

Disorder Parameter As Factor of Asymmetry in Real Fluids

Vitaly Rogankov^{C,S}

Department of Physics, Odessa State Academy of Refrigeration, Odessa, Ukraine

In this work the phenomenological continuum model of a fluid phase transition in water from triple up to critical point is presented as an alternative to the conventional crossover formalism based on the discrete decorated lattice models. By contrast to the scaling variants of EOS, the developed description of coexistence curve (CXC) is consistent with the continuum van der Waals-type fluctuational EOS (FEOS). The undimensional T-dependent parameter $As(T)=(T/Ps)(dPs/dT)$ is incorporated as the main measurable quantity to control the real interrelation between the order parameter and disorder (sg-sl)-parameters in the framework of thermodynamic Clapeyron equation. It is known that former is the main factor of asymmetry in the expansions truncated after linear terms and consistent with the scaling CXC-description of the extended critical region. In the FEOS-formalism the coupled disorder parameter is introduced as a factor of asymmetry in real fluids which is absent, as a rule, in discrete spin systems. An existence of some analogy between the continuum and discrete approaches is demonstrated at low and moderate subcritical temperatures of water. First of all, it is presence of the particle-hole-type symmetry similar to that in the lattice-gas model. At low temperatures the "liquid-like branch" of the symmetrical "phase diagram" coincides with the stable branch of saturated liquid while the "gas-like branch" is localized completely within the spinodal of water. It is shown at high subcritical temperatures that the possible divergency of "CXC-diameter" can be explicitly represented in terms of near-critical behavior observed for dAs/dT . In opposite to the conventional crossover approach, the developed FEOS-formalism does not incorporate any analytical or nonanalytical (Wegner's-type) truncated expansions with the fitted asymmetrical terms and mixed scaling variables. Only the input CXC-data are necessary to transform them into three T-dependent FEOS-coefficients without any adjustable parameters. The discussed method provides the adequate representation of the whole subcritical range and the reliable prediction of one-phase properties on the basis of known CXC-data. It is much simpler than the alternative approaches in which the standard equality of unmeasurable, model-dependent chemical potentials is used for the phase-diagram predictions.