PREFACE

Polymer composites made of polymer-dispersed with inorganic dopant, are lightweight materials and play an important role in many medical and technological applications such as drug delivery, photoluminescence, dosimetry, food packaging, electronic devices, etc. Polymers are the most used matrices in such composites, specifically due to their important properties such as non-corrosiveness, transparency, durability, flexibility, electrical resistance, etc. Many polymer composites have been prepared using a wide variety of nanofillers such as metal oxides, carbon nanotubes, metals, semiconductors, etc. Research on the use of nanoparticles has increased over the past few decades, and significant works have been carried out to understand nanofillers and their composites with polymers. Physico-chemical properties of nanomaterials can alter by way of their confinement to nanometer spatial dimension, surface effect, quantum size effect, small size effect, and macroscopic quantum tunneling effect. Composites materials, in general, are usually formed by combining two or more physically different materials. These composites have some structural and functional properties which are different from those of the individual materials. Composite polymers with nanofillers prove to be a very effective route for tuning properties by varying the size and concentration of the nanofillers.

Irradiation effect on polymers/polymer composites plays a vital role in modifying material properties such as optical, electrical, mechanical, and thermal properties and also surface morphology by interaction of ion beam with matterials. Swift heavy ions penetrate deep into materials, lose their energy due to interaction with matter and produce a large and narrow disordered zone along their trajectories. Hence these heavy ions do not uniformly modify the material whereas gamma rays do. The irradiation may also cause amorphization, chain scission, crosslinking, decrease the molecular weight, unsaturated bonds, form radicals, and cause loss of volatile components. The effect of the ion beam on materials depends on the ion energy, fluence and ion species.

The present work aims to investigate gamma-ray and carbon ion irradiations on structural, optical, luminescence, electrical properties and surface morphology of polymer composites. All the samples investigated were prepared using the solution casting method. Al_2O_3, Eu_2O_3 and SiO_2 were selected as nanofillers while Polystyrene and Polyvinyl alcohol were selected as polymer matrices. The pristine and irradiated polymeric films were characterized using powder X-ray diffraction (XRD), Fourier Transform Infrared (FT-IR) Spectroscopy, photoluminescence, thermoluminescence, UV-Visible spectroscopy, impedance spectroscopy, differential scanning calorimetry, and atomic force microscopy.

The whole work is listed in the thesis and divided into the following chapters:

Chapter 1 describes general information about polymers and polymer composites. It also includes applications of polymer nanocomposites. A brief description of ionizing radiation in the field of materials science and its effect on various properties of polymers is explained. A detailed literature survey of materials used and the objective of the present work are presented.

Chapter 2 deals with detailed information on materials used and composites' preparation methods. The working principle and operation of 15 UD Pelletron have been described. It includes a brief description of various characterization techniques employed for offline data analysis of pristine and irradiated polymer nanocomposites.

Chapter 3 describes the effect of gamma rays and 90 MeV carbon ion beam irradiations on PS/ Al_2O_3 nanocomposites and their characterization. The explanation for modification of various properties of the nanocomposites after irradiation, such as structural, electrical, luminescence, optical, thermal properties, and surface morphology, is given.

Chapter 4 discusses the effect of gamma rays and 90 MeV carbon ion beam irradiations on PS/Eu_2O_3 nanocomposites. The changes observed in structural, optical, luminescence, electrical, thermal properties, and surface morphology after gamma rays and carbon ion beam irradiations are explained in detail.

Chapter 5 focuses on the study of the irradiation effect on various properties of PVA/ H_3PO_4/SiO_2 nanocomposite polymer electrolytes. The structural, optical, electrical, thermal properties and surface morphology of the pristine and irradiated polymeric films have been studied using X-ray diffraction, UV-visible spectroscopy, dielectric spectroscopy, differential scanning calorimetry and AFM, respectively. The results are reported. The explanation for the influence of gamma rays and 90 MeV carbon ion beam irradiations on various properties of nanocomposite polymer electrolytes is given.

Chapter 6 This chapter summarizes the work carried out and highlights its significant conclusions together with the future scope of work.