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On the Numerical Solution and Limitations of Energy Equation for Vertical Bridgman System with Varying Temperature Gradient at the Boundary

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Abstract: In vertical Bridgman crystal growth systems solid-liquid interface shape is one of the most important factors affecting the product quality. Most of the theoretical studies to determine the interface shape consider the numerical solution to the heat-conduction and the energy equation. The purpose of this work is to present and discuss a numerical solution to the energy equation (also called the convection-diffusion equation) for a vertical Bridgman system with varying temperature gradient at the boundary. Different system parameters are examined and the importance of the pulling rate for different materials in the utilization of the energy equation is emphasized. The limitations and the accuracy of the energy equation in describing the interface shape are presented and discussed. A finite difference scheme is utilized for the numerical solution using different approaches to the problem and the results are obtained for different temperature profiles and crucible radii. It is observed that the slope of the axial temperature profile within the material is mainly affected by the crucible translation rate.

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