Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Surface morphological stabilization of crystalline solids under the simultaneous action of electric, thermal, and mechanical fields DWAIPAYAN DASGUPTA, GEORGIOS SFYRIS, RAUF GUNGOR, DIMITRIOS MAROUDAS, Department of Chemical Engineering, University of Massachusetts Amherst — We report a detailed analysis of the morphological stability of planar surfaces of electrically and thermally conducting stressed crystalline elastic solids under the simultaneous action of an electric field, an imposed temperature gradient, and uniaxial tension. Our analysis is based on linear stability theory and self-consistent dynamical numerical simulation according to a fully nonlinear model that accounts for curvature- and stress-driven surface diffusion, surface electromigration and thermomigration, as well as surface diffusional anisotropy. Our self-consistent dynamical simulations combine a front tracking method for monitoring surface morphological evolution with Galerkin boundary-integral computations of the displacement and temperature fields and the electrostatic potential. We determine the surface morphological stability domain boundaries and the critical values of the applied electric-field strength and temperature gradient required to stabilize the planar surface morphology. We explore the synergistic or competing effects on the surface morphological response of the simultaneously applied thermal and electric fields, aiming at optimization of the electric-field strength and temperature gradient requirements for planar surface stabilization.

Georgios Sfyris
Department of Chemical Engineering, University of Massachusetts Amherst

Date submitted: 11 Nov 2011 Electronic form version 1.4