

# CONTEMPORARY METALLIC MATERIALS

---

Md Abdul Maleque  
Iskandar Idris Yaacob  
Zahurin Halim



IIUM PRESS

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

# **CONTEMPORARY METALLIC MATERIALS**

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

ISBN: 978-967-418-164-2

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

<b>Chapter 1</b> Upgrading of Laterite Ore by Reduction and Leaching <i>Hadi Purwanto and Pramusanto</i>	1
<b>Chapter 2</b> Upgrading of Iron Sand by Magnetic Concentration and Reduction <i>Muta'alim, Hadi Purwanto, Nuryadi Saleh and Pramusanto</i>	7
<b>Chapter 3</b> Microstructure and Mechanical Properties of Neutron Transmutation Doped of Silicon under Cf-252 Neutron Bombardment <i>Agus Geter Edy Sutjipto, Roslan Yahya</i>	16
<b>Chapter 4</b> Effect of Stabilizer Addition on Crystal Formation of Zirconia Synthesize From Zircon Sand <i>Yuhelda Dahlan Hadi Purwanto, Nuryadi Saleh and Pramusanto</i>	20
<b>Chapter 5</b> Upgrading of Iron-rich Laterite Ore Using Reverse Flotation <i>Hadi Purwanto, Mutaalim, Yuhelda Dahlan, Nuryadi Saleh and Pramusanto</i>	27
<b>Chapter 6</b> Influences of Additives on Copper Film Quality and Gap Filling Capability of Plating Process <i>Shahjahan Mridha and Law Shao Beng</i>	34
<b>Chapter 7</b> Grain Refining in AISI 430 Ferritic Stainless Steel Welds by Addition of Metal Powder <i>Shahjahan Mridha and Muhammed Olawale Hakeem Amuda</i>	41
<b>Chapter 8</b> Grain Refinement Practices in Ferritic Stainless Steel Welds <i>Muhammed Olawale Hakeem Amuda and Shahjahan Mridha</i>	48
<b>Chapter 9</b> Alloy Coating on Steel Surfaces by Melt Synthesis of Elemental Metal Powders <i>Shahjahan Mridha</i>	53

<b>Chapter 10</b>	59
Synthesis And Characterization of Lithium Manganese Copper Oxides for use in Lithium Rechargeable Cells	
<i>I.I. Yaacob, N. Kamarulzaman, and W.J. Basirun<sup>f</sup></i>	
<b>Chapter 11</b>	65
Influence of Grain Size on Magnetic Properties of Electroplated NiFe	
<i>Yusrini Marita and Iskandar Idris Yaacob</i>	
<b>Chapter 12</b>	70
Composite Coating on Titanium Alloy Using High Power Laser	
<i>Shahjahan Mridha</i>	
<b>Chapter 13</b>	75
The Tribological Behaviour of Al-Si Automotive Piston Material	
<i>Arifutzzaman and Md Abdul Maleque</i>	
<b>Chapter 14</b>	81
Conceptual Design of Folding Bicycle Frame with Light Weight Materials	
<i>Md Abdul Maleque and Mohd Nizam</i>	
<b>Chapter 15</b>	86
Reverse Engineering of Automotive Piston	
<i>Md Abdul Maleque and A. Arifutzzaman</i>	
<b>Chapter 16</b>	92
Recent Trend in Application of High Temperature Ferritic Fe-Cr Alloys in Power Plant	
<i>Mohd Hanafi Bin Ani and Raihan Othman</i>	
<b>Chapter 17</b>	98
Measurement of Oxygen Permeability in Bulk Alloys by Internal Oxidation of Dilute Constituent	
<i>Mohd Hanafi Bin Ani and Raihan Othman</i>	
<b>Chapter 18</b>	104
Recent Trend on Application of High Temperature Ferritic Fe-Cr Alloys in Solid Oxide Fuel Cells	
<i>Mohd Hanafi Bin Ani and Raihan Othman</i>	
<b>Chapter 19</b>	110
Principle of Solid Electrolyte Oxygen Sensor	
<i>Mohd Hanafi Bin Ani and Raihan Othman</i>	
<b>Chapter 20</b>	116
Surface Oxygen Potential on the Oxide Scale during High Temperature Oxidation of Fe-Cr Alloys at 1073 K	
<i>Mohd Hanafi Bin Ani and Raihan Othman</i>	

