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Electromigration-driven surface morphological stabilization of coherently strained thin films on elastically deformable substrates GEORGIOS SFYRIS, RAUF GUNGOR, DIMITRIOS MAROUDAS, Department of Chemical Engineering, University of Massachusetts Amherst — We study the surface morphological stability of a coherently strained thin film grown epitaxially on a substrate and subjected to an external electric field; both infinitely thick and finite-thickness elastic substrates are examined. Due to its lattice mismatch with the substrate material, the film may undergo a Stranski-Krastanow (SK) instability, resulting in formation of islands on the film surface. To examine the morphological stability of the epitaxial film's planar surface state, we conduct a linear stability analysis based on a three-dimensional model of driven surface morphological evolution. We also consider the use of thin compliant substrates, which partly accommodate elastically the lattice-mismatch strain. We find that, regardless of the substrate type, the simultaneous action of a properly applied and sufficiently strong electric field is necessary to stabilize the planar morphology; in such cases, surface electromigration can inhibit SK-type instabilities and control the onset of island formation on the film surface. Our analysis shows that the critical electric-field strength required to stabilize the planar morphology of a thin film on a compliant substrate can be reduced by up to two orders of magnitude compared to that for a conventional thick substrate.

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