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A finite element study of the stability of spontaneous curling of thin shells XIAOMIN HAN, Thayer School of Engineering, Dartmouth College, QIAOHANG GUO, College of Material Science and Engineering, Fuzhou University, KEVIN CHU, Serendipity Research, IAN TRASE, NAN HU, ZI CHEN, Thayer School of Engineering, Dartmouth College — Thin shells are of great interest in engineering due to their ubiquity in nature. The mechanical instabilities of thin shells are a key factor in understanding many real world phenomena, such as the closure of a Venus flytrap or the curling of a dried leaf. Given the analytical theory that quantitatively described the stability of thin shells subject to surface stress, we are able to identify a dimensionless parameter that controls the stability of thin shells. Finite element analyses are employed to numerically examine the predictions. Bilayer plates are fabricated where one layer is pre-stretched and has much smaller Young's modulus than the other layer to examine mechanical instability. By measuring the two principle curvatures on the plate, the onset of bifurcation can be determined. Different initial conditions and material properties are taken into account in the FEA, including initial curvature, Poisson's ratio, and the magnitude of surface stress. The numerical experiments agree well with the theory.

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