

## ELECTROCHEMICAL STUDIES ON POLY (ETHYLENE OXIDE) BASED ALUMINUM-ION CONDUCTING GEL-POLYMER ELECTROLYTES

Thenmolie K. <sup>1</sup>, Jathushan V. <sup>2</sup>, Vignarooban K. <sup>3</sup>

<sup>1</sup>*Department of Physics, Faculty of Science, University of Jaffna, Sri Lanka*

<sup>2</sup>*Department of Physical Science, Faculty of Applied Science, Trincomalee  
Campus, Eastern University of Sri Lanka*

**Abstract** - In the last two decades, Li-ion batteries have been developed with high energy and power densities to satisfy the need of electrochemical energy storage for portable electronics as well as automobiles. However, the limited natural resources of lithium raw materials compelled researchers to investigate alternative battery chemistries beyond lithium-ion, such as aluminum-ion batteries (AIBs). In this work, a set of novel gel-polymer electrolytes (GPEs) based on poly ethylene oxide (PEO) host polymer have been synthesized and characterized by electrochemical impedance spectroscopy and DC polarization techniques. Aluminium sulphate ( $\text{Al}_2(\text{SO}_4)_3$ ) is used as the ionic salt to get mobile ions within the polymer matrix. The optimized 8PEO10 $\text{Al}_2(\text{SO}_4)_3$ -40EC-42PC (wt. %) GPE composition showed an ambient temperature ionic conductivity of  $2.54 \times 10^{-4} \text{ S cm}^{-1}$ . Ionic conductivity versus inverse temperature variation showed Arrhenius behavior with almost same activation energies of 0.15 eV for all the compositions studied in this work. DC polarization test on SS/GPE/SS configuration showed that the highest conducting composition is dominantly an ionic conductor ( $t_{\text{ion}} \sim 0.99$ ) with negligible electronic conductivity, which is highly needed to avoid short circuits within the cell.

**Keywords:** *Aluminum-ion batteries, Gel-polymer electrolytes, electrochemical impedance spectroscopy, ionic conductivity, DC polarization.*