Calorific Properties for Inhomogeneous Liquid Under Gravity Near the Critical Point

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The field (high-altitude), $\Delta\mu \sim h$, and temperature, t, dependences of the entropy $s=dF_f/dt$, the heat capacity at constant volume $C_v=d^2F_f/dt^2$ and the thermal expansion $\alpha_t=d^2F_f/dtd\mu$ of the inhomogeneous substance under gravity field, h, near the critical point have been investigated on the basis of the fluctuation theory of phase transitions (FTPT) [1] and by using the behavior of the free energy surface of the system $F_f(\Delta\mu,t)$ [2]. On the basis of the FTPT [1] and theory of gravity effect [3] the equations for these calorific properties of inhomogeneous system have been derived for the three limiting critical directions (critical isochor, critical isotherm and phase interface). It has been for the first time revealed that the heat capacity and the thermal expansion of inhomogeneous substances have the non-monotonic temperature and field (high-altitude) dependences in the supercritical temperature region ($t > 0$) with the maximums at heights $h > 0$ or $h < 0$. The maximum values of heat capacity correspond to the critical point only when $t \geq 0$, $h \geq 0$. The equations for the lines of the extremes of the high-altitude [4] and temperature dependencies of the heat capacity and the thermal expansion have been obtained on the basis of the linear model of a parametric equation of state. These conclusions correspond to the experimental studies of the heat capacity in small confined systems under the terrestrial conditions [5] and also under the cosmic conditions of micro-gravity [6].

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