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Electromigration-driven morphological evolution of monolayer-thick epitaxial islands on substrates DIMITRIOS MAROUDAS, DWAIPAYAN DASGUPTA, GEORGIOS SFYRIS, Department of Chemical Engineering, University of Massachusetts Amherst — Electromigration-driven dynamics, with and without the simultaneous action of elastic strain, can lead to pattern formation of surface morphological features that may have significant impact on nanofabrication. An important example is epitaxial islands on substrates; for heteroepitaxial islands, misfit strain is induced due to lattice mismatch with the substrate. We develop a fully nonlinear model for the driven morphological evolution of monolayer-thick coherently strained islands on crystalline elastic substrates with diffusional mass transport limited to the island circumference. We carry out self-consistent dynamical simulations of such island dynamics, combining front tracking methods with solutions to the corresponding electrostatic and elastostatic boundary-value problems. We develop a universal scaling theory that explains the simulation results for the dependence of the island migration speed on the island size, electric field, and epitaxial system parameters for isolated, morphologically stable islands. We investigate systematically thermal, elastic, and size effects on the migration and morphological evolution of heteroepitaxial islands. We also find and characterize a variety of stable asymptotic states in the driven dynamical response of such heteroepitaxial islands.

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