PREFACE

The electrical energy utilization made a big revolution in transport industries because of its versatility among all other forms of energy. It is easy for transportation and also transformed into any other form of energy. In earlier days energy transport in other forms created endangering pollution problems. The prolonged research in the electrical energy transport was lacking many years because of good storage system, particularly an efficient battery for past twenty years, the thrust of scientific enquiry is directed now towards the development of reliable storage batteries.

The development of new solid materials for both electrolyte and electrode applications felicitate new types of electrical power generation and storage system. The solid state ionic materials could benefit for such power generation systems. With general concerns, the future energy generation and conservation, a rapid growth in research and development relating to ‘polymer electrolytes’ has ensured. The impetus for studying the fundamental aspects for polymer-salt systems have come about largely through the desire to develop thin film rechargeable lithium batteries based on these materials. With diversification of research into area other than lithium based polymer electrolytes, it has become apparent that there is potential for exploitation in many other energy-related applications.

Polymer is made up of many small molecules, which have combined to form single long or large molecules. Electroactive polymers have been the object of increasing academic and industrial interest for several years and substantial progress has been achieved in the development and the characterization of this new class of conducting polymer materials. These materials are usually classified in two large groups, according to the mode of their electric transport. One group includes
polymers having transport almost exclusively of the ionic type and another one is mainly electronic nature, which are called ‘polymer ionics’ and ‘conducting polymers’, respectively.

Ionically conducting polymers are typically described as polar macromolecular solids in which one or more of a wide range of salts has been dissolved. The most classic example is the combination of poly (ethylene oxide) PEO and lithium salts, LiX. In addition to this, the various types of polymer ionics can be easily fabricated into flexible thin films with large surface area where the ions are free to move and can conduct electricity as in conventional electrolytes.

Polymers have received considerable attention in the last two decades because of their low density, manufacturability, and capacity to accommodate volume changes as compared to a rigid inorganic solid electrolyte. Further, polymer electrolytes should performed the following parameters,

(1) high ionic conductivity of > 0.5 ms/cm.

(2) chemically and electrochemically stable

(3) mechanically strong and flexible

(4) thermally stable

(5) environmentally sage and a high affinity for the electrolyte solution.

In this study, several investigations were performed in the PVdF/PVC – LiClO₄ based blend electrolytes with the addition different plasticizers. In addition to that the ceramic-based polymer electrolytes were also prepared and its amorphicity, complexation behaviour, thermal stability and electrical conductivity studies were performed.
This thesis consists of seven chapters and organized as follows.

Chapter I gives the outline and the background of polymer electrolytes. A brief explanation of ionic conduction as well as on structural conductivity relationship is also presented.

Chapter II presents an overall review of gel and solid polymer electrolyte systems. Especially, PVdF/PVC blend electrolytes have been highlighted and its salient features are depicted till-date.

Chapter III explains the experimental details of the electrolyte preparation. The details of the instruments used for various characterizations are also outlined.

Chapter IV describes the results and discussion of PVdF/PVC blend electrolyte with the addition of Li salt. From this chapter, it is confirmed that 80:20 weight ratio of PVdF/PVC with LiBF₄ complex exhibited high conductivity with good mechanical stability. Further, it also explains the salt optimization in PVdF/PVC complex. It has been concluded that 8 weight % of LiBF₄ and LiClO₄ in PVdF/PVC (80:20) complex shows to be the best ratio for further investigations.

Chapter V describes PVdF/PVC – LiClO₄ system with the incorporation of different plasticizers. Its complexation behaviour, thermal stability and surface morphological studies are made. Further ionic conductivities of these electrolytes are measured at different temperatures and the results are discussed in detail.

Chapter VI explains PVdF / PVC - EC/PC - LiClO₄ system with the incorporation of ceramics such as TiO₂ and CeO₂. It is concluded that the room temperature conductivity of ceramic added system (especially TiO₂) exhibits higher conductivity as compared with the double plasticized system.

Finally, Chapter VII summarizes the conclusion of all the results reported in this thesis.