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Hu, Lina; Yue, Yuanzheng

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Abnormal enthalpy relaxation of germanium dioxides in the merging region: does Johari-Goldstein β relaxation exist in strong glasses?

Lina Hu, Yuanzheng Yue
Section of Chemistry, Aalborg University, Denmark

The merging of the primary α -relaxation and secondary relaxations (especially Johari-Goldstein β -relaxation), which occurs at a temperature somewhat above the standard glass transition temperature (T_g), has attracted much attention in recent years. For strong glasses with typical network structures, however, the secondary relaxation process, as well as the α - β merging region, is not well studied and understood due to the lack of a peak or a shoulder in the loss spectrum on the high frequency side of the primary α -relaxation. The present work focuses on the relaxation of the hyperquenched GeO₂ glasses. Upon fibre drawing, the GeO₂ glass is hyperquenched, and, hence, the liquid structure is frozen-in at a temperature well above T_g , but rather close to the liquidus temperature. Afterwards, the hyperquenched glass is subjected to annealing and subsequently to calorimetric scanning, by which information on enthalpy relaxation is obtained. The calorimetric results show that the enthalpy of the GeO₂ glass – one of the strongest glass systems, relaxes in quite a different manner than fragile systems. In the α - β merging region, all the primary α relaxation proceeds via the secondary relaxation. By using Williams's ansatz, we carried out further analysis on the dynamic properties of the secondary relaxation, in order to discover whether this secondary relaxation is real Johari-Goldstein β type or not. This study attempts to clarify whether the Johari-Goldstein β -relaxation is the intrinsic feature of the supercooled liquids and glasses. Such clarification is important for understanding glass transition phenomenon.