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Heterogeneous enthalpy relaxation in glasses far from equilibrium

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I present the complexity and heterogeneity of the sub-T_g enthalpy relaxation in glasses far from equilibrium, i.e., hyperquenched (HQ) glasses. The relaxation data are obtained using the hyperquenching – annealing – calorimetric scan approach. The extent of the heterogeneity of the sub-T_g relaxation increases with the liquid fragility. It is the heterogeneity of relaxation that results in challenges in modeling the relaxation process when using the existing phenomenological models. Here I report some preliminary results that my research group has achieved in modeling the sub-T_g relaxation. Two major modifications have been made with respect to the TNM model describing structural relaxation in glasses. First, a new stretching function is proposed and introduced into our approach to describe the broad, complex distribution of relaxation times, and hence, to model the heterogeneous enthalpy relaxation. Second, the substantial broadening of the glass transition region during the hyperquenching process is found and taken into account during modeling. To some extent, we have succeeded in modeling the sub-T_g enthalpy relaxation of relatively fragile HQ glasses by applying the modified model. However, the modified model is not capable of describing the fragility dependence of the enthalpy relaxation. The physical foundation needs to be established. Finally, I point out both problems encountered in our modeling work, and perspectives in the future modeling work.