CHAPTER I

Introduction

The dynamics spinodal decomposition of processes have been investigated both theoretically and experimentally in the field of small molecules concerning binary alloys, fluid mixtures, and inorganic glasses. In recent years, such studies have also become popular in the field of polymer blend systems. This is due to the high viscosity of polymeric systems associated with the connectivity of monomers, which slows down the dynamics and enables us to probe the phase separation behaviors over the wide time scales. According to experimental observations, the process of spinodal decompositions occurring in polymer blends can be qualitatively classified into three time regimes: (i) the early stage, where the spatial concentration fluctuations increase in amplitude while preserving the same wavelength; (ii) the intermediate stage, where both the amplitude and the wavelength increase with time; and (iii) the late stage, where the amplitude reaches the equilibrium value and only the wavelength grows with time.

For the early stage, the validity of the linear Cahn-Hilliard's theory has been examined with many experimental studies for polymer blends. However, the theory does not account for intrinsically nonlinear effects in the later stages such as coarsening. There are several theoretical explanations of late stage behavior such as the coarsening of domains with sharp interfaces, and the vaporization condensation mechanism. The domain growth in the late stage has been also studied by numerical and Monte Carlo simulation methods. The time dependence of the characteristic domain size was shown to satisfy a power law in the late stage. For polymeric systems, similar behavior was found in a detailed numerical study for three dimensions.

On the other hand, in the intermediate stage the nonlinear effects that are ignored in the Cahn-Hilliard's theory are known to become important, and the time dependence of the characteristic quantities different behavior than in the early and late stages. The theories have attempted to incorporate nonlinear effect into a theory of spinodal decomposition. Langer and workers have presented successful theories date. Other theories, that studied spinodal decomposition are Akcasu's theory and Nauman's thoery. These theories were created to explain the experiment results and modified Cahn-Hilliard and LBM's theories.

There were many researches observed the spinodal decomposition of polymer blends. but few researches were done to study about theory of spinodal decomposition to explain experimental results with new method.

For example, the research about spinodal decomposition of polymer blends was studied by Wang, Z.Y., et al [1993]. They studied the nonlinear theory of Langer, Bar-on and Miller by a new calculation method. They found that the results were compared with experimental data for polymer-blends system with respect to the value of theory. It was shown that the Langer, Bar-on and Miller theory can be used to describe the phase-separation behavior up to intermediate stages.

In this study, various theories of spinodal decomposition were studied. By fitting each theory with the same experimental data sets, the validity of theories can be achieved. Theories of Cahn-Hilliard, Langer, Bar-on and Miller, Akcasu ,et.al. and Nauman, et.al were chosen in this study ,and nobody has investigated these theories by using same data sets. Therefore, the studies of spinodal decomposition by new techniques are very interesting.

The study of each theory is very difficult because some theories are not in the form of structure function or intensity function, we therefore have to change them into an appropriate form and use them to fit data and calculate intensity data of spinodal decomposition theory.

1.1 THE OBJECTIVES OF THE PRESENT STUDY

To compare the light patterns from the small angle light scattering experiments to various spinodal decomposition theories of polymer blends, and to find the advantage and limitation of those spinodal decomposition theories.

1.2 THE SCOPE OF THE PRESENT STUDY

To compare the light patterns from the small angle light scattering experiments to spinodal decomposition theories of polymer blends, such as Cahn and Hilliard, Langer, Bar-on and Miller, Akcasu, and Nauman. The experimental data is in the form of light intensity, scattered angle and time.

From application of various spinodal decomposition theories, we will calculate the derivation of experimental data from each theory, then we will analyze to find the best theory that can be explained the experimental results. Moreover, we will analyze the difference between the experimental data and the predicted value from each theory.