PREFACE

The modification of material properties by swift heavy ion (SHI) irradiation has interested many researchers in recent years. Some unique modifications of the polymer property are possible due to SHI interaction, e.g. engineering of the polymer structure, which is never observed when using conventional radiations such as electrons or gamma rays The reason is very high electronic energy transfer along the ion paths, while SHI pass through the polymer materials. As a result SHI lose their energy via target electronic excitation and ionization and eventually imparts unusually high electronic energy density (~ keV/ nm) along the ion paths The ions lose energy during their passage through the material either by displacing the atoms by elastic collisions or exciting the atoms by inelastic collisions. The low energy (keV) ions may cause atomic displacement through elastic collisions with the nuclei of the target, while high energy ions lose most of their energy through electronic excitations (ionization) of the target atom except at the end of their trajectories where elastic collisions dominate.

Polymer composites filled with metal are of interest for many fields of engineering. This interest arises from the fact that the electrical characteristics of such composites are close to the properties of metals where as the mechanical properties and processing methods are typical for plastics. Polymers and metals come into contact in many areas of modern technology. Automobiles are increasing assembled using adhesives rather welds, metals catalysts are embedded in polymer electrolytes for fuel cells and prosthetic devices frequently feature acrylic bone cement in contact with metallic implant materials. Polymers are also used as substrates in the deposition of metallization lines for integrated circuit.

The application of ionizing radiations in polymeric materials and polymer metals composites has grown due to the fact that the physical and chemical properties of the polymers can be modified in a controlled way. Interest has also evolved in the peculiar nature of the ion-polymer, and it is also important to understand the effect of ion beam on a more fundamental level how the polymers interact with metal fillers. The interaction between metals and polymers is generally very weak and the cohesive energy of polymer is typically two orders of magnitude lower than the cohesive energy of metals. Thus the field of polymers and polymer composites modification by ion beam, and its characterization has become a very challenging field owing to vast technological implications. Our interest in dispersion of organometallic compound is mainly because organometallic compound is in complex form and will give more functional groups after ion beam irradiation compared to inorganic fillers. There is a possibility to form oxides, hydraoxides and other compounds by irradiation of organometallic dispersed polymer films. Ion beam irradiation has long been recognized as an effective method for modifying the properties of diverse materials, including polymers and polymer composites. Ion irradiation of such polymer composites can result in significant changes in the chemical structure of filled filler and polymer surface layers including (i) degradation of chemical bonds and backbone structure, (ii) crosslinking of polymer chains. A filled polymer differs substantially from the free one in wide range of properties. These materials can be crosslinked to obtain useful properties.

The motivation behind the present work is to study the modification of organometallics dispersed polymers and pure polymers films by ion beam irradiation and study the radiation induced changes in dielectric, structural, microharndess, thermal properties and also surface morphology at different fluences.

In the work reported here, we have irradiated nickel-dimethylglyoxime and ferric oxalate dispersed polymethyl methacrylate (PMMA) and polyvinyl chloride (PVC) films, and pure polymers such as kapton (PI), polycarbonate (PC), polyether sulphone (PES) and blended polyvinyl chloride (PVC) with poly ethylene terephthalate (PET), at different fluences, using 80 MeV O^{6+} and 120 MeV Ni^{10+} ions at Inter University Accelerator Centre (IUAC), New Delhi.

The entire work is organized in following chapters.

Chapter-1

This chapter deals with the general introduction, importance of radiation in the field of material science, polymers and polymer metal composites, their impact on present day technologies. A brief description about heavy ion and important fundamental processes involved in ion beam interaction with polymer are discussed in order to understand the basic physical and chemical processes induced by energetic heavy ion beam. This chapter also deals with the mechanism of polarization in dielectrics and motivation for the present work.

Chapter-2

This chapter describes a detail account of structure, properties and utilities of the polymers which were used in the present work. The preparation of polymer films and organometallics complexes and their polymer composite films, estimation of range and energy using SRIM code, irradiation parameters and detail information about the dose used is also given. The specific details about the different techniques used in the characterization of samples are also discussed.

Chapter-3

In this chapter effects of 80 MeV, O^{6+} ions were studied on ferric oxalate dispersed PMMA and PVC and nickel dimethyglyoxime (Ni-DMG) dispersed PMMA films at different fluences. The results obtained from different characterization techniques showing the fluence dependent modification of above polymer composites. The radiation induced modifications in dielectric properties, microhardness, Mossbauer studies, surface morphology and average surface roughness of polymer composite films have been investigated at different concentrations (i.e. 5%, 10% and 15%) of filler and also at different fluences.

Chapter-4

In this chapter effects of 120MeV, Ni^{10+} ions were studied on nickel-dimethylglyoxime (Ni-DMG) dispersed PMMA films at different fluences. The results obtained from different characterization techniques showing the fluence dependent modification of above polymer composite and discussed in terms of electrical properties, Vickers hardness, particle size and crystallinity and surface morphology. These properties were discussed in terms of ion fluence and concentration of filler.

Chapter-5

This chapter deals with the electrical, mechanical(hardness) thermal and structural characteristics of 80MeV, O^{6+} ion irradiated PI, PC, PES and blended PVC+PET polymeric films at different ion fluences by different characterization techniques viz dielectric study, Vickers microhardness, FTIR spectroscopy, differential scanning calorimetry and thermogravimetric analysis.

Chapter-6

This chapter gives summary and conclusions derived from the present investigations along with the future plan of the work.

The REFERENCES, throughout the thesis, are numbered as square bracket in the text and are listed at the end of each Chapter.