# Chapter 1

# Introduction

Interfacial adhesion between constituents plays a crucial role in composite materials. Due to this significance of the interface, much effort has been and still is being spent trying to tailor the surface properties of the reinforcement to enhance compatibility with the matrix. In many composite systems, the chemical inertness and low surface energy of various polymers produce an inadequate bond with the matrix [1, 2]. Many surface modification methods such as corona discharge, plasma treatment, and flame treatment of these materials are used to enhance the interfacial between phases in composites and laminate. There are, however, drawbacks to each of these surface modification methods.

Corona is an effective process for high-speed, in-line applications. However, this technique is difficult to use on three-dimensional objects. Plasma treatment can be very effective in treating non-flat objects but requires a high vacuum environment and sophisticated apparatus. Flame treatment is a relatively cost-effective process but usually may be unable to apply for thermally sensitive materials [3].

UV/ozone process is well known as a surface modification for various polymer surfaces. The synergistic phenomenon of UV and ozone has attracted a lot of attention and has potential to apply in a continuous process, for improving surface compatibility between phases in polymer composites, since the surface modification can be occurred within minutes [3].



The UV/ozone treatment can be used to modify chemical and physical states of the material surface without altering its bulk properties. These attributes indicate that UV/ozone treatment of the fiber surface can be an important technique for controlling interfacial adhesion [3-5].

The advantages and benefits of this process are that it can be:

(i) capable of treating any polymer surface

(ii) adaptable to treat flat or convoluted external surface

(iii) inexpensive with short treatment time

(iv) environmentally benign

(v) adaptable to a robotic or a continuous exposure environment

(vi) simple, and

(vii) tailorable for optimum adhesion.

A development of continuous composite manufacturing is a very important step for high productivity and reproducibility of polymer-based composites. There are several techniques for continuous manufacturing process of polymer composites such as pultrusion and filament winding. However, the effective continuous surface modification methods of polymeric fibers to incorporate in composites system are lacked.

This thesis presents a surface modification process for continuous polymer composite manufacturing using UV/ozone treatment. The objective is to develop a process model to make the cost-effective surface preparation process for continuous composite manufacturing. In this entire work, the polyester fiber (poly (ethylene terephthalate), PET-fiber) was used to incorporate as a discontinuous phase in epoxy resin (continuous phase).

The combination effects of exposure to UV and various gas species (nitrogen, air, oxygen, air/ozone and oxygen/ozone) as well as treatment time onto morphology and chemistry of PET-fiber surfaces were investigated by using scanning electron microscope and energy dispersive x-ray analysis (SEM/EDX). The tensile performances of the resulted PET/epoxy composites were also studied to evaluate the effectiveness of the proposed process. Furthermore, the fracture behaviors of composites were investigated by fractography of the composite specimens.