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Science Results from Ground Based Research (4)

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GROUND MEASUREMENTS OF MOLECULAR DIFFUSION IN MULTICOMPONENT LIQUID SYSTEMS IN THE FRAME OF THE DCMIX RESEARCH PROGRAM

Abstract

The DCMIX research program aims investigating the diffusive properties of ternary liquid mixtures under microgravity conditions. A series of experimental campaigns are conducted aboard the International Space Station. The implemented experimental technique is based on the interferometric measurement of the liquids. The thermodiffusion and the molecular diffusion coefficients are obtained by imposing a temperature gradient to the liquid and by measuring the compositional segregation.

Several ternary systems of very different chemical properties have been studied. During the first experimental campaign, DCMIX1, we investigated a series of regular systems composed of nDodecane, Isobutylbenzene and 1,2,3,4-Tetrahydronaphtalene. The diffusive properties approaching the demixing zone were studied for Toluene–Cyclohexane-Methanol systems during DCMIX-2. Changes in sign of the Soret coefficients in aqueous systems were studied for Water-Ethanol-Triethyleneglycol mixtures in DCMIX3. Finally, systems containing fullerene in Toluene-Tetrahydronaphtalene and Polystyrene in Toluene-Cyclohexane will be investigated during DCMIX4.

We report ground measurements of molecular diffusion coefficients performed under gravity conditions by the Open Ended Capillary technique. An innovative experimental procedure has been developed to optimize the accuracy of the identification the entire matrix of diffusion coefficients in multicomponent systems. We describe the experimental set up and the mathematical modeling and we report measured diffusion coefficients for a series of systems investigated in the frame of the DCMIX program. The obtained coefficients are compared to the data observed under microgravity conditions during the DCMIX experiments. The results are discussed and we present a detailed analysis of the evaluation of the accuracy on each of the obtained coefficients.