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Polymer Surface Diffusion as a Function of Molecular Weight

JANET WONG, STEVE GRANICK, Dept. Materials Science and Engineering, University of Illinois at Urbana-Champaign — This talk describes the first measurements to elucidate polymer surface diffusion over the full range of surface concentration and as a function of molecular weight. The model system, polystyrene adsorbed onto mica and quartz from chloroform, was selected to allow molecular weight (M) to vary by more than 2 orders of magnitude and the surface coverage to vary by more than 3 orders of magnitude. Spatially-resolved measurements of surface translational diffusion (D_s) were made using fluorescence correlation spectroscopy (FCS), which is a single-molecule technique. The value of D_s was found to scale as a power-law in M. Remarkably, the absolute value of the power-law was -1 for mica and the most homogeneous quartz surfaces, -3/2 for less homogeneous quartz surfaces, and never took intermediate values. Explanations remain speculative but appear to involve the dominance of Rouse and reptation diffusion mechanisms, respectively. In the latter case, curvilinear motion is guided not by entanglement with other chains but instead by patchiness (topographical and chemical) of the surface adsorption sites.

Janet Wong
Dept. Materials Science and Engineering,
University of Illinois at Urbana-Champaign

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