

# ADVANCES IN MATERIALS ENGINEERING

---

## Volume 1

Edited By:  
Zahurin Halim  
Iskandar Idris Yaacob  
Md Abdul Maleque



IIUM PRESS

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

# **ADVANCES IN MATERIALS ENGINEERING VOLUME 1**

Edited By:

Zahurin Halim  
Iskandar Idris Yaacob  
Md Abdul Maleque



**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 -967-418-167-3

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><br>Preparation and Characterization of Thermoplastic Natural Rubber (TPNR) Nanocomposites<br><i>Noor Azlina Hassan, Sahrim Hj. Ahmad, Rozaidi Rasid and Norita Hassan</i> | 1  |
| <b>Chapter 2</b><br>Polymer Clay Nanocomposites: Part I<br><i>Noor Azlina Hassan and Norita Hassan</i>   | 6  |
| <b>Chapter 3</b><br>Effect of Processing Parameters on the Tensile Properties of TPNR Reinforced Short Carbon Fibre Composite<br><i>Hazleen Anuar, Sahrim Hj. Ahmad and Rozaidi Rasid</i>  | 11 |
| <b>Chapter 4</b><br>Effect of Maleic Anhydride Polyethylene on Damping Properties of HDPE/EPDM Nanocomposite<br><i>Hazleen Anuar, Nur Ayuni Jama, and Shamsul Bahri Abdul Razak</i>        | 16 |
| <b>Chapter 5</b><br>Comparative Study on the Effect of Plasticizer on Thermal Properties of Polylactic Acid<br><i>Hazleen Anuar and Muhammad Rejaul Kaiser</i>                             | 22 |
| <b>Chapter 6</b><br>Quality of Copper Film Electroplated on Silicon Wafer Using Different Current Densities<br><i>Shahjahan Mridha</i>   | 28 |
| <b>Chapter 7</b><br>Laser Nitriding of Titanium<br><i>Shahjahan Mridha</i>   | 39 |
| <b>Chapter 8</b><br>Composite Coating on Titanium Alloy Using High Power Laser<br><i>Shahjahan Mridha</i>  | 45 |

|  |   |
|--|---|
| <b>Chapter 9</b>   |   |
| Measurement of Moisture Absorption in Borophosphosilicate Glass (BPGS) Films   | 50  |
|  | <i>Shahjahan Mridha and Shiau Khee Tang</i>   |
| <b>Chapter 10</b>  | 58  |
| The Effect of Processing Parameter on Tensile Properties of Thermoplastic Natural Rubber Nanocomposites  |   |
|  | <i>Noor Azlina Hassan, Sahrim Hj. Ahmad, Rozaidi Rasid and Norita Hassan</i>  |
| <b>Chapter 11</b>  | 64  |
| Comparison of Mechanical Properties Between Untreated and Sulphuric Acid Treated Short Carbon Fiber Reinforced Thermoplastic Natural Rubber (TPNR) Composite |   |
|  | <i>Noor Azlina Hassan, Norita Hassan, Sahrim Hj. Ahmad and Rozaidi Rasid</i>  |
| <b>Chapter 12</b>  | 69  |
| Water Absorption of TPNR Reinforced Short Carbon Fibre Composite   |   |
|  | <i>Hazleen Anuar, Sahrim Hj. Ahmad and Rozaidi Rasid</i>  |
| <b>Chapter 13</b>  | 74  |
| Enhanced Tensile Strength with Sulphuric Treated Short Carbon Fibre  |   |
|  | <i>Hazleen Anuar, Sahrim Hj. Ahmad and Rozaidi Rasid</i>  |
| <b>Chapter 14</b>  | 79  |
| Effect of Fibre Length on Tensile Properties of TPNR-Kenaf Fibre Composite   |   |
|  | <i>Hazleen Anuar, Sahrim Hj. Ahmad and Rozaidi Rasid</i>  |
| <b>Chapter 15</b>  | 84  |
| Effect of Nanoclay on Mechanical Properties of PLA-Clay Nanocomposite  |   |
|  | <i>Hazleen Anuar and Muhammad Rejaul Kaiser</i>   |
| <b>Chapter 16</b>  | 90  |
| Extraction of Glucose From Kenaf Core by Using Chemical Pre – Treatment Process  |   |
|  | <i>Nurhafizah Seeni Mohamed, Hazleen Anuar, Maizirwan Mel, Rashidi Othman, Nur Aisyah Mohd Norddin, Nur Aimi Mohd Nasir, Mohd Adlan Mustafa Kamalbhrein</i> |
| <b>Chapter 17</b>  | 96  |
| Wear of Nitride Coating Produced by Ti-Al Melt Synthesis in Nitrogen Environment   |   |
|  | <i>Shahjahan Mridha</i>   |
| <b>Chapter 18</b>  |   |
| Effect of Dispersant on Protein Foaming-Consolidation Porous Alumina Containing Hydrothermal Derived Hydroxyapatite Nanopowder                               | 103   |
|  | <i>Iis Sopyan and Ahmad Fadli</i>   |

