CHAPTER V

CONCLUSIONS

The UV evanescent field is an electromagnetic field which is generated by UV radiation under attenuated total reflection (ATR). This field can induce the surface degradation of poly (ethylene terephtahlate) or PET. The degradation products brought about higher hydrophilicity than ester units of PET that was perceived by the spectra change of ATR FT-IR of un-irradiated PET. This change was provided the new hydroxyl species (2750-3650 cm^{-1}) and carboxylic species (approximately 1700 cm^{-1}) that were hydrophilic. Besides, the change can induce phase transformation from crystalline phase to amorphous phase (increasing peak at 1338 cm^{-1} and decreasing peak at 1371 cm^{-1})

The UV irradiation under ATR condition is a novel surface degradation technique that can be applied for improving the hydrophilicity of the PET surface. The novel degradation technique is obviously differed from conventional UV transmission. The physical and chemical changes of irradiated PET were shown different of both UV irradiations. The irradiated PET by UV transmission showed color changes from colorless to yellow-orange at the exposed side and opaque white in the bulk. This observed color change was clearly seen and was a good indicator for the change of physical properties included the mechanical properties of the bulk irradiated PET samples as that occur in the annealing process. Unlikely the irradiated PET under the UV evanescent field, a noticeable physical change was not observed.

Moreover, the infrared and Raman spectral changes of irradiated PET under the UV evanescent field were compared with that of the irradiated PET by conventional UV transmission. The observed ATR FT-IR spectra of irradiated PET by both irradiations indicated the degraded species that were varying with irradiation times. The curve fitting showed the difference in composition of irradiated PET by both irradiation methods. The spectra of irradiated PET by UV transmission exhibited

a greater number of carbonyl species than that of irradiated PET under the UV evanescent field. The peaks maxima at lower wavenumber indicated polymeric water in the UV transmission irradiated PET film.

The Raman spectra indicated the change in the bulk properties of irradiated PET by UV transmission because the PET sample can absorb the UV radiation and emit the excess energy. That excess energy was emitted in term of thermal energy which was higher than the glass transition temperature of PET. This thermal activity induced the conformation change from amorphous phase to crystalline phase. The UV evanescent field irradiation can be penetrated to the irradiated PET sample at nanometer level, thus it can be induced photo-degradation at the PET surface only. By this reason, the bulk properties of irradiated PET under the UV evanescent field irradiation were expected to be unchanged. In addition, the Raman spectra of the irradiated PET under the UV evanescent field also showed an un-noticeable baseline shift.

The UV evanescent field is an alternative degradation technique for improving hydrophilicity of PET surface without changing the bulk properties. This technique can induce surface degradation of various PET forms (i.e., film, staple fiber, and filament). The infrared spectra of various PET irradiated showed the similar change. The changes showed low magnitude of phase transformation due to crystallinity of PET. Additionally, the hydrophilic species at the PET surface have a good stability under the ambient condition. Therefore, the UV evanescent field technique can be applied for various PET forms in many industries. However, the UV evanescent field process needs additional study for highest efficiency in each application such as device design, irradiation times, and intensity of UV radiation.