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Nature of a Supercritical Mesophase

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Abstract : It has been reported that at temperatures above the critical there is no “continuity of liquid and gas”, as originally hypothesized by van der Waals. Rather, both gas and liquid phases, with characteristic properties as such, extend to supercritical temperatures. Each phase is bounded by the locus of a percolation transition, i.e. a higher-order thermodynamic phase change associated with percolation of gas clusters in a large void, or liquid interstitial vacancies in a large cluster. Between these two-phase bounds, it is reported there exists a mesophase that resembles an otherwise homogeneous dispersion of gas micro-bubbles in liquid (foam) and a dispersion of liquid micro-droplets in gas (mist). Such a colloidal-like state of a pure one-component fluid represents a hitherto unchartered equilibrium state of matter besides pure solid, liquid or gas. Here we provide compelling evidence, from molecular dynamics (MD) simulations, for the existence of this supercritical mesophase and its colloidal nature. We report preliminary results of computer simulations for a model fluid using a simplistic representation of atoms or molecules, i.e. a hard-core repulsion with an attraction so short that the atoms are referred to as “adhesive spheres”. Molecular clusters, and hence percolation transitions, are unambiguously defined. Graphics of color-coded clusters show colloidal characteristics of the supercritical mesophase.

Keywords : critical phenomena, mesophase, supercritical, square-well, critical parameters
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