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How mechanical behavior of glassy polymers enables us to characterize melt deformation: elastic yielding in glassy state after melt stretching?[1] SHI-QING WANG, ZHICHEN ZHAO, MESFIN TSIGE, YEXIN ZHENG, department of polymer science, university of akron — Fast melt deformation well above the glass transition temperature Tg is known to produce elastic stress in an entangled polymer due to the chain entropy loss at the length scale of the network mesh size. Here chains of high molecular weight are assumed to form an entanglement network so that such a polymer behaves transiently like vulcanized rubber capable of affine deformation. We consider quenching a melt-deformed glassy polymer to well below Tg to preserve the elastic stress. Upon heating such a sample to Tg, the sample can return to the shape it took before melt deformation. This is the basic principle behind the design of all polymer-based shape-memory materials. This work presents intriguing evidence based on both experiment and computer simulation that the chain network, deformed well above Tg, can drive the glassy polymer to undergo elastic yielding. Our experimental systems include polystyrene, poly(methyl methacrylate) and polycarbonate; the molecular dynamics simulation is based on Kremer-Grest bead-spring model.

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