Heterophase states and secondary liquid phase

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Ya.I. Frenkel has developed the theory of non-interacting heterophase fluctuations [1] which was reconsidered by M. Fisher [2] in the droplet model of critical phenomena. The fluctuon model of interacting heterophase fluctuations generalizes Frenkel's model and gives description of the essentially heterophase liquid states [3,4]. As shown in [5], frustration plays a key role at the mode of liquid-to-glass transformation determining the width of glass transition temperature range. In [5] volumetric interaction of fluctuons was ignored. Meanwhile, just this interaction causes correlations of fluctuons, as follows from Bogolyubov's theory.

A fluctuon model of heterophase state, taking into account the frustration and volumetric interactions of heterophase fluctuations, is formulated and used for description of the heterophase liquid states. Within the framework of this model the theory of the fluid solidification is developed. It is found that the width of a temperature band of a glass transition is proportional to the renormalized frustration parameter. The equations for a pair correlation function of fluctuons are deduced and the solutions of these equations are found at the pair volumetric interactions described by Yukawa potential. It is shown that volumetric interaction under special condition cause formation of the fractal aggregates of fluctuons. The fractal dimension is larger than 1 and equal to or less than 3. The correlation length is considerably larger than the range of Yukawa potential. It is shown that the liquid state with the fractal fluctuon aggregations (the Fischer cluster) is a secondary phase. Thermodynamics of the secondary phase is investigated. It occurs that that transformation of the secondary phase into primary one and vice versa is the 1^{st} order phase transition. The relaxation spectrum (ultra slow modes) of the fluctuon pair correlations is determined.

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