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Analysis of the traveling heater method for the growth of cadmium telluride

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Abstract

We discuss the development and implementation of a comprehensive mathematical model for the traveling heater method (THM) that is formulated to realistically represent the interactions of heat and species transport, fluid flow, and interfacial dissolution and growth under conditions of local thermodynamic equilibrium and steady-state growth. We examine the complicated interactions among zone geometry, continuum transport, phase change, and fluid flow driven by buoyancy. Of particular interest and importance is the formation of flow structures in the liquid zone of the THM that arise from the same physical mechanism as lee waves in atmospheric flows and demonstrate the same characteristic Brunt–Väisälä scaling. We show that flow stagnation and reversal associated with lee-wave formation are responsible for the accumulation of tellurium and supercooled liquid near the growth interface, even when the lee-wave vortex is not readily apparent in the overall flow structure. The supercooled fluid is posited to result in morphological instability at growth rates far below the limit predicted by the classical criterion by Tiller *et al.* for constitutional supercooling.

Keywords: A1. Computer simulation, A1. Convection, A1. Mass transfer, Heat transfer, A2. Travelling heater method growth, A2. Travelling solvent zone growth, B2. Semiconducting II-VI materials

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