Absorption of Sound Near the Critical Point of Stratification in Binary Solutions

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The consideration of kinetic phenomena near the critical points of solutions is widely based on the dynamic scaling hypothesis. It is assumed that there is a characteristic frequency, which is determined by the equilibrium correlation radius. Particularly, the absorption of sound per wavelength, which is conditioned by the relaxation of concentration fluctuations near the critical point of stratification, is determined by a universal function of reduced frequency. A lot of experimental work was devoted to the study of the absorption of sound near the critical point of stratification. However, only the results of measurements in the nitro-ethane/iso-octane system (M.A. Anisimov *et al.*) revealed a universal dependence of absorption per wavelength on the reduced frequency. However, those results cannot be considered to be final proof of the theory, since they were obtained for a narrow frequency range (4.2 to 15 MHz). For a wider experimental test of the dynamic scaling theory, we measured the absorption of sound in a nitrobenzene-hexane system (critical temperature 293.45 K, critical concentration 0.42 m.f. of nitrobenzene) in wide range of frequencies (0.05 to 100 MHz) and reduced temperatures (0.0001 to 0.1). Measurements of the absorption of ultrasound were carried out by static reverberation (0.05 to 3 MHz) and pulse (3 to 100 MHz) methods. The experimental error did not exceed 5 %. We compared the obtained results to the theory of relaxation of concentration fluctuations by Kawasaki. It was shown that for low reduced frequencies, the experimental results are in quantitative agreement with Kawasaki theory. For higher frequencies, there is a discrepancy between the theoretical predictions and the experimental data. The results of our measurements show that this discrepancy is explained by the fact that the theory does not take into account higher terms (with respect to the quadratic ones) in the expansion of the non-equilibrium pressure with respect to the degrees of order parameter.