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Electromigration- and thermomigration-driven surface morphological stabilization of coherently strained thin films on elastically deformable substrates GEORGIOS I. SFYRIS, DWAIPAYAN DASGUPTA, DIMITRIOS MAROUDAS, 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 and temperature gradient. Due to its lattice mismatch with the substrate the film may undergo a Stranski-Krastanow (SK) instability, resulting in formation of islands on its surface. We consider various types of substrates placing emphasis on compliant substrates that partly accommodate elastically the lattice-mismatch strain in the epitaxial film. To examine the morphological stability of the film's planar surface state, we conduct a linear stability analysis based on a three-dimensional model of driven film surface morphological evolution. We find that the simultaneous action of properly applied and sufficiently strong external fields is necessary to stabilize the planar film surface morphology; in such cases, surface electromigration and thermomigration can inhibit SK-type instabilities and control the onset of island formation on the film surface. We derive the conditions for synergy and competition of the two external fields for surface stabilization and demonstrate the beneficial effects of the thermal field on reducing the critical electric-field strength required to stabilize the planar film surface morphology.

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