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SOLID STATE ELECTROCHEMICAL CELLS BASED ON PEO-$Mg(ClO_4)_2$ POLYMER ELECTROLYTE AND Mg/Cu ELECTRODES

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Polymer electrolytes have been of great interest partially due to its possible application in advanced high-energy electrochemical devices, i.e., batteries/fuel cells, electrochromic display devices/smart windows, photo-electrochemical solar cells, etc. Many of the solid state electrochemical cells that are being used or being developed at present are based on Li^+ ion conductors which are more expensive and less stable. Magnesium ion conducting solid polymer electrolytes have the advantage of low cost and the cells based on these electrolytes have the possibility of using magnesium metal as an electrode material. It is, therefore, interesting to study characteristics of Mg^{+2} ion based solid state cells.

In this work, we report the results of studies on various polymer electrolyte films developed based on PEO complexed with $Mg(ClO_4)_2$ salt with the plasticizer, ethylene carbonate (EC). Polymer electrolyte films have been prepared by solvent-cast method. DC polarization technique and Differential Scanning Calorimetry (DSC) have been employed for studying the complexation of the salts with the polymer and the plasticizer. The AC conductivity measurements have been made in these plasticized polymer electrolyte systems in the temperature range from 25 to 110 °C. The conductivity of the system with maximum conductivity was found to vary from 10^{-4} to 10^{-3} ohm^{-1} cm^{-1} within the above temperature range and the maximum conductivity of 6.43×10^{-4} S cm^{-1} at room temperature was found for the sample with composition $Mg(ClO_4)_2[0.5PEO + 0.5EC]_{10}$. The transference number suggests that the charge transport in these polymer electrolyte systems is mainly due to ions, with a negligible contribution from electronic. The conductivity vs temperature behavior is found to be of VTF type for all the complexes studied over the entire temperature range. The amorphous nature of the studied system was further confirmed by the DSC results.

Solid state electrochemical cells have been assembled by using the above electrolyte film as the electrolyte and Cu and Mg as electrodes. The performance of these polymer based solid electrochemical cells have been studied by the discharge characteristics at different loads. The open circuit voltage (V_{OC}) and the short circuit current (I_{SC}) for the cell configuration $Mg/Mg(ClO_4)_2[0.5PEO + 0.5EC]_{10}/Cu$ were found to be 1.36 V and 1.63 mA respectively. The capacity of the cell was found to be 3.01 mAh.