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Island Size Scaling and Evolution during Strained Film Epitaxy
ZHI-FENG HUANG, Department of Physics and Astronomy, Wayne State University, KEN ELDER, Department of Physics, Oakland University — Strained film growth often gives rise to the self assembly of nanostructures such as quantum dots or islands. While there has been and continues to be much interest in such behavior the fundamental mechanisms that determine the precise morphologies remain unclear. In this work the phase field crystal model, which incorporates the atomic length and diffusive time scales, and the corresponding amplitude equations are used to examine this phenomenon. Direct numerical simulations of the model and a linear stability analysis of the amplitude equations are presented. The results predict that the average island size is inversely proportional to the strain. This result is consistent with recent experiments on SiGe, but inconsistent with the predictions of classic continuum elasticity theory (or the Asaro-Tiller-Grinfeld instability). Basic mechanisms identified in our study, which are associated with the crystalline nature but absent in all continuum approaches, are discussed.

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