PREFACE

Nowadays, there is a growing interest in polymer applications in the field of adhesion, coatings, microelectronics, biomaterials, membrane separation process, medicine etc needs modified surface properties. The polymer surface possesses high hydrophobicity and chemical inertness, and for a specific applications may require an improved compatibility. The polymer surface applications are always limited due to the shortcoming of low surface energy. One way to modify such polymers is plasma treatment. The advantages of the plasma treatment include no contamination as the plasma treatment is carried out in vacuum, different gases for different applications can be used and the surface modification is rather uniform over the large area.

Plasma surface modification involves the interaction of the plasma generated excited species with a solid interface. The plasma process results in a physical and /or chemical modification of the first few molecular layers of the surface, while maintaining the properties of the bulk. The interaction of plasma gas with polymeric surface gives four primary effects, the removal of organic materials, cross linking via activated species of inert gases, ablation and surface chemical restructuring. The effectiveness of plasma on these complex interfaces is determined by the plasma source gases, the configuration of the plasma system and the plasma operating parameters. Selection of a specific process is determined by the physical and chemical comparison of the material to be processed as well as by the ensuing process required. Surface modification is often sensitive to time and environmental exposure, where the surface may lose its plasma induced physical and chemical properties.

Plasma is an environmentally safe method of organic removal and surface modification. Plasma processes can be tailored to produce hydrophobic or hydrophilic surfaces on metal, plastic, glass or polymers. Knowing how plasma addresses the adhesion in the first step for considering it in a manufacturing process.

Polymers are of thermoplastic, elastomers and thermosets types. They are characterized by their glass transition temperature (T_g). Thermoplastic polymer transforms from glassy to rubbery state at T_g. Elastomers are cross-linked rubbery polymer and can be stretched easily and rapidly recovers their original dimensions when the applied stress is released. Thermosets are rigid polymers which are greatly restricted by a high degree of cross-linking. In our study, we incorporated polycarbonates (PCs), polyethylene terephthalate (PET), polytetrafluoroethylene (PTFE) and polyethersulfone (PES) thermoplastic polymers. PCs are synthetic polymer, applied successfully in the field of adhesion, biomaterials, protective coatings, microelectronic devices and thin film technology. PET is one of the most important thermoplastic used in the microelectronics, biomedical field because of its excellent mechanical properties due to the presence of the aromatic ring in polymer structure. PTFE is a polymer used as insulator in cables, connector assemblies, and for printed circuit boards because of its good dielectric properties. PES has been applied in a wide range of areas, such as electrical, automotive, aerospace, medical, consumer products and seperation processes. Polyethersulfone (PES) is a high performance engineering thermoplastic that has been adopted as a material for membrane applications in medicine for hemodialysers and oxygenators. As a membrane in blood contacting applications some of the factors that could influence its protein interactions include its surface energetic, hydrophobicity/hydrophilicity character and surface morphology.

The above four polymers (PC, PET, PTFE and PES) were considered for surface modification using plasma. These polymers were irradiated / treated with bipolar argon plasma. The pristine and modified surfaces were characterized by means of contact angle measurement, X-ray photoelectron spectroscopy (XPS), Atomic force microscopy (AFM), ATR-FTIR spectroscopy and Vickers' Microhardness measurement.

Present work is organized into the following chapters:

Chapter 1

This chapter deals with the importance of thermoplastic polymers, plasma and their applications in the field of adhesion, coatings, microelectronics, biomaterials, membrane separation process, and in medicine, importance of surface modification using plasma treatment and motivation for present work.

Chapter 2

This chapter serves as a brief introduction to experimental technique (plasma chamber) and parameters used during the plasma treatment. Various characterization techniques have been applied to do off-line analysis of the pristine and treated samples.

Chapter 3

In this chapter the results of spectroscopic studies using XPS and ATR-FTIR are discussed.

Chapter 4

In this chapter the results of surface free energy, morphology and hardness studies are presented.

Chapter 5

This chapter summarizes the results obtained by bipolar argon plasma treatments. It also gives conclusions derived from the present work.

Future perspectives, as well as possible extension of the present work have been explained.

The references are numbered in square bracket in the text and are listed at the end of the last chapter.