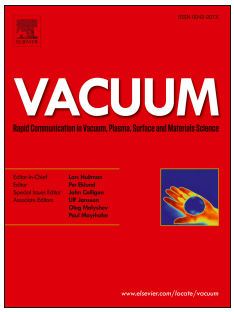
Accepted Manuscript



The influence of cooling rate on the microstructure and phase fraction of gas atomized $NiAl_3$ alloy powders during rapid solidification

Liming Sang, Yi Xu, Pengjun Fang, Honglin Zhang, Yuntao Cai, Xinyu Liu

PII: S0042-207X(18)30954-0

DOI: 10.1016/j.vacuum.2018.08.057

Reference: VAC 8204

To appear in: *Vacuum*

Received Date: 3 June 2018

Revised Date: 27 August 2018

Accepted Date: 28 August 2018

Please cite this article as: Sang L, Xu Y, Fang P, Zhang H, Cai Y, Liu X, The influence of cooling rate on the microstructure and phase fraction of gas atomized $NiAl_3$ alloy powders during rapid solidification, *Vacuum* (2018), doi: 10.1016/j.vacuum.2018.08.057.

The influence of cooling rate on the microstructure and phase fraction of gas atomized $NiAl_3$ alloy powders during rapid solidification

Liming Sang, Yi Xu*, Pengjun Fang, Honglin Zhang, Yuntao Cai, Xinyu Liu

School of Materials Science & Engineering, Southwest Jiaotong University, Chengdu 610031, China

*-Corresponding Author: xybwbj@swjtu.cn

Abstract: $NiAl_3$ alloy powders were produced by nitrogen gas atomization in this paper. The microstructure and phase compositions of different particle size powders were characterized by scanning electron microscopy (SEM), X-ray diffraction (XRD) and electron backscattered diffraction (EBSD). The atomized powders are composed of Ni_2Al_3, $NiAl_3$ and Al-eutectic phases, and three main types of solidification microstructures were identified: dendrites, refined dendrites, and compounds. Phase fraction of three representative particles with diameter of 60, 140 and 220 μm were measured. Moreover, the Newtonian heat transfer formulation coupled with the classical heterogeneous nucleation was used for analyzing the influence of heat transfer coefficient and cooling rate on the thermal history of droplets. Therefore, this work highlights the experimental results matched well with the theoretical calculation and guides the further production of high $NiAl_3$ phase Raney nickel catalytic powders.

Keywords: $NiAl_3$ alloy powder, gas atomization, solidification microstructure, phase fraction, Raney nickel catalyst

1. Introduction

Raney nickel catalysts are wildly applied to promote hydrogenation or dehydrogenation reactions since it was discovered [1], for instance in hydrogen fuel cells [2,3]. Traditionally, Raney nickel catalysts are produced by casting ingots of a 50-50 wt.% mixture of Ni and Al that are subsequently crushed into coarse powders so that the catalysts can be activated by leaching in a concentrated solution of alkali