Is the glass-forming melt in equilibrium state?

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Abstract

Is the glass-forming melt in equilibrium state?
The four convenient states of glass-forming substance are "the stable equilibrium liquid (**L**), the metastable supercooled liquid (**SCL**), the unstable nonequilibrium glass (**G**), and the stable crystal (**C**)" [1]. If one considers glass as the *self-organizing* system [2,3] then even glass-forming melt ($T > Tm$) does not correspond to equilibrium state whose properties depend only on temperature at a given pressure. Using a special method for analysis of the viscosity-temperature data [4,5] the dynamical liquid-liquid transitions (DLLT) are demonstrated for both the true melt (**L**) and the supercooled liquid (**SCL**). Each DLLT represents a transition from one viscous pattern to another; there is no a definite pattern $\eta i(T)$ at a given temperature range but a set of possible patterns belonging to the attractor characteristic for the substance. Glass (**G**) structure is formed by the thermally activated bond waves [2,3], which are orientated by information fields [6] existing during solidification. Such a self-organized structure not necessarily relaxes into crystal (**C**), and the fate of glass is determined by a competition between the translation-type crystalline long-range order and the orientation-type bond wave one.

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