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Transport, dielectric and thermal properties of nano-composite polymer electrolytes PEO-LiCF3SO3-Al2O3 and PEO-Li(CF3SO2)2N-Al2O3

Poly(ethylene) oxide PEO, complexed with lithium trifluoromethenesulfonate (LiCF3SO3 or LiTf) or lithium(bis)trifluoromethanesulfonate imide (Li(CF3SO2)2N or LiTFSI) are among the most widely studied solid polymer electrolyte materials. However, their ionic conductivities need to be enhanced in order to use them in practical polymer electrolyte based batteries. In the present work, ionic conductivity and dielectric and thermal measurements have been performed on two nano-composite polymer electrolyte systems, (PEO)9LiCF3SO3+10 wt% Al2O3 and (PEO)9LiTFSI+10 wt% Al2O3 incorporating Al2O3 powder of pore size 5.8 nm and neutral surface groups. It is observed that in both these systems, the conductivity enhances substantially due to the Al2O3 filler. At 40 oC, the ionic conductivity of (PEO)9LiTf increases from 1.35x10-5 S cm-1 to 4.41x10-5 S cm-1 while the ionic conductivity of (PEO)9 LiTFSI increases from 3.27x10-^{5} S cm-^{1} to 1.21x10-4 S cm-1 due to the addition of 10 wt% of Al2O3. DSC measurements of the (PEO)9LiTf system with and without alumina filler did not show a distinct glass transition but exhibited the PEO melting temperature around 60 oC. In contrast, the (PEO)9LiTFSI system showed the glass transition temperature around - 41.7 ^{o} C even after the addition of the filler. This polymer electrolyte, with and without the filler particles, did not exhibit the PEO melting transition around 60 oC. This is consistent with the presence of a crystalinity gap in the phase diagram around PEO. LiTFSI = 9:1 as reported in the literature. The dominant dielectric relaxation peak in the _" vs frequency spectrum of both these polymer electrolyte systems has been assigned to ion pair relaxations. Both polymer electrolyte systems exhibit an increase of *fm* due to the addition of the alumina filler. As the ion pair relaxation frequency can be taken as a measure of the ionic mobility, these results suggest that the conductivity enhancement result from the increase in ionic mobility in both these nano-composite polymer electrolytes.