CHAPTER I

INTRODUCTION

Poly(trimethylene terephthalate) (PTT), a semicrystalline polymer, is a linear aromatic polyester which was firstly synthesized by Whinfield and Dickson in 1941. But it was not commercially available due to the high cost of 1,3 propanediol (PDO), one of the raw materials used to produce PTT. However, recent breakthroughs in PDO synthesis via hydroformylation of ethylene oxide, process improvements in traditional synthetic route through acrolein, and promising bioengineering route have reduced the cost of PDO. These render PTT as becoming a commercial polymer, joining the other well-known linear aromatic polyesters, poly(ethylene terephthalate) (PET) and poly(buthylene terephthalate) (PBT). PTT has potential uses as fibers, films, and engineering thermoplastics, with some of its properties are roughly between those of PET and PBT. Of interest is that PTT had a better tensile elastic recovery and a lower modulus than PET and PBT. These two properties are very desirable for making soft, stretchable fabrics.

It is well-known that semicrystalline polymers only crystallize in temperatures between the glass trassition temperature T_g and the melting temperature T_m. The crystallization process can be classified into two categories depending on the route from which the melt is brought to crystallize. If the initial state is from the high temperature melt, it is melt-crystallization, while, if the initial state is the low temperature melt (viz. can only be accomplished if the high temperature melt is fully quenchable), it is cold-crystallization. Melt-crystallization involves crystallization from the high-temperature molten state of the polymers, while cold-crystallization involves crystallization from the frozen-in amorphous state (viz. brought about by quenching the high-temperature molten polymers to a temperature below their T_g's) of the polymers. The polymer samples should be stay at a temperature higher than its T_m first. Studies related to melt-crystallization of polymers are abundant, while those related to cold-crystallization are scarce.

Since the physical and mechanical properties of a semi-crystalline polymer are strongly dependent on the extent of crystallization and morphology formed during processing, studies on the inter-relations among the effects of crystallization conditions on crystallization kinetics, crystalline structure, crystalline morphology, and the resulting physical and mechanical properties are very important. Investigations related to chain conformation, crystal structure, and morphology in PTT have been reported extensively in recent years. Studies which have been carried out on the subject of isothermal crystallization kinetics of PTT include Avrami crystallization kinetics and the isothermal kinetics of the linear growth rates, while studies related to non-isothermal crystallization behaviour of PTT either from the melt or the glassy melt are unprecedented. Since normal processing conditions involve non-isothermal and non-isobaric crystallization conditions, studies related isothermal crystallization behaviour along are certainly not enough.

In the search for new polymeric materials, blending of polymers is a method for obtaining new desirable property combinations without having to synthesize novel structures. Generally, the final properties of the blends are strongly dependent on the developed crystallinity and morphology, occurring during the processing. In addition, the miscibility of components also affects the final properties of the blends. In order to ensure high temperature and environmental resistance, the high performance thermoplastics are usually characterized by a certain degree of crystallinity. Therefore, it is of interest to understand the miscibility of polymer blends containing at least one component capable of crystallizing.

Due to the above notion, the present contribution is aimed at studying the non-isothermal crystallization kinetics of PTT from both the melt and the glassy melt states and the results are reported in Chapters IV and V, respectively, while Chapter VI reported the results from the study in miscibility, melting behavior, crystallization kinetics, and morphology of the blends of PTT and PEN.