Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Morphological instabilities of rapidly solidified binary alloys under weak flow[1] KATARZYNA KOWAL, STEPHEN DAVIS, Northwestern University — Additive manufacturing, or three-dimensional printing, offers promising advantages over existing manufacturing techniques. However, it is still subject to a range of undesirable effects. One of these involves the onset of flow resulting from sharp thermal gradients within the laser melt pool, affecting the morphological stability of the solidified alloys. We examine the linear stability of the interface of a rapidly solidifying binary alloy under weak boundary-layer flow by performing an asymptotic analysis for a singular perturbation problem that arises as a result of departures from the equilibrium phase diagram. Under no flow, the problem involves cellular and pulsatile instabilities, stabilised by surface tension and attachment kinetics. We find that travelling waves appear as a result of flow and we map out the effect of flow on two absolute stability boundaries as well as on the cells and solute bands that have been observed in experiments under no flow.

[1]This work is supported by the National Institute of Standards and Technology [grant number 70NANB14H012]

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Date submitted: 19 Jul 2017 Electronic form version 1.4