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Quantifying Crazing Deformation in Ultrathin Polymer Films YANG JIAO, MING-SIAO HSIAO, ANDREW GILLMAN, PHILIP BUSKOHL, LAWRENCE DRUMMY, RICHARD VAIA, Air Force Rsch Lab - WPAFB — The mechanical stability of ultrathin polymer films is not only of fundamental importance, but also critical to applications like nanoelectronics. The fragile nature of ultrathin films and sensitivity to the environment, present difficulties to quantifying mechanical properties, and thus discrepant results may be found in the literature. Here, we examine the plastic deformation of polystyrene (PS) films (20-300 nm) using an elastomer support to delay stress localization. Adhesion to and geometric constraint of the elastic substrate suppresses stress localization within the thin film, impeding film rupture, and allowing measurements of craze initiation and width evolution. Additionally, orthogonal compressive buckling provides an independent measurement of film stiffness. For PS, the strain onset of craze widening increases with molecular weight, and decreases with film thickness. These measurements are consistent with prior reports using the copper-grid technique and the ultrathin film tensile test; and confirm the molecular weight-dependence of fibril stability and the film thickness-dependence of break stain. Confirmation of this platform provides an alternative technique to assess deformation mechanisms of emerging materials, such as assemblies of polymer grafted nanoparticles.

Yang Jiao
Air Force Rsch Lab - WPAFB

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