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Deterministic Wrinkling Patterns of Thin Polymeric Coatings on Soft Substrates JIE YIN, Department of Mechanical Engineering, Massachusetts Institute of Technology, JOSE L. YAGUE, Department of Chemical Engineering,Massachusetts Institute of Technology, KAREN K. GLEASON, Department of Chemical Engineering, Massachusetts Institute of Technology, MARY C. BOYCE, Department of Mechanical Engineering, Massachusetts Institute of Technology
— Wrinkling surface patterns in soft materials have become increasingly important for a broad range of applications including stretchable electronics, microfluidics, thin-film property measurement, wetting and adhesion, and other surface area and topology controlled phenomena. Thermal and swelling mismatch between the thin surface layer and the soft substrate lead to spontaneous formation of buckling-induced disordered labyrinth patterns, which exhibit a mechanistically-determined short wavelength, but an undetermined and highly varied long wavelength. In this paper, analytical and computational models are presented to create deterministic wrinkling patterns through directed buckling methods, which capture the physics of the instabilities governing the formation of multiple wavelength wrinkling patterns, providing a predictive tool for design of deterministic wrinkling patterns. The fabrication of the deterministic patterns is accomplished using novel chemical vapor deposition processes. The role of these patterns in providing multifunctional performance is illustrated and discussed.

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