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USE OF CARBON EMBEDDED TiO_2 AS CATHODE MATERIAL IN RECHARGEABLE Mg BATTERIES WITH POLYETHYLENE OXIDE BASED GEL ELECTROLYTE

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In the past few years there has been an increasing interest on research and development of solid state polymeric lithium batteries. However, due to some problems such as the growth of a passive layer on lithium anode, high reactivity of lithium metal, limited availability as a raw material etc., scientists have realized that magnesium batteries would be one of the best alternatives to Li batteries. In this context, it is worthy to mention that magnesium is much more stable and less reactive than lithium towards the moisture and air. In addition, most of these Li batteries either employ MnO_2 based or V_2O_5 based cathodes due to their superior performances but neglecting the long term availability and the preparation cost of these materials. Therefore, by considering both these factors, in this study we have explored the possibilities of using of low cost TiO_2 as the cathode martial in magnesium batteries fabricated with Mg^{2+} ion conducting, quasi solid (gel)polymeric electrolyte based on polyethylene oxide (PEO) as the host matrix. In order to obtain quasi solid polymeric electrolyte having high Mg^{2+}ion conductivity with appreciably good mechanical properties, various compositions of PEO based polymer electrolytes were prepared using appropriate amount of PEO, magnesium trifluoromethanesulfonate $(CF_3SO_3)_2Mg$, ethylene carbonate (EC) and propylene carbonate (PC). Electrochemical stability of the electrolyte was characterized by Cyclic Voltammetry (CV). The best ionic conductivity of the electrolyte, estimated by the complex impedance measurements was in the order of 2.52×10^{-3} S/cm at room temperature for the composition of PEO (12.20 wt%), $(CF_3SO_3)_2Mg$ (14.6 wt%), EC (36.6 wt%), PC (36.6 wt%). The ionic conductivity of this electrolyte composition increased with the temperature following the usual Arrhenius behavior and showed a value of 3.44×10^{-3} S/cm at 60 ^oC. Batteries with cell configuration $Mg/PEO:EC:PC:(CF_3SO_3)_2Mg/TiO_2$-C were fabricated, by varying the amount of carbon in the cathode until it gives the best battery performance with highest open circuit voltage and the short circuit current density. This cell exhibited a discharge capacity of 270 mAh/g and 1.85 V open circuit voltage with reasonably good cycling capacity.