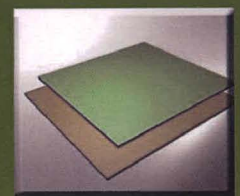


ADVANCES IN COMPOSITE MATERIALS



Iskandar Idris Yaacob
Md Abdul Maleque
Zahurin Halim



IIUM PRESS

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

ADVANCES IN COMPOSITE MATERIALS

**Iskandar Idris Yaacob
Md Abdul Maleque
Zahurin Halim**



IIUM Press

Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011
©IIUM Press, IIUM

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without any prior written permission of the publisher.

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

Table of Content

Chapter 1	1
A Critical Review of Metal Matrix Composite Brake Rotor	
	<i>Md Abdul Maleque</i>
Chapter 2	7
Technology of Moulding for Composite Auto Brake Rotor	
	<i>Md Abdul Maleque</i>
Chapter 3	13
Fabrication of Nickel Aluminide (Ni ₃ Al) by Hot Isostatic Pressing (HIP)	
	Faizal Abu Zarim, Iraj Alaei, I.I. Yaacob
Chapter 4	17
Investigation of Mechanically Alloyed Nd-Fe-B Powder	
	I.I. Yaacob and H.K. Jun
Chapter 5	23
Synthesis And Characterization Of Nanocrystalline Ni ₃ Al Intermetallic Produced by Mechanical Alloying And Reaction Synthesis	
	<i>R. Ismail and I.I. Yaacob^b</i>
Chapter 6	29
The Effect of Hard Nanofillers on Mechanical Properties of PVC Nanocomposites	
	<i>Noorasikin Samat, Muhammad Alif Mohd Yusoff and Mohd Shahrul Rizal Bin Zakaria</i>
Chapter 7	34
Fatigue Fracture Mechanism of PVC/CaCO ₃ nanocomposite	
	<i>Noorasikin Samat, Alan Whittle and Mark Hoffman</i>
Chapter 8	40
Mechanical Behaviour of Eco Core Composite Sandwich Structure	
	<i>Norhasnidawani Johari Safiyah Hazwani Abd. Rahim and Zahurin Halim</i>
Chapter 9	45
Characteristics of Oil Palm Biomass via Mixture of Empty Fruit Bunch (EFB) Fiber and Mesocarp Fiber	
	<i>Zahurin Halim, Nabiha Mohd Noh and Nurshazana Mohamad</i>
Chapter 10	49
Mechanical Behaviour of Oil Palm Empty Fruit Bunch (OPEFB) Alumen-Composites Concrete	

Afiqah Omar, Nur Humairah A. Razak and Zuraida Ahmad

Chapter 11	55
The Influence of Biopolymer and Natural Fiber on the Physical and Mechanical Properties of Cement Composite	
<i>Norshahida Sarifuddin and Zuraida Ahmad</i>	
Chapter 12	62
Thermal and Morphological Study of Biopolymer Cotton-Albumen Clay (BCAC) Composites	
<i>Zuraida Ahmad, Teoh Swin Le and Kumaran A/L Samannamuthaliar</i>	
Chapter 13	68
Effect of Compaction Time on the Properties of Coir Fiber Reinforced Cement-Albumen Composite	
<i>Amir Zakwan Roslin, Nur Humairah A. Razak and Zuraida Ahmad</i>	
Chapter 14	74
Oil Palm Empty Fruit Bunch (OPEFB) for Lightweight Composites Concrete	
<i>Afiqah Omar, Nur Humairah A. Razak and Zuraida Ahmad</i>	
Chapter 15	80
Fabrication of Metal Matrix Composite Automotive Brake Rotor (Part 1)	
<i>Md Abdul Maleque</i>	
Chapter 16	86
Fabrication of Metal Matrix Composite Automotive Brake Rotor (Part 2)	
<i>Md Abdul Maleque</i>	
Chapter 17	90
Wear of Aluminium Matrix Composite – Effects of Reinforcement Combination	
<i>Md Abdul Maleque and Rezaul Karim</i>	
Chapter 18	96
Mechanical Properties of Wood Plastic Composites	
<i>Ooi Chong Jin and Shahjahan Mridha</i>	
Chapter 19	101
Properties of Wood Fiber Reinforced Polypropylene Composite	
<i>Shahjahan Mridha and Nafis Sarwar Islam</i>	

