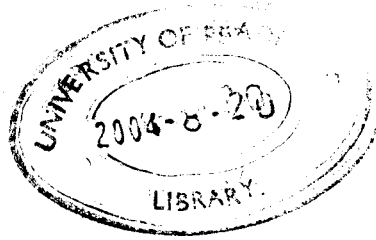


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**STUDY OF ELECTRICAL CONDUCTIVITY AND DIELECTRIC  
RELAXATION OF PEO BASED COMPOSITE POLYMER  
ELECTROLYTES AND PAN BASED POLYMER  
ELECTROLYTES**

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**STUDY OF ELECTRICAL CONDUCTIVITY AND DIELECTRIC  
RELAXATION OF PEO BASED COMPOSITE POLYMER  
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Solid polymer electrolytes are formed by complexing an ionic salt with a solid polymer. These solid polymer electrolyte membranes have received much attention in the recent past due to the possibility of using them in novel-nano technological commercial applications. These systems show somewhat high ionic conductivity, which make them potentially important as electrolytes in high energy density rechargeable batteries. This thesis focuses on several important factors such as ionic conductivity, dielectric relaxation and thermal properties, which control the ion transport mechanism and conductivity enhancement mechanism in Poly(ethylene oxide), PEO, based composite electrolytes and poly(acrylonitrile), PAN, based gel electrolytes.

In the case of PEO systems, Lithium bis(trifluoromethanesulfone)imide, (LiTFSI), Lithium trifluoromethanesulfonate, (LiTf), and Copper(II)trifluoromethanesulfonate, (CuTf<sub>2</sub>), have been used as the complexing salt to prepare the polymer electrolytes. PEO - LiTFSI, PEO - LiTf, PEO - CuTf<sub>2</sub>, have been chosen for this work. For composite electrolytes, four different sizes (< 10 μm, 37 nm, 10 – 20 nm, 5.8 nm) and four different types (acidic, basic, neutral, weak acidic) of alumina were used as ceramic fillers.

In all three composite polymer electrolytes, the ionic conductivity has enhanced considerably due to the incorporation of alumina filler grains. In the case of PEO – LiTFSI - Al<sub>2</sub>O<sub>3</sub> composite electrolyte, incorporating four different types of alumina grains, the results show that the filler particles do not interact directly with PEO chains and the degree of conductivity enhancement depends on the nature of the filler surface group and decreases as acidic > basic > neutral > weak acidic. Transient bonding with H<sup>+</sup> and O<sup>2-</sup> groups on alumina grain surface via Lewis acid-base type interactions appears to facilitate ionic motion by providing additional sites for ionic migration.

For the system, PEO - LiTf, out of the four different sizes of alumina fillers used, nano - porous alumina filler particles with pore size 5.8 nm have shown the highest conductivity increment. Further more, the conductivity versus filler concentration curves exhibit two conductivity maxima for filler grains with < 10 μm, 37 nm, and 10 – 20 nm grain sizes. The conductivity increase appears to be consistent with the idea that Lewis acid-base type interactions of ionic species with surface groups on alumina grains are responsible for the enhanced conductivity.

For the system, PAN / LiTFSI / EC / PC with 15.39 wt.% PAN / 2.56 wt.% LiTFSI / 82.05 wt.% EC+PC has shown the highest conductivity. The PAN polymer matrix appears to play a positive role in the ionic transport mechanism of the gel electrolyte rather than acting merely as an inert host.