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Molecular Visualization of the Spreading Process HUI XU, DAVID SHIRVANYANTS, University of North Carolina at Chapel Hill, KATHRYN BEERS, NIST, KRZYSZTOF MATYJASZEWSKI, Carnegie Mellon University, MICHAEL RUBINSTEIN, SERGEI SHEIKO, University of North Carolina at Chapel Hill —

We carried out atomic force microscopy studies of a polymer melt spontaneously spreading on a solid substrate with molecular resolution. Along with the position of the contact line, AFM enabled clear visualization of the molecules at every stage of the spreading process. Thus, one obtained direct information about (i) the position of the center of mass, (ii) orientation, and (iii) the local curvature for every individual molecule in its unique environment. Three characteristic rates, i.e. the spreading rate of the precursor film D_{spread}=$(3.9\pm0.2)\times10^3$ nm^2/s, the flow-induced diffusion rate of molecules within the film $D_{induced}$=1.3 ± 0.1 nm^2/s, and the thermal diffusion coefficient of single molecules D_{therm} $\leq0.10\pm0.03$ nm^2/s, were independently measured. Since $D_{spread} >> D_{induced}$, plug flow of polymer chains was identified as the main mass-transport mechanism of spreading with insignificant contribution from the molecular diffusion.

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