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Microgravity Experiments from Sub-Orbital to Orbital Platforms (3)

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GROUND MEASUREMENTS OF MOLECULAR DIFFUSION IN MULTICOMPONENT LIQUID SYSTEMS CONTAINING NANOPARTICLES AS A PREPARATION OF THE DCMIX4 MICROGRAVITY EXPERIMENT.

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 through several occurrences of the DCMIX experiment. 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.

In molecular diffusion studies, nanofluids represent a very interesting study system. Nanofluid particles are much larger in size than the solvents in which they are placed. As a consequence, nanoparticles should diffuse slower than their solvents. In the particular case of ternary systems, the study of such systems should allow particularly interesting observations about the couplings between diffusive processes. In the present paper, we report ground measurements of molecular diffusion coefficients performed under gravity conditions by the Open Ended Capillary technique, for Aluminum oxide, Silica oxide and fullerenes.