An Ionic Liquid based Gel Polymer Electrolyte for Zn / Sri Lankan Natural Graphite Rechargeable Cells

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Ionic liquids (ILs) have been identified as viable substitutes for solvents such as ethylene carbonate, propylene carbonate and diethylene carbonate which are known to be toxic in gel polymer electrolytes (GPEs). Hence, at present, they have received a great attention towards the global focus on fabricating devices using low cost, environmental friendly materials. In this study, investigations were carried out to analyze the performance of IL based GPE in a Zn/Sri Lankan natural graphite rechargeable cell. As per the literature survey, this type of cell configuration has not been reported before. GPE was prepared using the conventional solvent casting method. Poly (vinylidene fluoride–co–hexafluoropropylene), zinc trifluoro methanesulfonate and 1–ethyl–3–methyl imidazolium trifluoromethanesulfonate were used as the polymer, the salt and the IL respectively. Cell of the configuration, Zn/IL based GPE/natural graphite was characterized using Electrochemical Impedance Spectroscopy (EIS), Cyclic Voltammetry (CV) and Galvanostatic Charge Discharge (GCD) test. Open circuit voltage of the cell was about 1.0 V. This is quite sufficient for low power requirements. EIS results confirm that the GPE has a good ionic conductivity. The value of charge transfer resistance between the electrodes and the electrolyte obtained from EIS results is rather low. Cyclic voltammogramme obtained by cycling at 10 mV s^{-1} within the potential window 0.05 to 2.05 V has two reduction peaks and one oxidation peak. One reduction peak and the oxidation peak represent the movement of Zn ions. The other reduction peak is due to Zn ions. The specific charge of the cell was found to be 4.66 mA h g^{-1}. The average discharge capacity of the cell was 3.00 mA h g^{-1} as per the GCD test. Over 1000 cycles, cell showed an efficiency of 92% confirming the stability of the cell to tolerate the continuous cycling. Further improvement is needed for commercial applications.

Keywords: Ionic liquid, Natural graphite, Cyclic voltammetry