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Direct Measurement of Molecular Mobility in Actively Deformed PMMA Glasses HAU-NAN LEE, KEEWOOK PAENG, STEPHEN SWALLEN, MARK EDIGER, Department of Chemistry, University of Wisconsin-Madison —
To quantitatively understand the response of segmental motions to external stress, we performed optical measurements of dye reorientation in PMMA glasses during tensile creep deformation. Up to 1000-fold increases in mobility are observed during deformation, which supports the view that stress-induced mobility allows plastic flow in polymer glasses. Although the Eyring model describes this mobility enhancement well at low stress, it fails to capture the dramatic mobility enhancement after flow onset. In this regime, in addition to lowering the barriers for molecular motion, external stress apparently forces the shape of distribution of relaxation times to narrow significantly. The effect of stress on physical aging was also investigated. At low stress, physical aging and deformation-induced mobility act as two independent processes. However, after flow onset, the data are consistent with the view that aging has been erased by deformation.

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