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Formation of Polymer Glasses Under Stress and Its Influence on Physical Aging LAURA GRAY, PAUL YOON, CONNIE ROTH, Department of Physics, Emory University — Understanding and controlling the stability and physical aging of polymer glasses is important for many technological applications from gas separation membranes to optical coatings. We investigate the stability of polymer glasses when thermally quenched under different stress conditions. Ellipsometry is used to measure the physical aging rate of polystyrene films supported or transferred onto silicon wafers. We quantify the time-dependent decrease in film thickness that results from the increase in average film density during aging to obtain a physical aging rate. We have observed significant differences between films quenched in a free-standing versus supported state, even though all films were aged in a supported state. Films quenched in a free-standing state exhibit a strong thickness dependence to their physical aging rate at micron length scales, an order of magnitude or two larger than thicknesses where nanoconfinement effects on the glass transition and modulus are typically observed. In contrast, supported films do not display any film thickness dependence to their aging rate at this large length scale. All available evidence suggests that different stress conditions are the underlying cause of this effect. In order to investigate the role of stress during the vitrification of polymer glasses, we have constructed a unique jig to apply a known stress to free-standing films during the thermal quench.

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