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Current-driven complex dynamics of single-layer epitaxial islands on substrates DWAIPAYAN DASGUPTA, DIMITRIOS MAROUDAS, University of Massachusetts Amherst — We study theoretically the current-driven dynamics of isolated single-layer epitaxial islands on crystalline substrates, which provides important guidance toward surface nanopatterning approaches based on the current-driven assembly of such islands. We develop and validate a fully nonlinear model for the islands' driven morphological evolution on elastic substrates of face-centered cubic crystals in the regime where diffusional mass transport is limited to the island edge. For islands on ⟨110⟩-, ⟨100⟩-, and ⟨111⟩-oriented substrate surfaces, we report a transition in the asymptotic states reached by such driven island dynamics from steady to oscillatory, mediated by Hopf bifurcation. We characterize the bifurcation and explore the dependence of the stable time-periodic state beyond the Hopf point on the misorientation angle between the applied electric field and fast edge diffusion directions, the strength of the edge diffusional anisotropy, and the island size. For islands larger than a critical size, depending on the orientation of the substrate surface, we observe fingering and necking instabilities in the island morphology. We carry out a comprehensive numerical simulation study and explore the complexity of the driven island dynamics with the variation of the problem parameters.

Dwaipayan Dasgupta
University of Massachusetts Amherst

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