ADVANCES IN MATERIALS ENGINEERING

Volume 2

Edited By:
Md Abdul Maleque
Iskandar Idris Yaacob
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Chapter 007

Effect of Nanosized Alumina Reinforcement in Intermetallic Nickel Aluminide on the Formation of γ' Precipitates

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Abstract. Nickel aluminide-alumina nanocomposites were prepared by mixing nanosized alumina at 5 and 15 wt-percent with Ni and Al powder in a planetary ball mill. The mixture was then compacted and sintered under inert condition in a tube furnace. The occurrence of reaction synthesis during sintering was detected by the presence of a 'large' exothermic peak at below 600°C of a differential thermal analysis curve. The hardness value for the composite containing 5% alumina was about two times higher than Ni_3Al intermetallic. Its saturation magnetization (Ms) was very low indicating the presence of a small amount of elemental Ni. X-Ray Diffraction (XRD) measurements showed peaks corresponding to Ni-Al and Ni_3Al. Optical micrographs investigations revealed different microstructures for both composites due to increased lattice mismatch.

Introduction

Considerable research on ceramic reinforced composite has been conducted as to improve monolithic Ni_3Al and NiAl properties such as low ambient tensile ductility and insufficient high-temperature strength and creep resistance limit. Incorporation of these high temperature ceramic reinforcements in the form of particulates or fibres also decreases the composite's density and hopefully leads to increase in its specific properties. This enables material designers and manufacturer to fabricate high performance materials; the type of materials essential for the next generation of high technology industries such as aerospace/aircraft and high temperature applications. However, most of the studies are still in the feasibility stage aiming primarily at determining basic mechanical properties and chemical stability [1-4].

One of the major problem in forming intermetallics is their slow diffusion kinetics in intermetallic requires a long sintering time and a high sintering temperature[5]. Combination of conventional powder metallurgy with reaction synthesis technique can shortened the time and lowers the sintering temperature [6-7].

This chapter reports the effect of adding different amount of nanosized alumina in intermetallic nickel aluminide on the formation of gamma prime precipitate (γ') or aluminide. The influence of alumina reinforcement in nickel aluminide lattice parameters which is