Incompatible surface growth

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Abstract

A variety of natural and artificial processes rely on active mass deposition on the surface of a solid body. The associated class of phenomena is quite broad, including processes as diverse as growth of plants, cell motility, construction of retaining walls, formation of planets, crystallisation from solution and 3D printing. Surface growth is understood in this context as a continuous addition of new layers of mass on the external boundary of a solid. In elastic systems surface growth is usually accompanied by the development of geometrical incompatibility, leading to residual stresses and triggering instabilities. In [3, 2] we have developed a linearized theory of incompatible surface growth which quantitatively links the deposition protocols with post-growth states of stress. More recently, in [1] we have extended this analysis to account for both physical and geometrical nonlinearities of an elastic solid. This new development, which is highlighted in this submission, reveals the shortcomings of the linearized theory, in particular, its inability to describe kinematically confined surface growth and to account for growth-induced elastic instabilities.

References

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