|   |     |
|---|-----|
| <b>Chapter 19</b>   | 109 |
| Effect of Yolk Addition on Protein Foaming-Consolidation Porous Alumina-Calcium Phosphate Composites                                |     |
| <i>Iis Sopyan and Ahmad Fadli</i>   |     |
| <b>Chapter 20</b>   | 115 |
| Investigation of the Effect of Starch Addition on Protein Foaming-Consolidation Porous Alumina Containing Hydroxyapatite Nanopowder |     |
| <i>Ahmad Fadli', Iis Sopyan, Nur Syahidah and Nur Nadia</i>   |     |
| <b>Chapter 21</b>   | 120 |
| The Influence of Hydroxyapatite Loading on Protein Foaming-Consolidation Porous Alumina Sintered at 1300°C                          |     |
| <i>Ahmad Fadli 'and Iis Sopyan</i>  |     |
| <b>Chapter 22</b>   | 126 |
| High Density Polyethylene (HDPE) as an Alternative Material in Fuel Tank Production   |     |
| <i>Afiqah Afdzahuddin and Md Abdul Maleque</i>  |     |
| <b>Chapter 23</b>   | 132 |
| Porous Alumina-Hydroxyapatite Composites via Protein Foaming-Consolidation Method: Effect of HA Loading on Physical Properties      |     |
| <i>Iis Sopyan, Ahmad Fadli and Nur Izzati Zulkifli</i>  |     |
| <b>Chapter 24</b>   | 137 |
| Preparation and Characterisation of Low Density Polyethylene/Layered Silicate Nanocomposites  |     |
| <i>Salina Sharifuddin , Iskandar Idris Yaacob</i>   |     |
| <b>Chapter 25</b>   | 144 |
| Effects of Sodium Dodecyl Benzene Sulphonate (NaDBs) on Li Imide-PMMA Based Solid Polymer Electrolyte                               |     |
| <i>Fauziah Mohd Yusof and Iskandar Idris Yaacob</i>   |     |
| <b>Chapter 26</b>   | 149 |
| Effect of Milling Time on Mechanochemically Synthesized Nanohydroxyapatite Bioceramics  |     |
| <i>Iis Sopyan, S. Adzila and M. Hamdi</i>   |     |
| <b>Chapter 27</b>   | 155 |
| Morphological Analysis of Mechanochemically Synthesized Nanohydroxyapatite Bioceramics  |     |
| <i>Iis Sopyan, S. Adzila and M. Hamdi</i>   |     |
| <b>Chapter 28</b>   | 160 |
| Sodium Doped Nanohydroxyapatite Bioceramics through Mechanochemical Synthesis   |     |
| <i>S. Adzila, Iis Sopyan and M. Hamdi</i>   |     |

