Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Rheological Response of Ultrathin Polymer Films[1] GREGORY MCKENNA, PAUL O'CONNELL, Texas Tech University — A novel microbubble inflation experiment has been developed for the purpose of measuring the biaxial creep compliance response of ultrathin polymer films. Here we have performed experiments on two polymeric films, poly(vinyl acetate) (PVAC) and polystyrene (PS) having thicknesses ranging from 25 to 100 nm. Three findings come from these studies. 1) PVAc films show a segmental dynamics that is quantitatively the same as in the bulk with no reduction in the glass temperature T_g for even the thinnest films; 2) early results suggest that for the thinnest PS films the T_g decreases by up to 30 ^{o}C which demonstrates dramatically and quantitatively that the segmental dynamics of nanometer thick polymer films do not follow a universal behavior, i.e., the results seem to depend on chemical structure; 3) for both polymers we find that the creep compliance increases from the glassy value to a rubbery plateau that is greatly reduced from the bulk behavior, i.e., the stiffness is increased. This result suggests that entanglements in ultra thin films are much more effective than they are in the bulk—perhaps because of the two-dimensional aspect of the film.

[1]Thanks to NSF under grant DMR-0304640 and the U.S. Army ARO under grant W911NF-04-0207 for partial support of this project.

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Date submitted: 01 Dec 2004 Electronic form version 1.4