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Science Results from Ground Based Research (4)

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EXPERIMENTAL MEASUREMENT OF THERMODIFFUSION COEFFICIENTS

Abstract

Measurements of diffusion and thermodiffusion coefficients is achieved by using laser based optical digital technique. Because of simplicity, a Mach-Zehnder interferometer has been used. This method is non-intrusive, highly accurate and can provide a details 2-D transient visualization of temperature and concentration fields. Different binary liquid mixtures have been prepared from pure Decane, Dodecane, Isobutylbenzene and 1,2,3,4 Tetrahydronapthalene liquid. In this paper a comparison has been made between ground based data obtained from this technique and a theoretical approach based on irreversible thermodynamic theory. There are three steps to conduct the experiment. First step is the thermostabilizing with mean temperature, followed by the thermodiffusion with applied temperature gradient (second step) and the third step is the pure diffusion without temperature gradient. The duration of first step is 20 to 30 minutes. The second and third steps were 5 to 8 hours. In ground, gravity always plays negative role to separate of components due to thermodiffusion effect. To minimize the effect of gravity, the system has been heated from the top wall and cooled from bottom wall. Calibrated thermistors have been used to measure the temperature. Temperature was controlled by using PID temperature controller. Fringe images were recorded using CCD sensor for the entire experiment. In house post processing image analysis software has been developed to analyze the fringe images. Very good agreement has been achieved for the benchmark binary mixtures of Dodecane-Isobutylebenzene, Dodecane-Isobutylbenzene and Isobutylebenzene-1,2,3,4 Tetrahydronapthalene. The experiment has been extended towards two new binary mixtures of Decane-Isobutylebenzene and Decane-1,2,3,4 Tetrahydronapthalene. Two dimensional transient temperature and concentration evolution have been achieved and used to calculate thermodiffusion coefficients for all of the mixtures.