Transport Coefficients in a Ternary Mixture by Dynamic Analysis of Non-Equilibrium Fluctuations

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Experimental analysis of the dynamics of non-equilibrium fluctuations by light-scattering methods provides interesting information about the fluid transport properties, including the mass diffusion and Soret coefficients, as some of us demonstrated for binary mixtures [1]. Ternary mixtures are the next step beyond binary ones, and experiments on a molecular mixture of tetrahydronaphthalene/isobutylbenzene/n-dodecane [2] and on a polymer mixture of polystyrene/toluene/n-hexane [3] have been carried out. On those occasions, the focus was on the time decay of non-equilibrium concentration fluctuations at wave numbers large enough so that the gravity effects are negligible. This allowed us to obtain for the first mixture [2] an average of the two eigenvalues of the mass diffusion matrix, while for the second mixture [3] it was possible to obtain independent values for the two eigenvalues. Recently, the effects of gravity have been included in the theory, allowing a more detailed analysis of experimental data on a wider range of wave numbers [4]. In this work, we have subjected a ternary mixture of polystyrene/toluene/n-hexane to a vertical temperature difference. At the steady state, the applied temperature gradient generates, by Soret effect, a steady composition gradient. We have performed a dynamic analysis of non-equilibrium fluctuations by using our shadowgraph apparatus involving only one wavelength. Fitting experimental data for wave numbers ranging from 100 cm^{-1} to 1000 cm^{-1} allows us to obtain the two eigenvalues of the mass diffusion matrix as well as the two independent Soret coefficients of the mixture.

References:

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