Multiscale folding patterns and energy scaling in compressed thin films

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Thin films under compression develop complex folding patterns which show fold branching and refinement towards the boundary. Such patterns arise e.g. when a film is deposited at high temperature on a substrate with a larger thermal expansion coefficient than the film. Upon cooling debonding and subsequent folding can arise.

Following earlier work of Ortiz and Gioia, I will discuss a recent result on the optimal scaling of the energy of a thin film under compression which leads to two predictions. First, refinement of folds towards the boundary is neccessary for energy minimization. Second, a finite fraction of the energy concentrates near the boundary. These results hold both for fully nonlinear 3d elasticity, and reduced theories, such as the Föppl-von Kármán theory and the geometrically nonlinear bending theory of plates. A key ingredient in the setting of 3d nonlinear elasticity is a new rigidity estimate for deformations with low elasticity energy.

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