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Structure and Dynamics of Thin Molten Polymer Films

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While capillary wave theory accurately describes the surface structure simple liquids, complications arise for molten polymer films. The polymers high viscosity freezes long wavelength modes, Van der Waals interactions with the substrate modify the energetics, and the large molecular size leads to the failure of continuum hydrodynamics at nanometer length scales. X-ray scattering provides valuable information needed to understand polymer films at scales where these effects become important. Specular and diffuses scattering from polymer surfaces show capillary waves dominate the surface structure at long length scales, but indicates deviations from capillary wave roughness at nanometer length scales. Coherent x-ray scattering measurements of the relaxation rate of capillary wave fluctuations show remarkably good agreement with continuum theory for thick films and long wavelength modes [1]. Wide- angle x-ray scattering excited by standing waves measures density fluctuations as a function of depth within a liquid film and indicates that the near surface region of a film has modified properties. This work was funded by NSF Grant DMR- 0209542. [1] Hyunjung Kim et. al., Phys. Rev. Lett. 90, 068302 (2002)