# Measurement of Diffusion Coefficients in CAB / MEK / Styrene Polymer Solutions Using Soret Forced Rayleigh Scattering Method

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In the casting process of highly functional films, complex structures inside the films are formed by multicomponent diffusion. To control the structure of the film, it is required to measure the cross diffusion coefficients in multicomponent solutions. We have developed a measurement technique for mutual diffusion coefficients in binary solutions, namely the Soret Forced Rayleigh Scattering Method (S-FRSM). It is a non-contact, high-speed measurement using laser heating and the Soret effect. The fringe patterned laser beams (Argon ion laser, wavelength 514.5 nm) heat a sample to form a temperature distribution and the Soret effect induces a concentration distribution. After the heating, the temperature distribution decays quickly whereas the concentration distribution remains. The concentration distribution then decays exponentially due to the mass diffusion. These processes are detected by a diffracted probe beam (helium-neon laser, wavelength 632.8 nm). By analyzing the decay time constant of the attenuating signal for the concentration distribution, the mutual diffusion coefficient can be determined. In the present paper, we have focused on applying S-FRSM to measure the diffusion coefficients of one polymer in two solvent mixtures. We have chosen CAB (Cellulose Acetate Butyrate) / MEK (Methyl Ethyl Ketone) / Styrene as a ternary solution. These materials are actually used for the film productions by the casting process. To begin with, we have measured the mutual diffusion coefficient of CAB/MEK, CAB/Styrene solutions (CAB 5 to 50 wt %), and MEK/Styrene mixture (MEK 10, 50, 90 wt %) at 25 degrees Celsius to estimate the main diffusion coefficients in the ternary solution. Furthermore, we have established the theory for cross diffusion phenomena. The signal waveform of the concentration distribution decay in ternary solution was different from that in binary solutions. Therefore, S-FRSM is capable for investigating the effect of cross diffusion in the ternary solution.