

**ADVANCES
IN MATERIALS
ENGINEERING**

Volume 2

**Edited By:
Md Abdul Maleque
Iskandar Idris Yaacob
Zahurin Halim**



IIUM PRESS

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

**ADVANCES IN MATERIALS
ENGINEERING
VOLUME 2**

**Edited By:
Md Abdul Maleque
Iskandar Idris Yaacob
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

Md Abdul Maleque, Iskandar Idris Yaacob & Zahurin Halim: Advances in Materials Engineering

ISBN: 978-967-418-168-0

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
TEL: +603-6188 1542 / 44 / 45 FAX: +603-6188 1543
EMAIL: iiumprinting@yahoo.com

Table of Content

Chapter 1	Page
Amorphous Coating of Iron Nickel Alloy	1 Suryanto
Chapter 2	
Characterization of Electroplated Nanocrystalline NiFe Alloy Films	7 Yusrini Marita and Iskandar I. Yaacob
Chapter 3	
Corrosion Behavior of Zinc in Potassium Hydroxide Aqueous Solution	13 Suryanto
Chapter 4	
Development of Carbon Doped TiO ₂ Photocatalyst for Pigment Degradation	19 Muh Rafiq Mirza Julaihi, Asep Sofwan Faturohman Alqap and Iis Sopyan
Chapter 5	
Dynamic Mechanical Analysis of Carbon Fibre Composites	25 Hazleen Anuar, Sahrim Hj. Ahmad and Rozaidi Rasid
Chapter 6	
Effect of Composition on Phase Transformation of Iron-Platinum Nanoparticles	31 Koay Mei Hyeie and Iskandar I. Yaacob
Chapter 7	
Effect of Nanosized Alumina Reinforcement in Intermetallic Nickel Aluminide on the Formation of γ' Precipitates	37 Roslina Ismail and Iskandar I. Yaacob
Chapter 8	
Effect of Sintering Temperature on Protein Foaming-consolidation Porous Alumina-tricalcium Phosphate Composites	43 Ahmad Fadli and Iis Sopyan
Chapter 9	
Electrical Property of ITO Thin Film Deposited by Rf Magnetron Sputtering	49 Agus Geter Edy Sutjipto, Nurul Hajar and Farah Diana
Chapter 10	
Electrochemical Study of Zinc Selenide Thin Films Prepared for Photovoltaic Applications	55 Souad. A. Mohamad, A. K. Arof
Chapter 11	
Electrodeposited CdS / CdTe Solar Cells	61 Souad. A. Mohamad
Chapter 12	
Fabrication of Biomass Pellet from Mesocarp Fiber	65 Zahurin Halim and Nurshazana Mohamad
Chapter 13	
Fabrication of Kenaf Sandwich Panel	68 Siti Khadijah Abdul Rahman and Zahurin Halim

Chapter 14		
Foam Impregnation Method for Artificial Bone Graft Application		78
: Study on the Effect of Drying Time	Fariza Abdul Rahman and Zuraida Ahmad	
Chapter 15		
Foam Impregnation Method for Artificial Bone Graft Application		84
: Study on the Effect of Sintering Temperature	Zuraida Ahmad and Fariza Abdul Rahman	
Chapter 16		
FTIR Analysis - Aluminium Hydroxide Treated with Silane Coupling Agent		89
	Noorasikin Samat, Nor Suhaila Nor Saidi and Muhammad Saffuan Sahat	
Chapter 17		
Inorganic / Organic /Inorganic Double Junction Thin Film Solar Cells		92
	Souad. A. Mohamad	
Chapter 18		
Investigation on The Effect of Ultra Violet on Cotton Albumen Composite		96
	Zahurin Halim , Zuraida Ahmad and Fauziah Md Yusof	
Chapter 19		
Measurement of Oxygen Permeability in Bulk Alloys by Internal Oxidation of Dilute Constituent		100
	Mohd Hanafi Bin Ani and Raihan Othman	
Chapter 20		
Natural Dye Coated Nanocrystalline Tio ₂ Electrode Films for DSSCs		106
	Souad. A. Mohamad and Iraj Alaci	
Chapter 21		
Normal Deposition to Anomalous Deposition		109
	Suryanto	
Chapter 22		
Polymer Clay Nanocomposites: Part II- Synthesis of Polymer Nanocomposites		115
	Noor Azlina Hassan, Norita Hassan	
Chapter 23		
Production of Porous Calcium Phosphate Ceramics through Polymeric Sponge Method		120
	Asep Sofwan Faturohman Alqap, Nur Ain Rakman, and Iis Sopyan	
Chapter 24		
Silicone Doped Calcium Phosphate Powder Synthesized via Hydrothermal Method		126
	Asep Sofwan Faturohman Alqap, Iis Sopyan and Zuria Farhana Kushaili	
Chapter 25		
Stress Analysis of Backend Metallization		132
	Iskandar I. Yaacob and Goh Chia Lan	
Chapter 26		
Study on Metal Removing from Alumina Ceramics		137
	Agus Geter Edy Sutjipto and Muhyiddin Bin Budah@Udah	

