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A MAGNESIUM PRIMARY CELL BASED ON A NOVEL GEL POLYMER ELECTROLYTE

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Gel polymer electrolytes (GPEs) have been identified as a group of suitable alternative for liquid and solid electrolytes. They have shown excellent higher ionic conductivities than conventional polymer electrolytes. This paper reports about a gel polymer electrolyte based on the polymer, polymethylmethacrylate (PMMA) complexed with tetrapropylammopniumiodide ($Pr_4N^+I^-$), ethylene carbonate (EC), propylene carbonate (PC), iodine (I_2) and its performance in magnesium (Mg) based primary cells.

Appropriate amounts of the starting materials except I_2 were weighed and mixed using magnetic stirring. The mixture was heated at 80 ^{0}C for 1 hr. The required amount of I_2 was then added and the resulting viscous mixture was pressed in between two well cleaned glass plates. Thereby it was possible to obtain a bubble free thin film. By assembling a circular shape sample cut from the film in between two stainless steel (SS) electrodes, the ionic conductivity variation with temperature was measured at different frequencies. Same procedure was repeated by varying the amount of I_2. DC polarization test was done for an assembly in the form of SS / GPE / SS to realize the type of charge carriers. The composition which showed the highest room temperature conductivity was used to fabricate cells with Mg and carbon (C) + I_2 as the electrodes. A Mg strip was used as the anode. A pellet prepared using a mixture of C and I_2 in the weight ratio, 4:1 was used as the cathode. Several cells were assembled and their open circuit voltages (OCVs) as well as short circuit currents (SCCs) were measured. Also, they were tested for discharge characteristics under constant loads.

When I_2 concentration was increased, initially the conductivity was increased up to a certain value before it started to decrease. The initial conductivity increment may be due to the increasing of charge carriers with increasing I_2. But, the following reduction of conductivity may be due to formation of ion pairs and clusters which reduces ion concentration which in turn lowers conductivity. Almost all samples had conductivities in the range $10^{-4} – 10^{-3}$ Scm^{-1}. The highest conductivity was 5.02×10^{-3} Scm^{-1} and the composition of the that sample was 20 g PMMA : 30 g EC : 30 g PC : 40 g $Pr_4N^+I^-$ at I_2 concentration equals to 3%. DC polarization results revealed that sample is purely an ionic conductor. All cells had an average OCV of 1.8 V and SCC of 2 mA. The values show that cells are suitable for low power requirements.

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