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Influence of Marangoni-Induced Flows on Solidification Process in Horizontal Ribbon Growth Crystallization[1] ALIREZA PIRNIA, BRIAN HELENBROOK, Clarkson University — Using the horizontal ribbon growth (HRG) technique, sheets of single-crystal silicon can be efficiently produced with desired thicknesses, without incurring the losses that are inherent in conventional crystallization procedures. However, recent experimental observations have shown that current theoretical models of the HRG process have not accounted for all the physical processes involved. Due to high temperature variations in the molten pool in contact with the solidified ribbon and the strong dependency of silicon surface tension to temperature, Marangoni-induced flows can play a significant role in the formation of the ribbon. In this study, the HRG process is simulated numerically using an accurate *hp*-finite element procedure. It is observed that the Marangoni effect results in a strong flow close to the edge of the solidified ribbon, which forms a series of stationary vortices in conjunction with buoyancy flows. The vortices, which are a strong function of the underlying parameters such as the depth of the pool, the ribbon pull speed, and the cooling heat fluxes, can thin the ribbon and limit the maximum achievable pull speed. Moreover, it is observed that the flow field becomes unsteady at certain combinations of the governing parameters.

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