Abstract No: 172 ***Physical Sciences***

INVESTIGATION OF CHARGE TRANSPORT IN POLYETHYLENE OXIDE-BASED IONIC CONDUCTORS

L.B.E. Gunasekara* and T.M.W.J. Bandara

Department of Physics, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
**erangagunasekara8888@gmail.com*

Solid polymer electrolytes are a key component in many electrochemical devices such as dye-sensitized solar cells (DSCs), batteries and supercapacitors. In this study, three electrolytes based on polyethylene oxide (PEO) host polymer, ethylene carbonate (EC) plasticizer and Al_2O_3 filler were investigated. The polymer electrolyte comprised of $(PEO)_9(EC)_9(LiCF_3SO_3)_2(Al_2O_3)_{0.75}$ was synthesized, and characterized by analyzing DC conductivity, frequency dependence of AC conductivity and complex dielectric function. For in-depth analysis of electrolytes, dielectric analysis was used to determine charge carrier density (n), mobility (μ) and diffusion coefficient (D) of the electrolytes. The method of calculating charge transport parameters is further reinforced by making it possible to calculate these parameters simply by using electrochemical impedance analysis. A plasticized and composite electrolyte (PEO + EC + Al_2O_3 + $LiCF_3SO_3$), a composite electrolyte (PEO + Al_2O_3 + $LiCF_3SO_3$) and a plasticized electrolyte (PEO + EC + $LiCF_3SO_3$) were prepared to study the effects of organic solvents and fillers on n, D and μ. The temperature dependence of n, D and μ has also been studied. The total number of Li^+ ions available in polymer electrolytes from the salt was evaluated to check the reliability of the method. According to the calculations, EC can increase ionic conductivity by increasing the number of free mobile ions. Even though polymer electrolyte with Al_2O_3 has low ionic conductivity than that of the plasticized polymer electrolyte, the physical properties improve along with the addition of Al_2O_3. The present study confirms that the plasticizer EC and the filler Al_2O_3 contributed to improve the conductivity by enhancing n and μ. At 28 °C, $(PEO)_9(EC)_9(LiCF_3SO_3)_2(Al_2O_3)_{0.75}$ shows n, D and conductivity of 1.27×10^{27} m^{-3}, 3.8×10^{-11} m^2 s^{-1} and 2.96 mS cm^{-1}, respectively. The values determined for D, μ and n parameters of the three electrolytes are in agreement with those available for similar electrolytes.

Financial assistance from the University of Peradeniya (*Grant No. URG/2019/27IS*) *is acknowledged.*

Keywords: Electrochemical impedance analysis, Gel polymer electrolyte, Solid polymer electrolyte