Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

High Resolution Numerical Model of Optically Heated Float-Zone Crystal Growth with Applied Magnetic Field YUE HUANG, BRENT HOUCHENS, Department of Mechanical Engineering and Materials Science, Rice University — During optically heated float-zone crystal growth processing, thermocapillary forces drive a flow in the melt. This steady, axisymmetric base flow is susceptible to instabilities, resulting in defects as the final crystal is solidified from the melt. To damp these instabilities, a magnetic field is employed. The stability of this flow, neglecting buoyancy, is studied with a full-zone model. The velocity and temperature fields are calculated by a spectral collocation method using Chebyshev polynomials as basis functions. Obtaining accurate base flows is crucial to the success of the subsequent stability analysis. A 2nd order vorticity transport representation is compared with a 4th order stream function representation. At low Hartmann numbers, the results are in good agreement. However, as resolution demands increase, the 2nd order vorticity transport formulation yields a better numerical representation by avoiding large computational errors caused by 4th and 3rd derivatives of Chebyshev terms in the 4th order stream function representation. This allows the stability analysis to be carried out at larger Hartmann numbers, where the critical thermocapillary Reynolds number is much greater.

Yue Huang
Department of Mechanical Engineering and Materials Science, Rice University

Date submitted: 02 Aug 2008 Electronic form version 1.4