Another scenario for glass transition phenomena

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In the traditional framework[1)] of glass transition phenomena, the slow dynamics of glass forming liquids has attributed to supercooling; Configurational entropy, which is an entropy difference between supercooled liquid and crystalline states, has been the issue of the discussion. But this framework propounds some critical problems including famous Kauzmann paradox[2)]. Furthermore, it cannot answer more essential question of how to apply thermodynamics to non-ergodic glass state. The scenario for glass transition phenomena has not been concluded.

Under this situation, we have constructed another scenario for glass transition phenomena, which is very different in its essential basis from the traditional one. We seek the origin of slow dynamics to liquid-liquid phase transition (LLT) not to supercooling. This scenario can solve the Kauzmann paradox. Furthermore, it is enable to give a clear meaning to fragility[3)] index, whose entity has not been understood now. It predicts fragility index increases with pressure, which is consistent with the experimental result of liquid glycerol[4)].

In this poster presentation, we indicate the formalism of our scenario. In addition to the scenario itself, we also show our experimental results as an experimental basis for the validity of seeking the origin of glass transition to LLT. In liquid Se-Te mixture, which is a system not only a good glass-former but also a system exhibiting LLT, characteristic properties for glass forming liquids such as density inhomogeneity (fluctuation)[5)], relaxation intensity[6)], and relaxation time[7)] change much in conjunction with LLT not with supercooling. We also comment on whether the glass ‘transition’ is suitable to be regarded as a phase transition and how to apply thermodynamics to the non-ergodic glass systems.

We believe that our scenario can give a new perspective to understand glass transition phenomena. We are welcome many comments and criticisms on it.

References:
1) G. E. Gibson et al, J. Am. Chem. Soc. 45, 93 (1923)
2) W. Kauzmann, Chem. Rev. 43, 219 (1948)
3) C. A. Angell, Science 267, 1924 (1995)
4) R. L. Cook et al, J. Chem. Phys. 100, 5178 (1994)
5) Y. Kajihara et al, Phys. Rev. B 86, 214202 (2012)
6) Y. Kajihara et al, J.Phys.: Condens. Matter 20, 494244 (2008)
7) M. Yao, Y. Kajihara, et al, J. Non-Cryst. Sol. 312–314, 361 (2002)