

Accepted Manuscript

Dynamic instability of the steady state of a planar front during non-equilibrium solidification of binary alloys

Klemens Reuther, Peter K. Galenko, Markus Rettenmayr

PII: S0022-0248(18)30494-9

DOI: <https://doi.org/10.1016/j.jcrysgro.2018.10.008>

Reference: CRYG 24781

To appear in: *Journal of Crystal Growth*

Received Date: 3 July 2018

Accepted Date: 3 October 2018



Please cite this article as: K. Reuther, P.K. Galenko, M. Rettenmayr, Dynamic instability of the steady state of a planar front during non-equilibrium solidification of binary alloys, *Journal of Crystal Growth* (2018), doi: <https://doi.org/10.1016/j.jcrysgro.2018.10.008>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Dynamic instability of the steady state of a planar front during non-equilibrium solidification of binary alloys

Klemens Reuther^{a,*}, Peter K. Galenko^a, Markus Rettenmayr^a

^a*Otto Schott Institute of Materials Research, Friedrich Schiller University Jena, Germany*

Abstract

The dynamic stability of the steady state arising during rapid solidification of a binary alloy with a planar front is examined. Earlier work (Galenko and Danilov, 2000) that was derived under the assumption of dilute solutions and linearized phase diagrams is extended and generalized to the case of non-linear phase diagrams and concentrated alloys. The present treatment confirms the validity of the earlier derived criteria for the stability of a steady state of a planar front independently of any thermodynamic model describing non-equilibrium solidification of binary alloys.

It is found that in temperature and concentration ranges where the solidus concentration increases with increasing solidification velocity, the steady state of the planar front is dynamically unstable. It is discussed how such a dynamic instability of the steady state of a solidifying planar front has an effect on its morphological stability. This is a possible explanation for the discrepancy between morphological stability theory and published experimental data (Hoglund et al. 1998) obtained from rapidly solidified Si-Sn melts.

Keywords: A1. rapid solidification, A1. morphological stability, B1. alloys

1. Introduction

It is general knowledge that solidification processes with interface velocities in the order of magnitude of the diffusion velocity cannot be described by equilibrium thermodynamics. Instead, non-equilibrium effects lead to the establishment of velocity dependent solidus and liquidus lines or (hyper)surfaces that are termed kinetic phase diagrams [1, 2].

Several thermodynamic models that describe non-equilibrium effects and predict kinetic phase diagrams are documented in the literature. One of the most prominent models is the “continuous growth model” (CGM), first formulated by Cahn [3] and refined by Aziz and Kaplan [4]. This model, however, predicts

*Corresponding author

Email address: klemens.reuther@uni-jena.de (Klemens Reuther)

Download English Version:

<https://daneshyari.com/en/article/12018895>

Download Persian Version:

<https://daneshyari.com/article/12018895>

[Daneshyari.com](https://daneshyari.com)