Transport studies on nano-composite solid polymer electrolyte for lithium batteries

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The studies on solid polymer electrolytes (SPE) attracted very much due to their flexibility, compact, leak proof, solid state structures, etc. The conventional polymer electrolytes are not suitable for practical applications due to their low conductivity. Attempts were made to improve the conductivity by addition of liquid plasticizer or aprotic solvents and recently, reported that the addition of nano size particles such as TiO_2, SiO_2, Al_2O_3 to the polymer-LiX complex improves the conductivity and mechanical properties of the film[1]. In the present study, our approach is to improve the ionic conductivity of the PEO-LiX based polymer electrolyte by dispersion of synthesized nano size TiO_2 particle and also the addition of low molecular weight PEG to reduce the polymer chain, thus providing conduction path for the migration of lithium ion in the polymer matrix.

The nano-composite solid polymer electrolyte (NCSPE) was prepared through sol - gel process by dispersion of TiO_2 nano particle (TiO_2 nano particle was synthesized by sol - gel process and treated with hexa– methyl– di-silazane (HMDS) to remove the surface hydroxyl groups of TiO_2 powder. The sample were pyrolyzed at various temperatures and characterized by XRD. The grain size of the TiO_2 particle was found to be 6.6nm). The high viscous gel is caste on teflon sheet and dried in vacuum oven for 24h at 60^0C. Transparent films were obtained and kept inside the glove box (Mbruan, Unilab). Impedance measurements were carried out using SI11260 gain-phase analyzer connected with SI1286 electrochemical interface in the frequency range of 3Hz to 1MHz at room temperature as well as at higher temperature. The impedance results showed that the addition of 5%TiO_2 nano-size particle to the polymer matrix improves the conductivity (1.34 x 0^{-4} S/cm) by an order of magnitude at room temperature. The temperature dependence conductivity plot shows the non-Arrhenius ionic behavior. DSC measurements were carried out on the polymer film in the temperature range of -20 to 70^0C and results showed that the conductivity increases with increasing the temperature. The synthesis of TiO_2 powder & NCSPE, transport properties like impedance data, transference number and the conduction mechanism will be presented and discussed.

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