Mechanics of Film Instability

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Morphological wrinkling of a soft material with a stiff thin layer has been widely observed both in nature and in modern industry. A basic characteristic of such film/substrate systems is their ability to experience large deformation under compressive stresses, which inevitably leads to formation of patterns on the surface. Such pattern formation is often the result of loss of stability or symmetry breaking. Knowledge on how such instabilities arise and evolve is essential to describe, understand, predict, and ultimately to design complex functional materials and structures, for example the fabrication of stretchable electronic devices and micro/nano-scale surface patterning control. In the first part of this talk, quantitative prediction of various instability patterns based on advanced computational methods and theories will be presented, from planar to curved geometry. All the cases involve highly nonlinear deformations and multiple bifurcations. The second part of this talk will be focused on our recent contributions in mechanics of hyperelastic membranes and 2D materials.

Fan XU is full professor of solid mechanics at Fudan University (China). He received his bachelor's degree in engineering mechanics from Wuhan University (China) in 2009, and his master's degree in solid mechanics from Arts et Métiers ParisTech (France) in 2011. He completed his PhD in solid mechanics from University of Lorraine (France) in 2014, studying mechanics of instability of film/substrate systems. He continued to work in LEM3-CNRS as a postdoctoral researcher, and expanded his interests to mechanics of soft materials and slender structures. His current research interests include mechanics of thin films, soft matters, metamaterials and 2D materials. He has published more than 20 papers in SCI journals such as Phys. Rev. Lett., Nat. Biomed. Eng., J. Mech. Phys. Solids, Int. J. Solids Struct., Int. J. Eng. Sci., Int. J. Nonlinear Mech., and Extreme Mech. Lett. His research was highlighted as picture story by Nature Physics. He received the ASME Prize (French section) by American Society of Mechanical Engineers (ASME) in 2016, and was selected as "Ten Emerging Star Scientists in China" in 2018.
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