Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Measuring the relaxation dynamics and thermo-mechanical properties of ultrathin polymer glasses CHRISTOPHER M. STAFFORD, JUN YOUNG CHUNG, DOYOUNG MOON, JACK F. DOUGLAS, Polymers Division, NIST — The measurement of the mechanical properties and relaxation dynamics in ultrathin films is experimentally difficult. In this talk, we present a new wrinkling-based method to measure the temperature dependence of the Young's modulus in thin and ultrathin polymer films. This method can also capture the relaxation dynamics of these films at temperatures near and below Tg, as the wrinkling patterns decays back to being flat. We find that the temperature dependence of the modulus conforms to a pattern of behavior found in diverse amorphous solids. Curiously, the apparent activation energy for the rate of wrinkling relaxation progressively decreases as the films becomes thinner, approaching a value comparable to the high temperature activation energy observed in bulk fluids. This trend, along with a broadening of Tg, is consistent with simulations and independent previous measurements, suggesting that film confinement progressively suppresses collective motion in ultrathin glassy polymer films.

Christopher M. Stafford
Polymers Division, NIST

Date submitted: 14 Dec 2009 Electronic form version 1.4