E1 – 32

A polyacrylonitrile (PAN) based gel electrolyte and their applications in Li rechargeable batteries and artificial muscles

The gel electrolytes, made by trapping a liquid electrolyte in a polymer matrix such as polyacrilonitrile (PAN) or poly (methyl methacrylate) (PMMA) have received much attention during the past few years.

This study is an attempt to find the optimum composition in the gel electrolyte system, PAN-EC-PC-$LiCF_3SO_3$, that gives the highest room temperature conductivity and to study the possibility of its applicability in a Li rechargeable cell and in an artificial muscle. Here, EC refers to ethylene carbonate and PC refers to propylene carbonate.

A mixture of $LiCF_3SO_3$, PAN, EC and PC with different compositions was heated while string at 140 ^oC for 1 h. the hot mixture was pressed between two glass plates to obtain the electrolyte membrane. This was repeated varying both salt and PAN concentrations and all the steps were performed inside a glove box purged with argon gas. Mpedance measurements were done from -20 ^oC to 80 ^oC. Cells were fabricated using the polymer electrolyte sandeiched between a Li anode and a polypyrrole (PPy) conducting polymer cathode. Cell characteristics were studied by cyclic voltammetry and continuous charge-discharge processes. Artificial muscles of configuration Ppy/PAN/Ppy were made using two identical polypyrrole conducting polymers.

The highest room temperature conductivity of $1.21x10^{-3}$ S cm^{-1} was obtained for the composition 15 mol% PAN – 42 mol% EC – 36 mol% PC – 7 mol% $LiCF_3SO_3$ Li cells showed capacity values comparable to the theoretical values and the cells could be cycled more than 800 cycles with an efficiency of 99.95%. The mechanical movement of the artificial muscle Ppy/PAN/PPy, could be seen through 90 ^{o} between the two voltage levels – 3.0 V and 3.0 V.