CHAPTER I

INTRODUCTION

1.1 UV evanescent field induced surface degradation of PET

Poly(ethylene terephthalate) or PET is a commercial thermoplastic polymer which has been used many million metric tons per year in various industries such as food industries, textile industries, automotive industries, biomedical devices, etc., [1-3]. PET has good physical and mechanical properties and inexpensive. Moreover, it can also be recycled. As a result, PET is an attractive target for many researches and applications. Although PET is an excellent polymer, it has some disadvantages that limit its usage in many applications. The hydrophobic property of PET affects its wettability, printability, colorability, and biocompatibility [4]. Modification techniques has been developed and applied for improving hydrophilic property of PET. The modifications also increase the value of PET.

Modification with ultraviolet (UV) radiation is the widely used technique because it is a low cost process and clean technology. Moreover, it can be applied in a continuous manner. The UV modification involves irradiation of PET by an intense UV radiation. The radiation excited the molecules of PET while induces photo-degradation such as photolysis and photo-oxidation reaction. When the photo-degradation takes place, the PET can change into hydrophilic functional groups. Therefore, the photo-degradation can enhance the hydrophilic property of PET. However, the conventional UV modification may affect the desired bulk properties of PET such as mechanical property.

In recently years, various modification techniques have been developed for increasing hydrophilic property while keep the excellent bulk properties. The survey of prior literatures, the hydrophilic surface modification techniques include flame treatment, plasma or corona treatment and chemical treatment [5]. These techniques

have some specific advantages and disadvantages. Some techniques are high cost for operation while others involve complicated operation.

An UV irradiation under attenuated total reflection (UV-ATR) is a novel degradation technique which can be generated UV evanescent field at the interface and is applied for surface modification. This technique is an alternative surface modification technique of PET. The technique induces photo-degradation of PET surface by using UV evanescent field. This degradation process produces carboxylic and hydroxyl species that can be increased the hydrophilic property of PET surface. These species can be observed by ATR FT-IR spectroscopy and FT-Raman spectroscopy.

The UV evanescent field induced surface degradation of PET can be applied for improving hydrophilicity on the PET surface. The UV evanescent field can be penetrated into material surface that can be controlled by changing the ATR parameters. The penetration depth of UV evanescent field depended on the wavelength, angle of incidence and refractive indexes of the IRE. Since the UV evanescent field is only penetrated at interface between internal reflection element and PET surface, this field has not affected the bulk properties of PET.

1.2 The objective of research

The objective of this research is to introduce a novel degradation technique by using UV evanescent field irradiation for improving hydrophilic property at the surface of PET. Some factors related to the modification process such as degradation times, PET types and stability of hydrophilic species under ambient condition were studied. The changes at the molecular level of the irradiated PET were investigated by ATR FT-IR and FT-Raman spectroscopy. These results are compared with that of conventional UV-transmission irradiation and un-irradiated PET.

1.3 Scope of research

1. Study the possibility of photo-degradation of PET under UV evanescent field irradiation by using diamond μATR probe and investigate the change by ATR FT-IR spectroscopy.
2. Comparison the chemical changes of the irradiated PET under the UV evanescent field irradiation with that of conventional UV transmission and un-irradiated PET by using ATR FT-IR and FT-Raman spectroscopy.
3. Study the factors affect the UV evanescent field treatment such as irradiation times, various PET forms, and the stability of hydrophilic species under ambient condition.