

Scaling of the shear viscosity of the system nitrobenzene – *n*-heptane in the critical region

A DEGA-DAŁKOWSKA

Institute of Physics, A Mickiewicz University, Grunwaldzka 6, 60–780 Poznań, Poland

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Abstract. The temperature dependence of shear viscosity of the system nitrobenzene-*n*-heptane has been studied near the critical concentration. The critical exponent of the shear viscosity Φ was calculated from the empirical formula $\eta = \eta_{id} \varepsilon_{sp}^{-\Phi}$ and compared with the theoretical and experimental results obtained for other critical systems. The shear viscosity satisfies scaling law relations similar to those previously established for equilibrium properties.

Keywords. Critical phenomena; binary liquid mixtures; shear viscosity; critical exponent.

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1. Introduction

On approaching the critical point of liquid mixtures many of the physical quantities exhibit a characteristic behaviour which may be described as follows (Sengers and Sengers 1978; Kumar *et al* 1983):

$$L = L_B + L_C = L_B + A|\varepsilon|^{-\lambda} \left(1 + \sum a_i \varepsilon^{\Delta_i} + \dots \right), \quad (1)$$

where L_B is the 'background effect', which describes the part of the quantity L that does not show critical effects, $\varepsilon = (T - T_c)/T_c$, A is the amplitude, λ the critical exponent, a_i and Δ_i are the amplitudes and exponents describing the corrections to the scaling.

According to the recent theory of critical phenomena (Sengers and Sengers 1978; Pfeuty and Toulouse 1978) all systems that belong to a given universality class (d, n) where d is the dimension of the space and n the dimension of the order parameter, are characterized by the same values of the universal parameters (that is critical exponents). The renormalization group technique enables the determination of the accurate values of critical exponents for each universality class (d, n). The values thus obtained have been unified experimentally.

Dynamic renormalization group theory (Halperin *et al* 1974; Siggia *et al* 1976; Hohenberg and Halperin 1977; Bhattacharjee and Ferrell 1983) and mode-mode coupling theory (Kawasaki 1976; Kawasaki and Gunton 1978) provide the following relation describing the shear viscosity in the vicinity of the critical point:

$$\eta = \hat{\eta} \cdot (\xi_t \cdot \Lambda)^{z_\eta} = \hat{\eta} \cdot (\xi_0 \cdot \Lambda)^{z_\eta} \varepsilon^{-\Phi_\eta}, \quad (2)$$