

# ADVANCES IN MATERIALS ENGINEERING

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## Volume 1

Edited By:  
Zahurin Halim  
Iskandar Idris Yaacob  
Md Abdul Maleque



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# Table of Content

<b>Chapter 1</b> Preparation and Characterization of Thermoplastic Natural Rubber (TPNR) Nanocomposites <i>Noor Azlina Hassan, Sahrim Hj. Ahmad, Rozaidi Rasid and Norita Hassan</i>	1
<b>Chapter 2</b> Polymer Clay Nanocomposites: Part I <i>Noor Azlina Hassan and Norita Hassan</i>	6
<b>Chapter 3</b> Effect of Processing Parameters on the Tensile Properties of TPNR Reinforced Short Carbon Fibre Composite <i>Hazleen Anuar, Sahrim Hj. Ahmad and Rozaidi Rasid</i>	11
<b>Chapter 4</b> Effect of Maleic Anhydride Polyethylene on Damping Properties of HDPE/EPDM Nanocomposite <i>Hazleen Anuar, Nur Ayuni Jama, and Shamsul Bahri Abdul Razak</i>	16
<b>Chapter 5</b> Comparative Study on the Effect of Plasticizer on Thermal Properties of Polylactic Acid <i>Hazleen Anuar and Muhammad Rejaul Kaiser</i>	22
<b>Chapter 6</b> Quality of Copper Film Electroplated on Silicon Wafer Using Different Current Densities <i>Shahjahan Mridha</i>	28
<b>Chapter 7</b> Laser Nitriding of Titanium <i>Shahjahan Mridha</i>	39
<b>Chapter 8</b> Composite Coating on Titanium Alloy Using High Power Laser <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 Kamalbhryn</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>		103
Effect of Dispersant on Protein Foaming-Consolidation Porous Alumina Containing Hydrothermal Derived Hydroxyapatite Nanopowder		
	<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>	

## Investigation of the Effect of Starch Addition on Protein Foaming-Consolidation Porous Alumina Containing Hydroxyapatite Nanopowder

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**Keywords:** Porous alumina, hydroxyapatite, composites, protein foaming-consolidation.

**Abstract.** The object of this study was to produce porous alumina-hydroxyapatite (HA) composite bodies via protein foaming-consolidation method. Egg yolk was used as a pore creating agent. Alumina and HA powders were mixed with yolk, starch and Darvan 821 A dispersant at an adjusted mass ratio to make slurry. The slurries were cast into cylindrical shaped molds and then dried for foaming and consolidation process. Subsequently, the dried bodies were burned at 600°C for 1 h, followed by sintering at temperature of 1400°C for 2 h. The starch addition was selected as the variable factor. The density of porous bodies increased from 2.40 to 2.81 g cm<sup>-3</sup> when starch amount increased from 1.0 to 3.0 g. The compressive strength was found 18.0 MPa at 38.3% porosity and it increased to 102.3 at 29.1% porosity. The pores of 50-600 μm size illustrating the rough enough internal surfaces, were obtained for potential use in hard tissue engineering.

### Introduction

Hydroxyapatite (HA) with the chemical formula  $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$  has been widely used extensively in medicine and dentistry for implant fabrication because of its biocompatibility with human bone and teeth [1]. Porous hydroxyapatite exhibit strong bonding to the bone where the pores provide a mechanical interlock leading to affirm fixation of the material. Bone tissue can growth well into the pores, increasing the strength of the HA implant. The minimum pore size required to enable ingrowth of the surrounding bone together with blood supply is about 100- 150 micron meter while for colonization of osteoblast in the pores, fibrovascular ingrowth and the deposition of new bone the pore size should be 200- 500 micron meter [2]. Porous HA cannot be heavy loaded because it usually possesses very low strength and toughness as its porosity increase. Compression strength of porous human bones vary between 2-12 MPa for cancellous bone and between 100-230 MPa for cortical bone while porous HA only have mechanical strength as low as 1.3-16 MPa [3].

On the other hand, porous alumina is relatively strong and tough, but has problem of biological inertness to bone tissue [4]. Therefore, it is interesting to manufacture alumina-hydroxyapatite composite of porous shape.

In the previous study, porous alumina ceramics were fabricated by a protein foaming-consolidation method and the control in slurry composition and drying processes resulted in the porosity of 40 – 71% [5]. In this paper, porous alumina-HA porous bodies were fabricated using this method and the effect of starch addition is investigated.