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Developing a molecular picture for polymer glasses under large deformation[1] SHI-QING WANG, SHIWANG CHENG, PANPAN WANG, University of Akron — Polymer glasses differ from most other types of glassy materials because they can be ductile under tensile extension. Remarkably, a ductile polymer can turn brittle and vice versa. For example, upon cooling, the glass changes from ductile to brittle at a temperature known as the brittle-ductile transition temperature (BDT). Aging causes the ductile glass to be brittle. Mechanical "rejuvenation" or pressurization brings a brittle glass into a ductile state. Finally, one glass can be ductile 100 degrees below T_g while another polymer is already brittle even just 10 degree below T_g. Polystyrene and bisphenol A polycarbonate are at the two extremes in the family of polymer glasses. How to rationale such a wide range of behavior in terms of a molecular picture has been a challenging task. What is the role of "chain entanglement"? Since many of the procedures including the temperature change do not alter the "chain entanglement", it is clearly insufficient to explain the nature of the BDT in terms of the entanglement density. Our work attempts to answer the question of what then is the role of chain networking. We have formulated a molecular picture that presents a unifying and coherent explanation for all the known phenomenology concerning the BDT and condition for crazing.

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