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Wrinkling of Inhomogeneously Strained Thin Polymer Films YU-CHENG CHEN, ALFRED J. CROSBY, University of Massachusetts Amherst — Wrinkles occur due to a mechanical instability when sufficient strain is applied to an incompressible thin film attached to a deformable substrate. For wrinkles made with a polymer film supported on a soft elastomer, the amplitude is directly proportional to the wavelength and the square root of the applied strain. This dependence has been confirmed with ideal substrates where the global strain is homogeneously distributed, but the influence of strain inhomogeneity has not been considered previously. We use the contact line wrinkling technique to prepare polystyrene thin films with periodic regions of different wrinkle amplitudes, hence strains, on soft substrates. The surfaces with inhomogeneous wrinkle amplitudes and directions approach a homogeneous structure upon the application of sufficiently large strains. The surface becomes homogeneous at a relatively small strain due to the growth rate difference between pre-wrinkles and new wrinkles. Moreover, we find the pre-wrinkled region starts strain localizing prior to the initially flat region. We derive relationships to describe these processes, providing fundamental knowledge of the wrinkling mechanism.

Yu-Cheng Chen
University of Massachusetts Amherst

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