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**SOLID POLYMER ELECTROLYTES BASED ON
POLYACRYLONITRILE AND ORGANICALLY MODIFIED
CERAMICS (ORMOCERS)**

A THESIS PRESENTED

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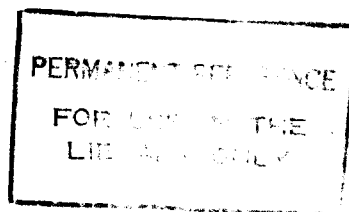
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**SOLID POLYMER ELECTROLYTES BASED ON POLYACRYLONITRILE (PAN)
AND ORGANICALLY MODIFIED CERAMICS (ORMOCERS)**

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PAN based electrolytes were made by complexing EC and PC with different salts namely, CuCNS, $\text{Cu}(\text{CF}_3\text{SO}_3)_2$, $\text{Mg}(\text{ClO}_4)_2$ and LiCF_3SO_3 . Sample preparation was done using the hot pressed technique. All systems yielded free standing electrolyte films.

System with 21 mol% PAN : 30 mol% EC : 45 mol% PC : 4 mol% CuCNS has a room temperature conductivity of $3.3 \times 10^{-5} \text{ S cm}^{-1}$ while the system with 20 mol% PAN : 41 mol% EC : 34 mol% PC : 5 mol% $\text{Cu}(\text{CF}_3\text{SO}_3)_2$ has a room temperature conductivity of $4.1 \times 10^{-3} \text{ S cm}^{-1}$. Conductivity variations with temperature of the two systems show Arrhenius and VTF behaviours respectively. Former system seems to be an anionic conductor and the latter system a mixed conductor with cationic and electronic contributions. Electrolytes made with $\text{Cu}(\text{CF}_3\text{SO}_3)_2$ has been used in cells of the form, $\text{Cu} / \text{PAN} : \text{EC} : \text{PC} : \text{Cu}(\text{CF}_3\text{SO}_3)_2 / \text{PPy} : \text{DBS}$ where DBS

stands for polypyrrole polymerized in the presence of DBS. Open circuit voltage was approximately 180 mV. A capacity of about 12 $\mu\text{A h}$ under a load resistor of 50 $\text{k}\Omega$ was obtained.

When $\text{Mg}(\text{ClO}_4)_2$ was incorporated with PAN : EC : PC, a room temperature conductivity of $3.2 \times 10^{-3} \text{ S cm}^{-1}$ can be obtained from the composition 18 mol% PAN : 64 mol% EC : 14 mol% PC : 4 mol% $\text{Mg}(\text{ClO}_4)_2$. Conductivity variation with the temperature takes the form of Arrhenius behaviour. Secondary solid state cells have been fabricated with this electrolyte in the form, Mg / PAN : EC : PC : $\text{Mg}(\text{ClO}_4)_2$ / PPy : DBS. Open circuit voltage lies around 1.5 V. Estimated capacity values are around 0.18 mA h.

System based on LiCF_3SO_3 has a room temperature conductivity of $1.2 \times 10^{-3} \text{ S cm}^{-1}$. Corresponding composition is 15 mol% PAN : 42 mol% EC : 36 mol% PC : 7 mol% LiCF_3SO_3 . Conductivity variation with temperature followed VTF behaviour. Stability of the electrolyte with lithium is somewhat acceptable. Test cells in the configuration, Li / PAN : EC : PC : LiCF_3SO_3 / PPy : X (X : CF_3SO_3^- , DBS^- , AS^-) have open circuit voltages around 4 V. It is possible to get more than 800 cycles with an efficiency of 99.95%. Artificial muscles in the form, PPy : X / PAN : EC : PC : LiCF_3SO_3 / PPy : X (X : CF_3SO_3^- , DBS^-) have been fabricated. Their movements were observed between two voltages. It is seen that the movements are faster when the assembly is thin.

Ormocer electrolytes are having somewhat considerable conductivity values. But, those values should be enhanced further to make them proper candidates for applications. Concept of all solid state cells may be feasible with ormocers.