

CONTEMPORARY METALLIC MATERIALS

Md Abdul Maleque
Iskandar Idris Yaacob
Zahurin Halim



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Edited by:

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Table of Content

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

| | |
|---|-----|
| Chapter 10 | 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^f</i> | |
| Chapter 11 | 65 |
| Influence of Grain Size on Magnetic Properties of Electroplated NiFe | |
| <i>Yusrini Marita and Iskandar Idris Yaacob</i> | |
| Chapter 12 | 70 |
| Composite Coating on Titanium Alloy Using High Power Laser | |
| <i>Shahjahan Mridha</i> | |
| Chapter 13 | 75 |
| The Tribological Behaviour of Al-Si Automotive Piston Material | |
| <i>Arifutzzaman and Md Abdul Maleque</i> | |
| Chapter 14 | 81 |
| Conceptual Design of Folding Bicycle Frame with Light Weight Materials | |
| <i>Md Abdul Maleque and Mohd Nizam</i> | |
| Chapter 15 | 86 |
| Reverse Engineering of Automotive Piston | |
| <i>Md Abdul Maleque and A. Arifutzzaman</i> | |
| Chapter 16 | 92 |
| Recent Trend in Application of High Temperature Ferritic Fe-Cr Alloys in Power Plant | |
| <i>Mohd Hanafi Bin Ani and Raihan Othman</i> | |
| Chapter 17 | 98 |
| Measurement of Oxygen Permeability in Bulk Alloys by Internal Oxidation of Dilute Constituent | |
| <i>Mohd Hanafi Bin Ani and Raihan Othman</i> | |
| Chapter 18 | 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> | |
| Chapter 19 | 110 |
| Principle of Solid Electrolyte Oxygen Sensor | |
| <i>Mohd Hanafi Bin Ani and Raihan Othman</i> | |
| Chapter 20 | 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> | |
| Chapter 21 | | 121 |
| Reverse Engineering for Automotive Fuel Tank | | |
| | <i>Md Abdul Maleque and Atiqah Afdzaluddin</i> | |
| Chapter 22 | | 127 |
| The possibility of utilizing scanning electron microscope for materials characterization | | |
| | <i>Agus Geter Edy Sutjipto</i> | |
| Chapter 23 | | 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> | |
| Chapter 24 | | 141 |
| Study on Zinc Oxide Crystal Growth | | |
| | <i>Agus Geter Edy Sutjipto, Liyana Abdul Gafar and Nor Azyati Syazwina Roselan</i> | |
| Chapter 25 | | 147 |
| Green Nanotechnology using SEM and AFM | | |
| | <i>A.G.E. Sutjipto and R. Muhida</i> | |
| Chapter 26 | | 155 |
| The effect of Cobalt addition on structural and magnetic properties of electrodeposited Iron-Platinum nanocrystalline thin films | | |
| | <i>Seoh Hian Teh¹, Iskandar Idris Yaacob</i> | |
| Chapter 27 | | 163 |
| Mechanochemical Synthesis of CeO ₂ Nanopowder using Planetary Ball Milling | | |
| | <i>Iskandar I. Yaacob</i> | |
| Chapter 28 | | 170 |
| A Study on Double Junction Zinc Based/Polymer Thin Film Solar Cell | | |
| | <i>S. A. Mohamad and A. K. Arof</i> | |
| Chapter 29 | | 176 |
| A Voltammetric Study of Zinc Telluride Thin Films Prepared for Photovoltaic Applications | | |
| | <i>S. A. Mohamad and A. K. Arof</i> | |
| Chapter 30 | | 181 |
| Electrodeposition Technique for ZnO Semiconductor Thin Films Fabrication | | |
| | <i>S. A. Mohamad</i> | |
| Chapter 31 | | 186 |
| Electroless Nickel Based Coatings From Solution Containing Sodium Hypophosphite | | |
| | <i>Suryanto</i> | |

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

Reverse Engineering of Automotive Piston

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Keywords: Reverse engineering; Automotive piston; Tensile strength; Microstructure.

Abstract: To be aware of the present operating conditions of the automotive piston which are depended on mechanical and tribological properties, composition, microstructure and morphologies a comprehensive study of reverse engineering on an automotive piston is very essential. Therefore, the main aim of this work is to investigate and analyze a conventional automotive piston by performing the mechanical test, wear test and microstructure analysis. A piston was destructed for various experiments and investigations. Tensile test was performed using universal tensile testing (UTM) machine whereas hardness test was done on Vickers hardness tester. Microstructure and chemical analyses were performed using optical microscope (OM) and energy dispersive x-ray spectroscopy (EDX) analyzer respectively. The wear test was performed using pin-on-disk (POD) machine. The tensile test results showed that the ultimate tensile strength and modulus of elasticity of the piston were 215 MPa and 73 GPa respectively, whereas the Vickers hardness number of this material was found to be 155 HV_{0.5kgf}. The micrograph shows the phases of Si plate with ~17% of Si surrounded by α -Al matrix referring to the hypereutectic Al-Si alloy which was proven by the EDX analysis as well and the wear test results showed the moderate specific wear rate (with the range of 1.81 to 3.1 $\times 10^{-6}$ mm³/N-m). The current reverse engineering analysis provides a guideline to replace or introduce a new material especially metal matrix composite for the application of new generation automotive piston with better properties, lighter weight and higher performance.

Introduction

The engine is the most crucial part of an automotive car and piston may be considered as the heart of engine which is wholly dependent on an engine crankshaft for power and movement. Automotive engine piston is one of the most complex components among all other parts. In order to understand the existing direction of materials, present design, working details and manufacturing process of automotive piston and also for the future direction in new materials with new design, a comprehensive study on the reverse engineering is essential [1]. Study shown that the aluminum-silicon eutectic or hyper eutectic alloys are cast to produce majority of pistons and are known as ‘piston alloy’, which provides the best overall balance