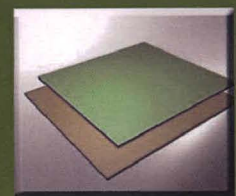
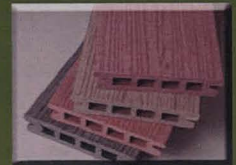


ADVANCES IN COMPOSITE MATERIALS



Iskandar Idris Yaacob
Md Abdul Maleque
Zahurin Halim



IIUM PRESS

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

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IIUM Press

Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011
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Perpustakaan Negara Malaysia

Cataloguing-in-Publication Data

Iskandar Idris Yaacob, Md Abdul Maleque & Zahurin Halim: *Advances in Composite Materials*.

ISBN: 978-967-418-231-1

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed by :
IIUM PRINTING SDN. BHD.
No. 1, Jalan Industri Batu Caves 1/3
Taman Perindustrian Batu Caves
Batu Caves Centre Point
68100 Batu Caves
Selangor Darul Ehsan

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Fabrication of Nickel Aluminide (Ni_3Al) by Hot Isostatic Pressing (HIP)

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Keywords: Nickel aluminide, hot Isostatic pressing, powder metallurgy.

Abstract: Nickel aluminide was prepared by powder metallurgy technique. Nickel and aluminium powders were mixed according to 3:1 molar ratio. Different mixtures were ball-milled on separate runs. Undesirable results caused the ball milling step to be skipped and hipping was performed directly without milling. Hipping was done for 2 hours at 1250° C but the product was a brittle and low strength nickel aluminide pellet with poor mixture of nickel and aluminum.

Introduction

Inter-metallic is a type of material that constitutes two or more different type of metals that have distinct chemical formulas [1]. Inter-metallic's have both metallic and covalent bonding, in which the latter is a characteristic of ceramics. They also possessed long range-ordered crystal structure. These attributes provide inter-metallic's with high yield strength, as well as high temperature strength. Interestingly, until a certain point (800° C to 900° C), the strength of inter-metallic's increase with increasing temperature [2].

The past 20 years has seen the rise of interest in nickel aluminide inter-metallic compound, especially the one with Ni_3Al chemical formula. Low density, high oxidation and corrosion resistance and the ability to retain strength at elevated temperature propelled Ni_3Al to the forefront of major researches. Thanks to these virtues, nickel aluminide has been considered as the ideal structural material for high temperature and hostile environment [3].

On the downside, nickel aluminide has low ductility at room temperature and poor high temperature creep resistance [4]. The addition of boron [5], slip system modification, single crystal utilisation and grain refinement [3] have been put forward as the solutions to these drawbacks.

There are several techniques for nickel aluminide fabrication. Among these are conventional melting and casting, reaction synthesis, micropyretic synthesis and powder metallurgy. Exo-Melt, developed by Oak Ridge National Laboratory in 1985, is arguably the best method amongst these, having the ability to produce Ni_3Al at industrial scale [2].

Hot Isostatic Pressing (HIP) is utilised primarily to consolidate metal powders and densification of high performance castings [6]. During its operation, high pressure gas and