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Current-Driven Nanowire Formation on Crystalline Conducting Substrate Surfaces DWAIPAYAN DASGUPTA, ASHISH KUMAR, DIMITRIOS MAROUDAS, Univ of Mass - Amherst — Using a simulation study, we demonstrate a new, driven-assembly-based approach to single-layer nanowire formation on fcc crystalline substrate surfaces. In this approach, we manipulate individual epitaxial islands using an external electric field to drive the formation of single nanowires or arrays of them. We have developed and validated a fully nonlinear model of current-driven island evolution mediated by diffusional mass transport along the island edge and accounting for edge diffusional anisotropy and island coalescence and breakup. Using a linear stability theory, we analyze the morphological stability of islands with equilibrium shapes and predict the occurrence of morphological instability for islands larger than a critical size under the action of an electric field along the slowest edge diffusion direction on {110}, {100}, and {111} substrate surfaces. Consistent with the theoretical prediction, dynamical simulations show that large-size islands undergo a fingering instability which, following finger growth and, depending on the substrate orientation, necking instability, leads to formation of single or multiple nanowires. We find that the nanowires have constant widths, on the order of tens of nanometers, and explain analytically the nanowire dimensions.

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