|   |     |
|---|-----|
| <b>Chapter 29</b>   | 165 |
| Thermal Profile Analysis of Composite Brake Rotor   |     |
| <i>Md Abdul Maleque and Abdul Mu'min Adebisi</i>  |     |
| <b>Chapter 30</b>   | 172 |
| The Effect of Fibre Content on Thermal Property of Coir Fibre Reinforced Cement-Albumen Composite |     |
| <i>Faridatul Faezah Razali, Nur Humairah Abdul Razak and Zuraida Ahmad</i>                        |     |
| <b>Chapter 31</b>   | 178 |
| Pulsed Electrodeposition  |     |
| <i>Suryanto</i>   |     |
| <b>Chapter 32</b>   | 184 |
| Electroless Nickel Based Coatings From Solution Containing Sodium Hypophosphite                   |     |
| <i>Suryanto</i>   |     |
| <b>Chapter 33</b>   | 189 |
| Characterization and Utilization of Fly Ash   |     |
| <i>Suryanto</i>   |     |
| <b>Chapter 34</b>   | 195 |
| Workability of Coir Fibre- Reinforced Cement-Albumen Composite                                    |     |
| <i>Nur Humairah Abdul Razak and Zuraida Ahmad</i>   |     |
| <b>Chapter 35</b>   | 201 |
| Preparation of Rice Husk for Raw Material of Silicon  |     |
| <i>Hadi Purwanto and Nor Fazilah Mohd Selamat</i>   |     |

## Effects of Sodium Dodecyl Benzene Sulphonate (NaDBS) on Li Imide-PMMA based Solid Polymer Electrolyte

Fauziah M.Yusof<sup>1</sup> and Iskandar I.Yaacob<sup>2</sup>

1. Faculty of Engineering, University of Malaya

2. Kulliyah of Engineering – International Islamic University Malaysia

✉ : [iskandar.yaacob@iiu.edu.my](mailto:iskandar.yaacob@iiu.edu.my)

**Keywords:** ion dissociation; ionic conductivity; ionic mobility.

**Abstract.** The properties of solid polymer electrolyte (SPE) of Li Imide-PMMA based is modified by a small addition of sodium dodecyl benzene sulphonate (NaDBS). The ionic conductivity of the system increases up to 0.98wt% addition of NaDBS. This feature can be explained by the large molecular structure of DBS anions which acts as spacers between the polymer chains. This results in enhancement in both the ion dissociation and ionic mobility. These systems form a transparent and free standing SPE films. The systems are characterized using impedance spectrometer, X-ray Diffraction (XRD), Fourier Transform Infra Red (FTIR) analysis and UV-Visible spectrophotometer. XRD study reveals that the SPE film is amorphous. Meanwhile, UV-Visible spectrophotometer tests show that the SPE transparent films have excellent transmission modulation over the visible region. FTIR analysis indicates no complexation of NaDBS with Li Imide-PMMA system suggesting that DBS molecules only act as spacers for the system.

### Introduction

SPE can be defined as a material consisting of ionic salts dissolved in an appropriate polymer, which enable ionic conduction at room temperature [1]. The ionic conduction is due to mobile anionic or cationic ions that act as the conducting species. Selection of materials is very important due to the ability of ions to dissociate and become mobile in the SPE .

PMMA is a transparent amorphous polymer which has a polar functional group which is the ester group. It exhibits a high affinity for both lithium ions and plasticizing agents. This feature is basically used for selecting the polymer host for SPE [2]. The functional group has a high donor electron number which enriches free ion fractions or ion dissociations in SPE. While a high chain flexibility of the polymer backbone allows for high ionic mobility.

In this paper we study the effect of sodium dodecyl benzene sulphonate (NaDBS) salt with big anion size on Li Imide-PMMA based SPE. Basically, salt with big anion size has low lattice energy which promotes better ion dissociation feature, hence providing better ionic mobility. Salts with big anion size have extensive dispersion of the negative charge that promotes plasticizing effect and free ion movement in SPE [3].

NaDBS consists of Sodium ion bonded to dodecyl benzene sulphonate (DBS) ion. DBS ion is formed by a combination of a benzene ring, a sulphonate group and an alkane hydrocarbon chain. Therefore, its large molecular structure can create spaces in the SPE system which increases the free volume of the SPE hence helps in free ion movement in the SPE system.