Molecular cooperativity in the dynamics of glass-forming systems
LIANG HONG, PURUSHOTTAM GUJRATI, Department of Polymer Science, the University of Akron, Akron, Ohio 44325, VLADIMIER NOVIKOV, ALEXEI SOKOLOV, Chemical Sciences Division at ORNL, Oak Ridge, Tennessee 37837 —

The mechanism behind the sharp slowing down of the main structural relaxation in a glass-forming liquid upon approaching the glass transition remains a great puzzle. Most of the theories relate this mechanism to the cooperativity in molecular motion. On the other hand, the collective vibration in the pico-second time region, the so-called boson peak, is also described as a cooperative process. In our recent work (L. Hong, et al., J. Chem. Phys., in print), we demonstrated that the collective vibrations and the main structural relaxation involve a similar length scale of cooperative molecular motions. More importantly, we found that the cooperativity length scale in different materials directly correlates to only one part of the mechanism of slowing down the structural relaxation, i.e., the dependence of the structural relaxation on volume. In this presentation, we will further demonstrate that this correlation holds true not only for different chemical species, but also for the same chemical specie with different molecular weight or under pressure. The results are compared to predictions of theoretical models.

Liang Hong
Department of Polymer Science, the University of Akron, Akron, Ohio 44325

Date submitted: 06 Jan 2010

Electronic form version 1.4