Chapter 27		
Surface Quality of <i>Dipterocarpus Spp</i> under Tropical Climate Change: Effect of Pre-Weathering		146
	Mohd Khairun Anwar Uyup, Hamid Hamdan, Paridah Mat Tahir, Hazleen Anuar, Noorasikin Samat, Siti Rafidah Mohamed	
Chapter 28		
Surface Topography of Sulphuric Treated Carbon Fibre		151
	Hazleen Anuar, Sahrim Hj. Ahmad and Rozaidi Rasid	
Chapter 29		
Synthesis and Characterization of Electrodeposited Iron-Platinum Nanostructured Thin Films		157
	Seoh Hian Teh and Iskandar I. Yaacob	
Chapter 30		
Synthesis of Magnetic Nanoparticles in Water-in-Oil Microemulsions		164
	Iskandar I. Yaacob	
Chapter 31		
The Effect of R-ratio on Fatigue Crack Propagation in Plasticised PVC and Modified PVC		170
	Noorasikin Samat, Alan Whittle and Mark Hoffman	
Chapter 32		
The Effect of R-ratio on Fatigue Crack Propagation in Un-plasticized PVC and Modified PVC		175
	Noorasikin Samat, Alan Whittle and Mark Hoffman	
Chapter 33		
Thin Film of Indium Tin Oxide and Its Deposition Technology Deposition		180
	Agus Geter Edy Sutjipto, Sugrib Kumar Shaha	
Chapter 34		
X-ray Photoelectron Studies on the Surface Chemical States of Yttria-Stabilized Zirconia Thin Film in Aqueous Acid Hydrofluoric		186
	Sukreen Hana Herman, Mohd Hanafi Ani, and Susumu Horita	
Chapter 35		
ZnO / Polymer Junction Growth for Hybrid Solar Cell Applications		194
	Souad. A. Mohamad	

Measurement of Oxygen Permeability in Bulk Alloys by Internal Oxidation of Dilute Constituent

Mohd Hanafi Bin Ani¹ and Raihan Othman²

^{1,2} Faculty of Engineering – International Islamic University Malaysia

✉ : mhanafi@iium.edu.my

Keywords: Oxygen Permeability, Ferritic Fe Alloys, Internal Oxidation, Metal-Oxide Interface.

Abstract. The oxygen permeability of Fe base binary alloys has been studied by the means of internal oxidation of dilute constituents. The concentration of alloying elements and the shape of precipitated oxides affect the calculated oxygen permeability. It is demonstrated that higher amount of metal-oxide interface increase the oxygen permeability. It is understood that metal-oxide interface provide fast path for oxygen to diffuse.

Introduction

Internal oxidation is a phenomenon where dilute alloy constituent(s) forms oxide in the metal matrix. It is of important in high temperature, and may alter the properties of the alloys. Wagner [1] has quantitatively analysed the formation of internal oxidation in binary alloy, and proposed the conditions in which oxides are form internally. It is experimentally observed that the growth of internal oxidation zone (IOZ) follows basically the parabolic rate law.

$$x^2 = 2K_p t \quad (19.1)$$

where x is the depth of IOZ, t is the oxidation time and k_p is the parabolic rate constant. The parabolic rate constant could be determined from the slope of figure depth of IOZ versus oxidation time. The parabolic growth of IOZ indicates that diffusion is the rate controlling process.

Wagner [1] has proposed theoretical expression for the kinetics of internal oxidation. In case of Fe-Cr alloys;

$$x^2 = \frac{2N_O^{(s)}D_O}{\nu N_{Cr}} t \quad (19.2)$$

where N_{Cr} is the original concentration of Cr. From equations (19.1) and (19.2), it is well understood that the parabolic rate constant, k_p is proportional to the oxygen permeability, $N_O^{(s)}D_O$. In this way, the permeability of oxygen in α -Fe in could be determined. Figure 19.1 shows the schematic diagram of the formation of internal oxide and external scale in Fe-Cr alloy. If Cr concentration in Fe-Cr alloy is low, then the internal precipitates of Cr_2O_3 in the alloy matrix (Figure 19.1(a)). From the equation (19.2), the growth rate of IOZ is decrease with the increase of Cr concentration in the alloy and the decrease of oxygen permeability, $N_O^{(s)}D_O$ in the alloy. By increasing the Cr concentration, the outward flux of Cr in the alloy is