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Non-Contact Measurements of Stiffness in Confined PS Films by Fluorescence and XPCS CHRISTOPHER EVANS, Northwestern University, SURESH NARAYANAN, ZHANG JIANG, Argonne National Lab, JOHN TORKELSON, Northwestern University — Fluorescence is used to detect stiffness in confined polystyrene (PS) films through the intensity ratio (I3/I1) of the dye molecule pyrene. Free-standing PS films show a softening (an increase in I3/I1) when the film thickness decreases below 400 nm, and a stiffening (a decrease in I3/I1) below thicknesses of 200 nm. Silica- and PDMS-supported PS films show no softening but report stiffening for films less than 200 nm thick, a result not in accord with the Tg reductions seen for PS on silica. X-ray photon correlation spectroscopy (XPCS) also reports stiffening in PS on silica through the relaxation times of capillary waves at the polymer surface. A two order of magnitude increase in relaxation time is observed for small in-plane wavevectors (q) in a 30 nm PS film compared to a 120 nm film. Bilayer films of PS supported on various bulk underlayers studied by XPCS indicate that lower substrate modulus leads to faster PS surface relaxation times. These are the first reported non-contact measurements related to stiffness in confined PS on silica.

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