Adsorption, Order-Parameter Profile, and Surface Tension in the Extended Critical Region

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The phenomenological generalization of the crossover equations obtained on the basis of the renormalization group method [1] are applied to the analysis of the nonasymptotic crossover behavior of the adsorption, order-parameter profile in the interface and near a wall, and surface tension of one-component fluids in the wide temperature range around the critical point. Crossover expressions for the adsorption and surface tension can be represented as universal functions of the rescaled dimensionless temperature $t = (T/T_c - 1)/Gi$, where Gi is a Ginzburg number. In the asymptotic critical region at temperatures $t \ll 1$ the crossover model reproduces the well-known equations for the order-parameter profile and adsorption coefficient [2,3]. At $t \gg 1$ the obtained equations transform into the corresponding mean-field equations. The results of our calculations in the asymptotic regimes exhibit an excellent agreement with both theories.

A comparison with experimental data have been made for the Sugden parameter and the surface tension of carbon dioxide and ethane. A good agreement between experimental values and theoretical predication is observed in the temperature range $10^{-3} \ll t \ll 10^{3}$.

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