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The stiffening of ultrathin polymer films in the rubbery regime – the relative contributions of bending, membrane stress and surface tension PAUL O'CONNELL, GREGORY MCKENNA, Texas Tech University — A novel nano-bubble inflation technique has been developed which allows the determination of the absolute creep compliance of ultrathin polymer films as thin as 9 nm. Previous results have shown that the degree of reduction in Tg with film thickness is not universal, with PVAc showing no change in Tg down to 23nm while PS shows a significant reduction at thicknesses below approximately 80nm. Interestingly the rubbery plateau region for both materials shows a similar stiffening as the thickness is reduced. At low inflation pressures the film is dominated by the bending stiffness of the film while at higher pressure the film is under membrane conditions and the response is dominated by the biaxial stiffness of the film. In addition the film is subject to surface tension effects. Compliance data have been measured as a function of applied pressure and have been analyzed to determine the relative contribution to the response from these three modes. The results suggest that at sufficiently large deformations the bending contribution is small while the surface tension contribution varies depending on loading conditions, film thickness etc. However neither contribution is sufficient to account for the observed stiffening in the rubbery regime

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