Light Scattering Study of Tricritical Phenomena in Quaternary Solutions of Water, N-Decane, N-Undecane and Tert-Butanol

N. Wang
Department of Chemistry, Lanzhou University, Lanzhou, Gansu, China

X.-Q. An
College of Chemistry and Environment Science, Nanjing Normal University, Nanjing, China

W.-G. Shen[C, S]
Department of Chemistry, East China University of Science and Technology, Shanghai, China
shenwg@lzu.edu.cn

A series of quaternary solutions of water, n-decane, n-undecane and tert-butanol construct the quasi-ternary systems where the binary mixtures of n-decane and n-undecane may be taken as the quasi-pure components. The properties of these quasi components are determined by the mass ratio of n-decane to n-undecane, which controls the approach of the quaternary solutions to the tricritical point. At appropriate compositions a series of three coexisting phases from the upper critical temperatures to the lower critical temperatures may be observed.

We made a series of measurements of scattering light intensities from three coexisting phases at midpoint temperatures (the average of upper critical temperatures and lower critical temperatures) at various scattering angles for quaternary solutions of water, n-decane, n-undecane and tert-butanol with different mass ratios of n-decane to n-undecane. The correlation lengths of three coexisting phases at the different midpoint temperatures were deduced. The values of tricritical exponents relating to correlation length and susceptibility were obtained from analyses of the light scattering data and found to be in consistent with the classical predictions. The Griffiths first and second sums were calculated. It was found that our experimental results could be well described by the Griffiths second sum rule, while the Griffiths first rule seemed fail to describe our measurements. Our measurements indicate that the tricritcal exponents are classical, while the tricritcal amplitude ratios are nonclassical, which is consistent with what we observed recently in measurements of coexistence curves for the same systems.

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