Integrated thermo-magneto-hydrodynamic control of Bridgman growth of semiconductor single crystals[1]

Baskar Ganapathysubramanian and Nicholas Zabaras
Materials Process Design and Control Laboratory
Sibley School of Mechanical and Aerospace Engineering
188 Frank H T Rhodes Hall
Cornell University
Ithaca, NY 14853-3801

The manufacturing of a semiconductor single crystal through the Bridgman process is a complex thermo-mechanical phase transition process. There have been significant advances in terms of enhancing the quality of the crystal by controlling the thermal and hydrodynamic processes during solidification. We will illustrate an integrated computational approach for the design and control of the solidification processes for producing high quality single crystals. This is based on a 3D simulator of the crystal growth process in the presence of an imposed magnetic field and varying thermal gradients. A 3D optimization problem is posed to design the temporal variation of the magnetic field and/or the imposed thermal gradients in order to achieve certain goals. These goals include maximizing the pulling rate, minimizing the thermal gradient imposed, as well as controlling the shape of the melt-solid interface.

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