

Recent Studies of Fluctuations in Polymer Films using XPCS

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In this talk, we shall discuss the use of dynamic off-specular X-ray scattering to study the dynamics of fluctuations in thin molten polymer films deposited on a solid substrate as they approach the glass transition. The results have revealed new insights into the effects of entanglement and the nature of the glass transition in these systems. Unlike bulk liquids, the adsorption and entanglement effects at the substrate result in the appearance of a shear modulus which manifests itself in the dynamics of the surface capillary wave relaxations, particularly when the film thickness approaches $2R_g$, where R_g is the radius of gyration of the chains. As the glass transition temperature is approached, the relaxation develops multiple relaxation times and finally approaches that given by the dynamics of only that portion of the chains corresponding to the molecular entanglement length. No evidence is found for a lower viscosity liquid surface layer on the films as has been surmised from previous observations that T_g is lowered from the bulk value as the film thickness approaches R_g .

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