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Pinpointing the onset of mechanical rejuvenation in a polymer glass by monitoring segmental dynamics before and after a constant strain rate pulse[1] KELLY HEBERT, JOSH RICCI, KELLY SURALIK, M.D. EDIGER, Univ of Wisconsin, Madison — Over time, dynamics in polymer glasses become slower through physical aging; it is thought that post-yield mechanical deformation may reverse the effects of physical aging in what has been termed "rejuvenation". We have monitored segmental dynamics in a poly(methyl methacrylate) glass before and after reversing constant strain rate pulses of varying magnitude to explore the onset of mechanical rejuvenation. We find that the segmental dynamics in the glass is unperturbed after pulses to $\varepsilon/\varepsilon_{\text{yield}} = 0.6$ or less. For pre-yield pulses of higher magnitude, we find evidence of rejuvenation, which is indicated by faster dynamics after the pulse. We find that full rejuvenation only occurs at a strain of $\varepsilon/\varepsilon_{\text{yield}} = 3$ or higher. This work is qualitatively consistent with recent simulations of Smessaert and Rottler and additionally shows quantitative agreement with predictions from the theory of Chen and Schweizer. However, in spite of observed enhanced dynamics on a molecular level, we find that large pre-yield pulses do not alter the mechanical response of the polymer during subsequent deformation. We explore the apparent contradiction between the macroscopic mechanical and molecular-level dynamical response of the glass to deformation.

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