Chapter 20		108
The effects of chemical and mechanical treatments on coir fibre to mechanical properties of coir-albumen-concrete		
	<i>Zuraida Ahmad and Nurizan Omar</i>	
Chapter 21		114
Architecture of Chopped Fiber Glass in Plastic Composite Processed Under Different Loads		
	<i>Ahmed Nazrin Md Idriss and Shahjahan Mridha</i>	
Chapter 22		119
Variation of Fiber Architecture on Loads applied in Fabrication of Epoxy/Woven Fiber Glass Composite		
	<i>Ahmed Nazrin Md Idriss and Shahjahan Mridha</i>	
Chapter 23		125
Impact Behavior of Carbon/ Epoxy Composite in Moisture and Temperature environments		
	<i>Shahjahan Mridha</i>	
Chapter 24		132
Impact Strength Behaviour of the Woven and Chopped Fiber Glass Composites at Different Temperatures		
	<i>Ahmed Nazrin Md Idriss and Shahjahan Mridha</i>	
Chapter 25		138
An Investigation of Hybrid Composites Tubes Subjected to Quasi-Static Loading		
	<i>Farrah Yussof¹ and Zuraida Ahmad</i>	
Chapter 26		144
Mechanical Behaviour of Biopolymer Cotton Albumen Clay (BCAC) Composites		
	<i>Teoh Swin Le, Kumaran A/L Samannamuthaliar and Zuraida Ahmad</i>	
Chapter 27		150
The Effect of Processing Parameters on Tensile Properties Empty Fruit Bunch (EFB) Fiber Reinforced Thermoplastic Natural Rubber Composites		
	<i>Noor Azlina Hassan, Norita Hassan, Sahrim Hj. Ahmad and Rozaidi Rasid</i>	
Chapter 28		155
Manganese Doped Hydroxyapatite Powder through Hydrothermal Method		
	<i>Asep Sofwan Faturohman, Alqap, Iis Sopyan and Niur Izzati Mazmaa</i>	

Chapter 29	161
Synthesis and Characterization of Sol-Gel Method Derived Zinc Doped Hydroxyapatite Powder	
<i>Asep Sofwan Faturohman Alqap, Nor Hidayu and Iis Sopyan</i>	
Chapter 30	167
Synthesis and Characterization of Nickel Iron–Silicon Nitride Nanocomposite	
<i>Iskandar I. Yaacob</i>	
Chapter 31	172
Fabrication of Nickel Aluminide Intermetallic-Alumina Nanocomposite	
<i>Roslina Ismail and Iskandar I. Yaacob</i>	
Chapter 32	178
Investigation on the Effect of Water Immersion on Cotton Albumen Composite	
<i>Zahurin Halim, Zuraida Ahmad and Fauziah Md Yusof</i>	
Chapter 33	182
Numerical and Experimental Investigation of Peel Strength of Composite Sandwich Structures	
<i>Zahurin Halim , Shahnor Basri and Mohd Ramli Ajir</i>	
Chapter 34	190
Finite Element Analysis of Interlaminar Stresses in Edge Delamination	
<i>Zahurin Halim and Meor Mohd. Adli Taib</i>	

Investigation of Mechanically Alloyed Nd-Fe-B Powder

Iskandar I. Yacoob¹ and H.K. Jun²

¹Kulliyyah of Engineering – International Islamic University Malaysia

²Faculty of Engineering, University of Malaya

✉ : iskandar_yacob@iium.edu.my

Keywords: Mechanical alloying, Nd-Fe-B powders, corrosion behavior.

Abstract: Elemental powders of Nd, Fe and B were mechanically alloyed using a planetary ball mill. The change of structure and particle size was examined. XRD pattern revealed that with prolonged milling, the mixture of the powders was transformed to nearly amorphous state. Smaller particle size was observed with prolonged milling. Magnetization of the mixture of powders was studied using AGM. The saturation magnetization of the mixture was observed to increase initially and then decrease with increasing milling time. The reduction of the magnetic properties was suspected to be due to surface damage which was incurred by extensive milling. The corrosion rate was observed to be higher for larger particle size (low milling time). This indicated higher mass gain percentage of larger particle size compared to lower particle size. The magnetic properties however, did not show any significant improvement after corrosion effect.

Introduction

Nd-Fe-B magnets are regarded as the most successful magnetic materials in the electronic and consumer application. Its high energy product property enables it to be used in voice coil motor and actuator. Various applications have been extended for Nd-Fe-B magnets due to its high ratio energy product to volume. This new material was discovered concurrently by Sagawa et al and Croat et al [1,2]. Initially, the common processing routes were the conventional powder metallurgy and melt-spin process [1,3]. Recent alternative routes have been developed such as mechanical alloying and HDDR, which can give the similar magnetic properties as described with previous methods [4,5]. Although Nd-Fe-B magnets exhibit good magnetic properties, its corrosion resistance is very low comparatively [6]. Thus, surface engineering of the material is necessary in order to enhance the corrosion resistance of the material [7]. Minor additives of alloying elements also showed some improvements on the corrosion resistance of the materials [8]. On the other hand, control of particle size is also favourable for corrosion resistance improvement of the materials [9].

Experimental procedures

Elemental powders of neodymium (>99%, average particle size –40 mesh), iron (99%, average particle size –325 mesh) and boron (>99%, average particle size 2 μ m) were used as starting materials. The powders were weighed and mixed in a glove box filled with argon gas. The nominal composition of the powders mixture was 33 wt% Nd, 66 wt% Fe and 1 wt% B (Nd₁₅Fe₇₇B₈). The mixtures of the powders were pre-mixed and then transferred into a