

ADVANCES IN MATERIALS ENGINEERING

Volume 1

Edited By:
Zahurin Halim
Iskandar Idris Yaacob
Md Abdul Maleque



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Table of Content

Chapter 1 Preparation and Characterization of Thermoplastic Natural Rubber (TPNR) Nanocomposites <i>Noor Azlina Hassan, Sahrim Hj. Ahmad, Rozaidi Rasid and Norita Hassan</i>	1
Chapter 2 Polymer Clay Nanocomposites: Part I <i>Noor Azlina Hassan and Norita Hassan</i>	6
Chapter 3 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
Chapter 4 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
Chapter 5 Comparative Study on the Effect of Plasticizer on Thermal Properties of Polylactic Acid <i>Hazleen Anuar and Muhammad Rejaul Kaiser</i>	22
Chapter 6 Quality of Copper Film Electroplated on Silicon Wafer Using Different Current Densities <i>Shahjahan Mridha</i>	28
Chapter 7 Laser Nitriding of Titanium <i>Shahjahan Mridha</i>	39
Chapter 8 Composite Coating on Titanium Alloy Using High Power Laser <i>Shahjahan Mridha</i>	45

Chapter 9		
Measurement of Moisture Absorption in Borophosphosilicate Glass (BPGS) Films		50
	<i>Shahjahan Mridha and Shiau Khee Tang</i>	
Chapter 10		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>	
Chapter 11		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>	
Chapter 12		69
Water Absorption of TPNR Reinforced Short Carbon Fibre Composite		
	<i>Hazleen Anuar, Sahrim Hj. Ahmad and Rozaidi Rasid</i>	
Chapter 13		74
Enhanced Tensile Strength with Sulphuric Treated Short Carbon Fibre		
	<i>Hazleen Anuar, Sahrim Hj. Ahmad and Rozaidi Rasid</i>	
Chapter 14		79
Effect of Fibre Length on Tensile Properties of TPNR-Kenaf Fibre Composite		
	<i>Hazleen Anuar, Sahrim Hj. Ahmad and Rozaidi Rasid</i>	
Chapter 15		84
Effect of Nanoclay on Mechanical Properties of PLA-Clay Nanocomposite		
	<i>Hazleen Anuar and Muhammad Rejaul Kaiser</i>	
Chapter 16		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>	
Chapter 17		96
Wear of Nitride Coating Produced by Ti-Al Melt Synthesis in Nitrogen Environment		
	<i>Shahjahan Mridha</i>	
Chapter 18		103
Effect of Dispersant on Protein Foaming-Consolidation Porous Alumina Containing Hydrothermal Derived Hydroxyapatite Nanopowder		
	<i>Iis Sopyan and Ahmad Fadli</i>	

Chapter 19	109
Effect of Yolk Addition on Protein Foaming-Consolidation Porous Alumina-Calcium Phosphate Composites	
	<i>Iis Sopyan and Ahmad Fadli</i>
Chapter 20	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>
Chapter 21	120
The Influence of Hydroxyapatite Loading on Protein Foaming-Consolidation Porous Alumina Sintered at 1300°C	
	<i>Ahmad Fadli 'and Iis Sopyan</i>
Chapter 22	126
High Density Polyethylene (HDPE) as an Alternative Material in Fuel Tank Production	
	<i>Afiqah Afdzahuddin and Md Abdul Maleque</i>
Chapter 23	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>
Chapter 24	137
Preparation and Characterisation of Low Density Polyethylene/Layered Silicate Nanocomposites	
	<i>Salina Sharifuddin , Iskandar Idris Yaacob</i>
Chapter 25	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>
Chapter 26	149
Effect of Milling Time on Mechanochemically Synthesized Nanohydroxyapatite Bioceramics	
	<i>Iis Sopyan, S. Adzila and M. Hamdi</i>
Chapter 27	
Morphological Analysis of Mechanochemically Synthesized Nanohydroxyapatite Bioceramics	155
	<i>Iis Sopyan, S. Adzila and M. Hamdi</i>
Chapter 28	160
Sodium Doped Nanohydroxyapatite Bioceramics through Mechanochemical Synthesis	
	<i>S. Adzila, Iis Sopyan and M. Hamdi</i>

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

Effect of Dispersant on Protein Foaming-consolidation Porous Alumina Containing Hydrothermal Derived Hydroxyapatite Nanopowder

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

Abstract. Present chapter reports the effect of dispersant loading on physical properties of porous alumina-hydroxyapatite composite bodies fabricated using protein foaming-consolidation method. Hydrothermal derived hydroxyapatite powder was used as bioactive ceramic. Alumina and HA powders were mixed with yolk, starch and darvan 821 A 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 temperatures of 1400°C for 2 h. The porous alumina-HA composites with pore size in the range of 50-500 μm and densities of 2.23 – 2.83 g cm⁻³ were obtained. Porosity of bodies decreased from 43.9 to 28.6% when dispersant amount increased from 0 to 7.0 g. The compressive strength of sintered bodies was found in the range of 20.3 to 104.8 MPa showing depends on porosity.

Introduction

Orthopaedic implants become an important thing in the biomedical implant market due to all of the problems arise in the medicine today. It is expected to increase 15-18% annually which will lead to market duplication [1]. Metals, polymers and ceramics are the candidate materials for application of bone graft [2]. Calcium phosphate is used in implantation because it can initiate a rapid biological response and able to improve the adhesion between bone and implant. Calcium phosphate will also provide scaffold for bone growth. It has been widely used as an alternative to these biological grafts in various types of bone surgery. Because of its good biocompatibility, bioactivity and osteoconductivity, calcium phosphate gets more attention to be applied as bone graft. The main constituent of bones from calcium phosphate is hydroxyapatite, (Ca₁₀(PO₄)₆(OH)₂) [1]. However, due to its poor mechanical properties, HA ceramics cannot be used for heavy loading application, but most commonly used in bone graft substitution and coating on metallic implants.

Porous HA exhibits strong bonding to the bone where the pores provide a mechanical interlock leading to a firm fixation of the material. However, too many or too large pores will reduce the strength of implant significantly. That is why, HA can only be used for small bone defects. Porous volume and interconnection between pores and size will affect the characteristics of development bioceramics [3]. To improve the mechanical strength while maintaining the bioactivity of the scaffold, porous alumina-hydroxyapatite have been shown to have higher strength than the HA porous implant. It will exhibit implant that enables positive biological or chemical material connections [4]. Alumina is used to make implantable orthopaedic devices, is a very well tolerated material with minimum tissue reaction after implantation. It exhibits high mechanical strength and