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The Onset of Plasticity in thin Polymer Films BEKELE J. GURMESSA, ANDREW B. CROLL, North Dakota State University — Polymers are widely used materials because of their numerous advantageous mechanical properties, for example their high degree of toughness. Despite the fundamental importance of the onset of plastic deformation to many material processes, it is still relatively poorly defined in the literature. Here we employ a carefully designed experimental method in order to evaluate the point of onset of plasticity in thin, glassy polystyrene films. Essentially we utilize the residual stress caused by local bending in the thin film. We show that plastic failure is initiated at extremely low strains, of order 0.1% for polystyrene. Not only is this critical strain small in comparison to bulk measurement, we also show that it is influenced by thin film confinement - leading to an increase in the critical strain for plastic failure as film thickness approaches zero. Finally, the same experimental method is used to investigate the response of confined block copolymer thin films in the ordered and disordered state.

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