

# CHAPTER I

## INTRODUCTION



Nowadays the polymeric material can be considered to be one of the essential components in varieties of products, for example, household appliances, toys, electric and electronic equipment, automobiles. These products require different physical, chemical, electrical, mechanical, and other properties from the polymeric materials. The ability to improve these properties of the polymeric materials to meet the current and future demand is still the important research and development activities in both academic and industrial sectors.

New properties of polymeric materials can be obtained in several ways [Brydson, 1995]. The synthesization of new types of homopolymers and copolymers is always an option; however, the cost and time needed is quite substantial. Another way is to use proper additives to improve the processing and service properties of the polymeric materials. Still another way is to form polymer blends by blending or mixing existing polymeric materials, either homopolymer or copolymer or both, together to obtain new properties. Polymer blends has enjoyed wide spread interests from both academic and industrial sectors in the past few decades because of their relatively minor

capital investment and shorter period of time needed with respect to synthesization. In addition, polymer blends can fill the deficiency in price/performance of the existing homopolymers and copolymers [Paul and Newman, 1978].

The preparation of polymer blends can be accomplished by several methods such as melt mixing, solvent casting, freeze drying. Each method has its own advantages and disadvantages and can influence the resulting properties of polymer blends [Walsh, 1985]. Solvent casting has been widely used in many academic studies of polymer blends due to its simplicity. The solvent casting parameters, such as the casting temperature, the type of solvent used, the evaporation rate of solvent, can affect several properties, e.g. mechanical properties, crystallinity, and miscibility, of polymer blends obtained [Hirschbuehler and Thies, 1975; Runt and Rim, 1982; Eastmond and Haraguchi, 1983]. However, the effects of these parameters have still not been clearly understood. Thongyai [1994] had reported the effects of solvent casting on the phase diagrams of polymer blends of tetramethyl-bisphenol-A polycarbonate (TMPC) and polystyrene (PS). He found that the phase separation behaviour of blends of TMPC and PS prepared by solvent casting method from toluene occurred at higher temperature than that of blends prepared from melt mixing method. That is to say that the miscibility of the blends of TMPC and PS was improved by solvent casting method. However, only the blend at 50 wt% of PS was examined in his research. Other workers had also reported the effects of solvent on the resulting properties of polymer

blends obtained from solvent casting method [Varnell, Runt and Coleman, 1981; Semerak and Frank, 1987; Lu, Pearce and Kwei, 1995].

It is therefore very interesting to study the effects of small molecular solvents on the behaviour of phase diagrams of other polymer blends to better elucidate the effects of solvents on the properties of polymer blends obtained from solvent casting method. The polymer blend of styrene-acrylonitrile copolymer (SAN) and poly(methyl methacrylate) (PMMA) was chosen in this work because these polymer pair can be prepared by both melt mixing and solvent mixing methods. Their phase diagram exhibit the lower critical solution temperature (LCST) behaviour, i.e. the polymer blend transforms from transparent to cloudy state upon heating [Chiou, Paul and Barlow, 1982]. Two classes solvents, namely, weak hydrogen bonding solvent and moderate hydrogen bonding solvent, were used. In addition, the effects of traces of solvent on the tensile strength of SAN/PMMA blends were also studied.

## **1.1 THE OBJECTIVES OF THE PRESENT STUDY**

1.1.1 To study the effects of small molecular solvents used for casting polymer blends on the phase diagrams of SAN/PMMA polymer blends.

1.1.2 To study the effects of traces of small molecular solvents on tensile strength of the SAN/PMMA polymer blends at various blend compositions.

## 1.2 THE SCOPE OF THE PRESENT STUDY

The polymer blends of styrene-acrylonitrile copolymer (SAN) and poly (methyl methacrylate) (PMMA) at various compositions (10, 20, 30, 40, 50, 60, 70, 80 and 90 wt% of SAN) were prepared from solvent mixing method. Weak hydrogen bonding solvents, e.g. methylene chloride and 1,2-dichloroethane, and moderate hydrogen bonding solvents, e.g. acetone, tetrahydrofuran, and methyl ethyl ketone, were used. The phase diagrams were obtained by plotting the cloud point temperatures against blend compositions. The phase diagrams of SAN/PMMA blends prepared by melt mixing were also obtained. The effects of the 5 small molecular solvents on the behaviour of phase diagrams of SAN/PMMA blends were then evaluated.

The polymer blends of SAN/PMMA at various compositions (10, 20, 30, 40, 50, 60, 70, 80 and 90 wt% of SAN) were prepared from melt mixing method. The tensile strength of samples with and without traces of the five solvents above were measured and compared. The glass transition temperatures of these samples were also measured. The effects of these small molecular solvents on the tensile strength of SAN/PMMA blends were then evaluated.