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Stretch-Induced density fluctuations in glassy polymers MIKIHITO TAKENAKA, SHOTARO NISHITSUJI, SHIMIZU HIROFUMI, Kyoto University, SHIN'YA YOSHIOKA, Osaka City University — Glass materials are hard but fragile. The fragileness of glass strongly depends on its processing and the heterogeneity developed during the processing in glass materials may be important in its destruction under deformation. However, the mechanism how the heterogeneity develops into cavitation or cracking is not well understood. Here we show that the stretch induced the violation of the incompressibility by the coupling between the stretch and density fluctuations due to the strong density dependence of viscosity in glassy polymer. We demonstrate that the small-angle X-ray scattering intensity of a glassy polymer increases with stretch and exhibits so-called butterfly pattern. This butterfly pattern agrees with that calculated with the Navier-Stokes equation including the density dependence of viscosity proposed by Furukawa and Tanaka [Nature, 443, 434 (2006)]. Moreover, the shear-thinning behavior agrees with the simulation results with the Navier-Stokes equation. Our results explored that the origin of the cavitation of glassy polymer is the violation of the incompressibility by the coupling between the stretch and density fluctuations.

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