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A Length Scale for the Free Surface of Polymer Films ETHAN GLOR, MARY KLING, NOLAN AVERBUCH, ZAHRA FAKHRAAI, University of Pennsylvania — Recent work in polymer physics shows that the relaxation dynamics near a free surface of a thin polymer film are significantly different from that of the bulk polymer. While experiments directly probing the surface and bulk relaxation dynamics are rare, the effect of this difference can be seen in the properties of some polymer thin films. For instance, studies have shown that polystyrene thin films exhibit a decreased glass transition temperature with decreased thickness. A common explanation for this observation is that the mobile surface occupies a greater percentage of a thin film, thus the average relaxation dynamics of the film is affected, and the glass transition temperature decreases. Despite extensive research in this area, little is known about many fundamental questions of this mobile surface layer, including the penetration depth of the layer and the mechanism by which the free surface of a polymer film is more mobile. In this study, we use ellipsometry to measure the Tg of polystyrene films of various film thicknesses, molecular weights, and at various cooling rates. From these experiments, we estimate both a length scale and molecular weight dependence for the depth of enhanced mobility near the free surface.

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