

IONIC CONDUCTIVITY AND FT-IR STUDY OF TETRAGLYME/KI/FUMED SILICA GEL POLYMER ELECTROLYTE**K.V.L. Amarasinghe¹, V.A. Seneviratne^{2*}, L.R.A.K. Bandara² and M.A.K.L. Dissanayake³**¹*Postgraduate Institute of Science, University of Peradeniya, Sri Lanka*²*Department of Physics, Faculty of Science, University of Peradeniya, Sri Lanka*³*Institute of Fundamental Studies, Kandy, Sri Lanka*

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The Gel Polymer Electrolytes (GPEs) are promising materials for the ever-growing need for high energy density power sources such as lithium ion rechargeable batteries and dye sensitized solar cells. The use of GPE, which carrying both cohesive properties of solid and diffusive properties of liquid, overcomes many practical problems that solid and liquid electrolytes causes. They exhibit high ionic conductivities at room temperature (RT) and good electrode-electrolyte interfacial property than with solid electrolytes, and long term stability than that of liquid electrolytes. Most of the previous research works were focused on GPEs with plasticizers, such as ethylene carbonate (EC) and propylene carbonate (PC), as the gelation agents. The emphasis of this work is on tetraethylene glycol dimethyl ether (tetraglyme), potassium iodide (KI) and fumed silica based GPE system without any plasticizer. The composite GPEs were formed by adding appropriate amount of fumed silica to the liquid electrolytes prepared with different O:I ratio. In this case, the fumed silica was added as a percentage to the total weight of tetraglyme and the salt KI. The maximum ionic conductivity of $3.78 \times 10^{-3} \text{ S cm}^{-1}$ was obtained for the liquid electrolyte with O:I molar ratio 20:1. The ionic conductivities of fumed silica added GPSs with different O:I ratio are also in the order of $\sim 10^{-3} \text{ S cm}^{-1}$ at RT. The highest ionic conductivity of $2.80 \times 10^{-3} \text{ S cm}^{-1}$ at RT was observed for the GPE sample with O:I molar ratio 15:1, incorporated with 10 wt.% fumed silica. However, the gel electrolytes showed slightly reduced ionic conductivity at RT, compared to the liquid electrolytes. This may occur due to the hindrance caused by the silica to the motion of polymer chains. The DC polarization test verified that the prepared electrolytes were predominantly ionic conductors. In this system, the main driving force to form a gel is believed to be the hydrogen bond between silanol groups on adjacent silica molecules or the hydrogen bonds between silanol groups of silica molecules and ether oxygen of tetraglyme molecules. FT-IR studies were carried out to investigate the form of interaction between the K^+ ions with the ether oxygen of tetraglyme. Many vibrational frequency modes have been identified to verify that the addition of the salt changes the conformation of the polymer tetraglyme which leads to changes in the FT-IR spectra of each liquid electrolyte.

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