

Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

How Polymers Diffuse in Molecularly-Thin Films LIANG HONG, STEVE GRANICK, University of Illinois at Urbana-Champaign — We explore the fundamental question, how polymer diffusion in molecularly-thin films differs from that in isotropic melts comprised of the same polymer. To explore this, a new surface forces apparatus was developed to enable, for the first time to the best of our knowledge, spectroscopic measurement in addition to force measurements of the traditional kind. Here we describe experiments using fluorescence correlation spectroscopy (FCS) and fluorescence recovery after photobleaching (FRAP). Melts of polydimethylsiloxane (PDMS) were confined between atomically-smooth mica surfaces at carefully controlled separations. Translational diffusion of the polymer was measured as a function of film thickness and molecular weight. We show that adsorption slows surface diffusion by over three orders of magnitude and that this effect propagates to thickness roughly 3 times the unperturbed radius of gyration (R_G). Confinement between two opposed surfaces further reduces the diffusion coefficient (D) by at most a factor of 5. Spatially-resolved measurements elucidate how D furthermore depends on the local pressure that squeezes the thin film, as well as on molecular weight.

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Date submitted: 18 Nov 2006

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