THE EFFECT OF ZIRCONIA (ZrO_2) NANO FILLERS ON THE IONIC CONDUCTIVITY OF PEO: $LiClO_4$ POLYMER ELECTROLYTES

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The development of novel solid state lithium ion conducting polymer electrolytes are needed for many electrochemical applications such as high energy density lithium batteries, fuel cells, smart windows, electrochromic displays and other electrochemical devices. In this work, a novel PEO-based, Li+ ion conducting composite polymer electrolyte has been prepared by the solvent casting method, incorporating nano-sized (20-30 nm) Zirconia (ZrO_2) as the filler. The O:Li ratio of the PEO_8LiClO_4 complex was maintained at 8:1 and the ZrO_2 filler concentration was varied from 5 to 20 wt %. Ionic conductivity of the nano-composite polymer electrolyte films was determined as a function of temperature from 25 ^{0}C to 100 ^{0}C by AC impedance spectroscopy. Differential Scanning Calorimeter (DSC) measurements were used to obtain the glass transition temperature, T_g, of the electrolyte samples.

The results showed that the addition of ZrO_2 in various compositions enhanced the ionic conductivity of the polymer electrolyte over the entire temperature range studied. Among various compositions studied, the composition with 15 wt. % of ZrO_2 filler particles showed the maximum conductivity enhancement from room temperature up to 100 ^{0}C. The glass transition temperature decreased from - 43 ^{0}C for the filler free electrolyte to - 49 ^{0}C for the filler-added electrolyte with 15 wt. % of ZrO_2. The decrease of T_g, indicates an increase of flexibility of the PEO chains. Nano-sized ZrO_2 particles can also contribute to the conductivity enhancement through the Lewis acid-base type interactions of mobile ionic species with filler surface groups.

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