Preface

The main developments in polymer science during the past thirty years have been improving our knowledge of the relationship between the structure of polymers and their properties. More recently the ability to manufacture polymers with specified structures has been invented although there is still much to learn about the development of "tailor made" polymers. Polymers, in performance characteristics, offer unique properties, application prospects and diversity. They also offer novelty and versatility usually not found in any other class of materials. The mankind has been in quest of new materials from ancient times. Polymers, although introduced in the materials field in a meaningful manner only very recently, occupy a major place in our life today. Polymers can be converted into strong solid articles, flexible rubber like sheets, swollen jelly-like food materials, etc.

Ion bombardment may modify/improve certain properties of materials that have been the driving force behind much of this research. Radiation effect is the subject of intense investigation in radiation chemistry, mainly to understand the radiolysis and polymerization mechanisms included by ionization radiation. The primary phenomena associated with the interaction of radiation with the polymers are chain scission, cross-linking, molecular emission and formation of double bonds. It is well known that cross-linking or chain scission effect does not only depend on the polymer structure but also on the characteristics of the radiation sources, viz; ion energy, ion species and fluence. Various gaseous molecular species are also released during irradiation. Cross-linking occurs when two free dangling ions or radical pairs on neighboring chains unite. This will enhance the modulus and hardness of the polymer. In partially crystalline polymers, it imparts a non-melting behavior and above the crystalline melting point, the cross linked polymer exhibits rubber elasticity. Radiation degradation is a random chain scission process, which reduces the molecular weight of the polymer, thus plasticizing the material. All these effects will depend on the composition, density, molecular weight of the polymer, temperature, the time of irradiation and the mass, energy, and fluence of the ion beam. Ion irradiation leads to modification in most of the properties like thermal, mechanical, structural and electrical properties.

The modification of polymer properties by energetic ions is a subject of widespread importance due to increasing use of polymers in radiation environment encountered in nuclear power plants, space-crafts, sterilization irradiators, high energy particle accelerators etc. These polymers imparted many technological implications in microlithography, microelectronics, optoelectronics, communication devices etc. The various scientific and technological applications of polymers are due to their structural, mechanical and thermal stability.

The present work is carried out on few polymers like polypropylene, polyimide, polyethylene terephthalate, polyether sulfone, polycarbonate and blended polymer (PVC+PET). This polymer comprises a class of engineering thermoplastic with high thermal and hydrolytic stability. These engineering polymers are applicable in many areas e.g., in electronics, medical applications and aerospace applications. These selected polymers were irradiated by 3 MeV proton beam at different fluences i.e. 10^{13}, 10^{14} and 10^{15} ions/cm^2. The effect of irradiation in the chemical structure of polymer resulting in modification in the electrical, thermal, optical and mechanical properties. Ion irradiation leads to modification in thermal property (T_m, melting temperature and T_g, glass transitions temperature). The hardness of the polymers also affected by the ion beam treatment. Most of the work on various polymeric materials reported in literature is focused on the modification of the chemical properties by ion irradiation. But little information is available on their mechanical and electrical properties e.g., dielectric constant, dielectric loss and hardness.

In present work, we have focused our study on the various physical (Mechanical, Electrical and Surface) and chemical (FTIR and Thermal) properties. The surface morphology of pristine and irradiated samples was also studied. We observed significant changes in irradiated samples compared to those of pristine one.

The entire work is organized into five chapters, which can be viewed as follows.

Chapter 1

This chapter deals with brief introduction about ion beam in material science, historical development of polymers, structure, morphology and its applications as well as effects of radiation on polymers, fundamentals principles of the interaction of energetic ions with polymers.

Chapter 2

This chapter deals with irradiation facility and techniques used to study the polymer modification, i.e. Variable Energy Cyclotron, FTIR, LCR meter, TGA, DSC, optical microscopy and Vickers' microhardness techniques.

Chapter 3

Some important properties of polymers used in the present work are discussed in this chapter. The specific detail about target preparation, thickness measurement, estimation of range and energy loss using SRIM code, irradiation and characterizations of theses polymers are reported here.

Chapter 4

This chapter gives the details view of the results obtained by different characterization techniques. It is divided into six parts to explain the results of six polymers separately and exclusively.

Chapter 5

Summary and conclusions of all the results of the experiments performed along with the future plan of the work have been presented.

The **REFERENCES**, throughout the thesis, are numbered between square bracket in the text and are listed at the end of each chapter.