Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Residual Stress Relaxation and Stiffness-Confinement Effects in Polymer Films: Characterization by Non-Contact Ellipsometry and Fluorescence Techniques SHADID ASKAR, JOHN TORKELSON, Northwestern University — The relaxation of residual stresses in spin-coated polymer films is characterized using two optical techniques: ellipsometry and fluorescence. Both techniques show that residual stresses relax over hours at several tens of degrees above the film glass transition temperature (Tg). Ellipsometry shows that thickness can increase or decrease during residual stress relaxation depending on thermal history of the film. However, the presence or relaxation of stresses has no measurable effect on Tg as measured by ellipsometry. We have adapted the well-known sensitivity of the pyrene dye fluorescence spectral shape to local environment polarity in order to characterize stress relaxation and to monitor stiffness-confinement effects. The spectral shape of the pyrene fluorescence spectrum shows similar stress relaxation regardless of whether relaxation is accompanied by increases or decreases in film thickness. Fluorescence also indicates that single-layer polystyrene films supported on silica stiffen with decreasing nanoscale thickness. For the first time, stiffness gradients as a function of distance from interfaces are demonstrated using pyrene label fluorescence in conjunction with multilayer films.

Shadid Askar
Northwestern Univ

Date submitted: 14 Nov 2014 Electronic form version 1.4