CHAPTER I

INTRODUCTION

Light scattering by dispersions of particles and molecules has been a major technique for polymer analysis for many years. The classical (static) light scattering used to obtain the absolute weight-average molecular weights, radius of gyration, second virial coefficients, and molecular weight of the scatterers in dilute solution (6).

In fluid, the molecules are constantly in random motion, known as thermal motion or Brownian motion (17). Light scattered off these molecules will fluctuate in intensity. However, if the time period to collect the data is much longer than the particle motion time scale, the technique is equivalent to the steady state or static conditions. The well-known result from static light scattering is normally presented as a Zimm-plot (12).

The development of the laser in the 1960s and the concurrent widespread use of photomultiplier detectors was made the high resolution to detect and measure the scattering signal within a very short time interval. Therefore, the development of spectrum analysis can be considered. An autocorrelation function of the photomultiplier tube output signal enables the translational diffusion coefficient to be measured.

Pusey *et al.* (10) have studied the solution of polystyrene in toluene, and found that the diffusion coefficient increases with increasing concentration of solution. Moreover, if the concentration is lower than 20 mg/ml the diffusion coefficient depends on the concentration with a linear relationship, and if the concentration is higher than 20 mg/ml the relation is hyperbolic. Raju *et al* (10) have studied the solution of polystyrene in benzene and decalin with various molecular weights and concentrations from 1 mg/ml to 20 mg/ml. The diffusion coefficient of low molecular weight was found to decrease with increasing concentration while the diffusion coefficient of high molecular weight increased.

Dubin (3) has examined the effect of polydispersity on the spectrum of light scattered by macromolecules in solution. He considered a mixture of equal numbers of the same molecular weight but of different diffusion coefficients. He found only the average diffusion coefficient D. Thompson has studied polystyrene latex spheres in water and observed that the self-beat method was quite sensitive to detect small amounts of large particles in the presence of large numbers of small particles. Chu has studied the solution containing only two species of macromolecules by using the sum exponential with relative strength known.

In this work, the two species of polystyrene mixed in solution were studied by the photon correlation technique. This technique enables the translational diffusion coefficient of polystyrene in cyclohexane to be found. By varying the weight fraction of the two species we can explain the properties of each species such as the zero concentration diffusion coefficient, size, and second virial coefficient at various temperatures ranging from 37.2 °C to 49.8 °C. Under favorable conditions, the intensity per unit concentration of each sample and the fraction of weight concentration of polystyrene in solution can be known.