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Local stress in thin polystyrene films BEKELE GURMESSA, ANDREW CROLL, Department of Physics, North Dakota State University — Thin polymer films have received significant attention due to the deviation of material properties from bulk values. Part of the difficulty in describing the underlying physics is an incomplete understanding of how internal and surface stresses affect thin films. Here we exploit "wrinkling" to create a simple model system in which local stress can be easily tuned. When a thin polymer film bound to an elastic substrate is subjected to a compressive stress the film buckles out of plane. Due to the curvature at each crest and trough of the wrinkles, there arise local stresses in the polymer film. The curvature of the wrinkles is controlled by the modulus of the film and substrate, the film thickness and the applied stress, allowing us to apply an arbitrary local stress. After wrinkling, films are annealed above their glass transition temperature which allows flow and relaxes any stress. The local stress is then transferred to that of a thickness variation in the thin film. Importantly the flow of thin polymer films can be modeled using the well established lubrication theory, resulting in a simple scaling model. Our model allows us to investigate the response of thin films where deviations from bulk behavior are expected, as well as more complex thin diblock polymer films.

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