Critical behavior of a supercritical cell fluid

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The analytic method for the description of the critical behavior of the fluid system at temperatures above the critical value of T_c (in the supercritical region) is developed on the basis of a cell fluid model. The collective variables approach [1] is used. The role of the interaction potential is played by the Morse potential [2] possessing the Fourier transform. The behavior of a cell fluid model with allowance for non-Gaussian fluctuations of the order parameter is considered near the critical point in the formalism of the grand canonical ensemble. A calculation technique, elaborated in [3] for the grand partition function, thermodynamic potential and equation of state of the model within the framework of the simplest non-Gaussian quartic distribution, supplements the previous study based on the mean-field approximation. The latter is not valid in the close vicinity of the critical point.

The obtained nonlinear equation linking the average density and the chemical potential is investigated. Proceeding from the obtained equation of state, the curves describing the dependences of the pressure and isothermal compressibility on the density are presented for various values of the relative temperature [3]. The Widom line for a supercritical cell fluid is constructed taking into account the extreme values of the isothermal compressibility. A specific feature of the approach is to use exclusively microscopic characteristics of the model (parameters of the interaction potential) for obtaining macroscopic quantities (pressure and other macroscopic quantities). The developed approach can be applied to the description of a phase transition in simple liquid alkali metals.

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2. J.K. Singh, J. Adhikari, and S.K. Kwak, Fluid Phase Equilib. **248**, 1 (2006).
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