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Science Results from Ground Based Research (4)

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THE DCMIX PROJECT: MEASUREMENT OF THERMODIFFUSION PROCESSES IN TERNARY
MIXTURES ON GROUND AND IN SPACE

Abstract

Ternary mixtures play an important role as model systems for the understanding of non-isothermal transport phenomena in liquids. The DCMIX project of ESA aims to establish reliable reference data for the Soret effect in ternary liquids and serves as a nucleus for ground based work. Up to now, three DCMIX campaigns have been carried out aboard the International Space Station ISS. The investigated ternary mixtures are dodecane/isobutylbenzene/tetralin (DCMIX1), methanol/toluene/cyclohexane (DCMIX2) and water/ethanol/triethylene glycol (DCMIX3). DCMIX4 is scheduled for 2018. The microgravity experiments are performed by means of the SODI instrument, a digital Mach-Zehnder interferometer. The DCMIX3 campaign has been coordinated by the Bayreuth team, and supporting laboratory experiments for DCMIX are supported by the German Aerospace Center DLR. For a full characterization of a ternary mixture, it is necessary to extract six independent parameters from the measured data, which is particularly difficult in case of similar diffusion eigenvalues. A detailed analysis shows that, nevertheless, stable values for the thermodiffusion and the Soret coefficients can be obtained. Additional errors arise from the inversion of the contrast factor matrix, which is frequently ill-conditioned. Besides first results from microgravity experiments, a complete data set for the DCMIX1 system measured on ground will be presented. We have found that the sign for the Soret coefficient of tetralin is always positive and the one of dodecane always negative. The Soret coefficient of isobutylbenzene changes sign depending on the composition of the mixture. This finding can be rationalized on the basis of a recently introduced phenomenological thermophobicity concept. A similar sign change of one of the components has also been predicted in molecular simulations of isotopic ternary mixtures.