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Wrinkling and Buckling in Freestanding Bilayer Films (G)*

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Periodic wrinkling of a rigid capping layer on a deformable substrate is a ubiquitous example of pattern formation in nature. Many experiments have studied wrinkle formation during the compression of thin rigid films on relatively thick pre-strained elastic substrates. The resulting wrinkling wavelength and amplitude can be predicted by minimizing the bending energy of the rigid film and the deformation energy of the soft substrate. To date, most wrinkling studies have focused on the regime where the substrate thickness can be considered semi-infinite relative to that of the rigid film. In this work we use optical and atomic force microscopy to study the wrinkling behaviour of thin rigid films upon compression by a pre-strained freestanding elastic substrate which cannot be considered semi-infinite. As the ratio of substrate to rigid film thickness is decreased, the system transitions from the semi-infinite wrinkling regime to one in which the entire bilayer film buckles upon compression. This transition is found to be strongly dependent on the pre-strain in the elastic film.

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