New model to simulate the relaxation behavior of glass

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Abstract

Glass is non-equilibrium material which spontaneously relax to the equilibrium liquid state. The structure relaxation can cause changes in most properties, including the dynamics of phase separation and crystallization. During the glass transition, relaxation from different atomic scale could be observed. In this work, a homemade experimental setup "ARABICA" is used, which couple DSC, Raman and Brillouin spectroscopy. The enthalpy information from DSC (short range order), the structural information from Raman scattering (short to middle range order) and the elastic information from Brillouin scattering (long range order) could be observed in the same time.
Typically, glasses would be cycled around the glass transition in the DSC with the different heating rate (0.5, 1 and 5 K/min) but after same cooling rate (200 K/min). To succeed good measurement it is then needed to have a glass with big glass stability and a high polarizability. The glass materials, which are used in this work, is Na2O-GeO2. Na2O-GeO2 glasses have a higher intensity in Raman and Brillouin spectrum, however, it is easily crystallize. From the first measurement the crystallization temperatures were determined. Later the samples were never heated above Tc-50∘C. In that way no crystallization was observed.
After the measurement from "ARABICA", a new model was created by using the data in isothermal system and using a distribution of activation energy. This model was then used to simulate non isothermal experiments. The results are compared to the data in dynamic situation obtained during thermal scan. Supposing the liquid state as the reference state did not able to reach good agreement.

Keywords: relaxation, Brillouin spectroscopy, relaxation model

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