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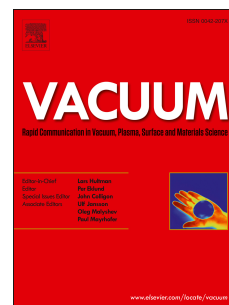
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The influence of cooling rate on the microstructure and phase fraction of gas atomized NiAl₃ alloy powders during rapid solidification

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Abstract: NiAl₃ 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 Ni₂Al₃, NiAl₃ 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 NiAl₃ phase Raney nickel catalytic powders.

Keywords: NiAl₃ alloy powder, gas atomization, solidification microstructure, phase fraction, Raney nickel catalyst

1. Introduction

Raney nickel catalysts are widely 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

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