5 wt% of α- Al_2O_3 (100 mesh) out of all the systems studied in this work using three different particle sizes of the filler. It is clear with the results obtained from POM that when the concentration of the filler particles increases, the number of the