Phenomenology of the Glass Transition

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This article and other articles in this folder are mainly informed by [2].

1 Strong and fragile glass

Glasses are often said to be very, very thick liquid. This claim is not that correct, actually. Viscosities of liquids usually obey the Arrhenius equation [1]

$$\eta = A \exp\left(\frac{E_a}{RT}\right), \tag{1}$$

and the $\log \eta$ - T_g/T relation is a straight line. Some glasses indeed have such a behavior and we call them **strong glasses**. Strong glasses can be viewed as thick liquids, which behave just like liquids but with a longer time scale. On the other hand we have **fragile glasses**, in which the $\log \eta$ - T_g/T relation is not a straight line: The larger T_g/T is, the faster η grows. The distinction between the two kind of glasses are shown in Figure 1 on page 1. We can say that the glass former of a strong glass is willing to form glass, so in a broad temperature range we can observe glass-liquid transition, while the transition temperature region is narrower for fragile glasses, so we say that the glass is *fragile* in that it is easily disturbed by the temperature. Note that *fragility* of glasses has nothing to do with *brittleness*. The meaning of the latter is the everyday meaning of "fragile".

The existence of fragile liquid means that

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References

[1] Tandy Grubbs. Viscosities of simple liquids - temperature variation. https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Exercises%3A_Physical_and_Theoretical_Chemistry/Data-Driven_Exercises/Viscosities_of_Simple_Liquids_-_Temperature_Variation. Accessed: 2021-11-17 03:59:58.

[2] AN Li-Jia LI Yan-Wei, SUN Zhao-Yan. Glass and glass transition. *Glass and Glass Transition*, 31(3):1, 2016.

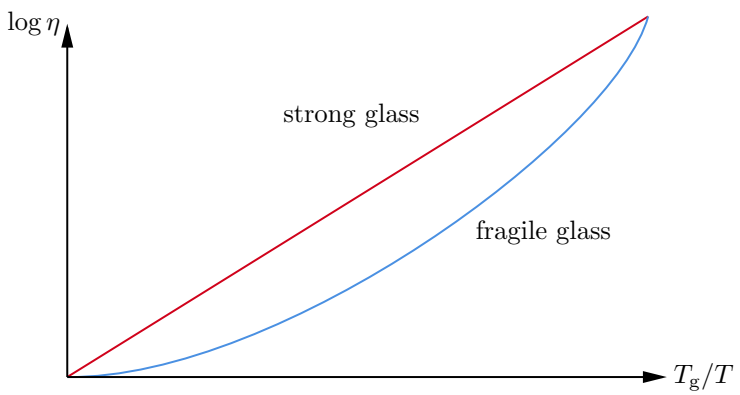

Figure 1: Viscosities of strong glasses and fragile glasses. Figure taken from Figure [2].