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**Rolling Wrinkles on Elastic Substrates** MICHAEL IMBURGIA, ALFRED CROSBY, Univ of Mass - Amherst — The mechanics of rolling contact between an elastomer layer and a thin film present unique opportunities for taking advantage of elastic instabilities, such as surface wrinkling, to create patterned surfaces. Here we present a plate-to-roll(P2R) geometry to laminate a thin film onto an elastomer layer in order to induce surface wrinkling. First, a poly(dimethylsiloxane)(PDMS) layer is draped around a roller and pressed into contact with a poly(styrene)(PS) film supported on a plate. Once rolling begins, the PS film preferentially laminates onto the PDMS layer. During this process, the deformation of the PDMS layer can induce wrinkling when the contact load exceeds a critical value. Wrinkle feature size consists of amplitudes of $0.2 - 4\mu m$ and wavelengths of $15 - 20\mu m$. Wrinkle amplitude can be controlled by contact load and roller curvature, as well as the mechanical properties and thickness of the film and elastomer. We develop semi-empirical equations to describe the effect of contact load and roller curvature on the wrinkle aspect ratio. Finite-element modeling of an elastomer layer in rolling contact with a rigid plate is used to support experimental results. Using these models, wrinkle-based technologies such as optoelectronics and enhanced adhesives can be envisioned.

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