	<i>Mohd Hanafi Bin Ani and Raihan Othman</i>	
<b>Chapter 21</b>		121
Reverse Engineering for Automotive Fuel Tank		
	<i>Md Abdul Maleque and Atiqah Afdzaluddin</i>	
<b>Chapter 22</b>		127
The possibility of utilizing scanning electron microscope for materials characterization		
	<i>Agus Geter Edy Sutjipto</i>	
<b>Chapter 23</b>		135
Piezoelectricity of Zinc Oxide Thin film as Source of Energy for Sensor Applications		
	<i>Agus Geter Edy Sutjipto, Liyana Abdul Gafar and Nor Azyati Syazwina Roselan</i>	
<b>Chapter 24</b>		141
Study on Zinc Oxide Crystal Growth		
	<i>Agus Geter Edy Sutjipto, Liyana Abdul Gafar and Nor Azyati Syazwina Roselan</i>	
<b>Chapter 25</b>		147
Green Nanotechnology using SEM and AFM		
	<i>A.G.E. Sutjipto and R. Muhida</i>	
<b>Chapter 26</b>		155
The effect of Cobalt addition on structural and magnetic properties of electrodeposited Iron-Platinum nanocrystalline thin films		
	<i>Seoh Hian Teh<sup>1</sup>, Iskandar Idris Yaacob</i>	
<b>Chapter 27</b>		163
Mechanochemical Synthesis of CeO <sub>2</sub> Nanopowder using Planetary Ball Milling		
	<i>Iskandar I. Yaacob</i>	
<b>Chapter 28</b>		170
A Study on Double Junction Zinc Based/Polymer Thin Film Solar Cell		
	<i>S. A. Mohamad and A. K. Arof</i>	
<b>Chapter 29</b>		176
A Voltammetric Study of Zinc Telluride Thin Films Prepared for Photovoltaic Applications		
	<i>S. A. Mohamad and A. K. Arof</i>	
<b>Chapter 30</b>		181
Electrodeposition Technique for ZnO Semiconductor Thin Films Fabrication		
	<i>S. A. Mohamad</i>	
<b>Chapter 31</b>		186
Electroless Nickel Based Coatings From Solution Containing Sodium Hypophosphite		
	<i>Suryanto</i>	

<b>Chapter 32</b> Aluminum Spray Coating for Corrosion Resistance of Steel	192
	<i>Suryanto</i>
<b>Chapter 33</b> Electrodeposition of Alloys	198
	<i>Suryanto</i>
<b>Chapter 34</b> Corrosion Behavior of Duplex Stainless Steel in Sea Water	204
	<i>Suryanto</i>
<b>Chapter 35</b> Cathodic Protection of Underground Pipes	210
	<i>Suryanto</i>

## Recent Trend in Application of High Temperature Ferritic Fe-Cr Alloys in Power Plant

Mohd Hanafi Bin Ani and Raihan Othman  
Faculty of Engineering – International Islamic University Malaysia  
✉ : [mhanafi@iium.edu.my](mailto:mhanafi@iium.edu.my)

---

**Keywords:** Ferritic Fe-Cr alloys, High temperature oxidation, Power plant, Steam.

**Abstract:** The applications of high temperature ferritic Fe-Cr alloys in power plant have been reviewed. The associated problems in steam power plant have been highlighted. It is understood that the development of new alloys for high temperature steam power plant is crucial to increase the energy conversion efficiency in power plant.

### Introduction

It is a matter of common knowledge that anthropogenic sources of green house gases like carbon dioxide (CO<sub>2</sub>), methane, chlorofluorocarbon and nitrous oxide are changing the climate of the world. Due to their propensity to insulate the earth like a blanket, the increasing emission of these gases increasingly cause retention of heat in the upper atmospheres and average global temperatures. Earlier, having realized the impending consequences of global warming, around 160 nations of the world had jointly implemented the UN Framework Convention on Climate Change (UNFCCC) by signing the Kyoto Protocol in December 1997. Although the protocol did not become legally binding due to non-involvement of U.S. and Australia, most of the remaining industrialized nations had set targets to reduce green house emissions and achieve their preset reduction goals by 2010. However, the European commission has recently issued warning that 13 of the EU's 15 member states were set to miss their emission targets by a huge margin. Thus the Kyoto Protocol, which was widely considered to be the only feasible opportunity to address the impending environmental disaster appears to be off the track.

Pre-industrial CO<sub>2</sub> levels hovered around 280 ppm until 1850. Human activities pushed those levels up to close to 370 ppm by early 2000. The rate of increase in CO<sub>2</sub> concentrations accelerated over recent decades along with fossil fuel emissions. Since 2000, annual increases of 2 ppm or more have been common, compared with 1.5 ppm per year in the 1980s and less than 1 ppm per year during the 1960s. Global temperatures have been recording a steady rise along with the quantities of CO<sub>2</sub> and methane in the atmosphere.

The Intergovernmental Panel on Climate Change (IPCC) has forecast in its Fourth Assessment Reports, 2007 [1] that global warming is set to intensify in the coming years, the long range effects of which would be unprecedented phenomena like rising oceans, melting of glaciers, dissolution of polar caps, extreme weathers, rise in tropical diseases, changes of seasons and disruption of ecosystems. Reports from different parts of the world already hint at the possibility that global warming may be slipping out of human control due to the fact