MAR14-2013-020062

Abstract for an Invited Paper
for the MAR14 Meeting of
the American Physical Society

A direct quantitative measure of surface mobility in a glassy polymer

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Thin polymer films are widely used in applications and have striking dynamical properties that differ from their bulk counterparts. With the simple geometry of a stepped polymer film on a substrate, we probe mobility above and below the glass transition temperature $T_{\rm g}$. Above $T_{\rm g}$ the entire film flows, while below $T_{\rm g}$ only the near surface region responds to the excess interfacial energy. An analytical thin film model for flow limited to the free surface region is developed and shows excellent agreement with sub-$T_{\rm g}$ data. The system transitions from whole film flow to surface localized flow over a narrow temperature region near the bulk $T_{\rm g}$. The experiments and model provide a measure of surface mobility in a sample geometry where confinement and substrate effects are negligible.

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