

# Table of Contents

## Preface

## Chapter 1: Titanium Powder Production and Characterization

<b>Characterization of Gas Atomized Ti-6Al-4V Powders for Additive Manufacturing</b> L.C. Tshabalala, N. Mathe and H. Chikwanda	3
<b>Development of Bio-Compatible Beta Ti Alloy Powders for Additive Manufacturing for Application in Patient-Specific Orthopedic Implants</b> E. Ivanov, E. del Rio, I. Kapchemko, M. Nyström and J. Kotila	9
<b>Titanium-Tantalum Alloy Powder Produced by the Plasma Rotating Electrode Process (PREP)</b> J.G. Yin, G. Chen, S.Y. Zhao, P. Tan, Z.F. Li, J. Wang and H.P. Tang	18

## Chapter 2: Production of Titanium Alloys and Porous Titanium Materials by Powder Metallurgy Methods

<b>Microstructure Characterization of <i>In Situ</i> Ti-TiB Metal Matrix Composites Prepared by Powder Metallurgy Process</b> H. Singh, M.D. Hayat, R. Das, X.G. Wang and P. Cao	25
<b>Preparation of Ti-5553 Alloy by Different Extrusion Processes from Elemental Powder Mixtures</b> F. Yang, B. Gabbitas, S. Raynova, A.P. Singh and L. Bolzoni	31
<b>Microstructure and Mechanical Properties of Ti-5Al-2.5Fe Alloy Produced by Powder Forging</b> M.T. Jia, C. Blanchard and L. Bolzoni	39
<b>The Effect of Heat Treatments on Microstructure and Mechanical Properties of As-Extruded Ti-6Al-4V Alloy Rod from Blended Elemental Powders</b> C. Romero Villarreal, F. Yang, S. Raynova and L. Bolzoni	45
<b>Effect of Microwave Sintering Parameters on the Physical and Mechanical Properties of Pure Ti and Blended Elemental Ti Alloys</b> S. Raynova, M.A. Imam, H. Taylor, F. Yang and L. Bolzoni	52
<b>Processing, Microstructures and Properties of a Ti-6Al-4V Extrusion Produced by an Industrial Scale Setup</b> A.P. Singh, F. Yang, R. Torrens, B. Gabbitas, B. Robinson and L. Bolzoni	60
<b>Mesenchymal Stem Cells Adhesion on Micro-to-Nano-Scaled Hierarchical Ti Implants Fabricated by Powder Metallurgy and Anodization</b> D.P. Zhao, Y. Zhang, H.M. Nie and M. Yan	70
<b>Influence of Alloying Elements in Fatigue Properties of <math>\alpha/\beta</math> Titanium Alloys</b> A.A. Hidalgo, W. Limberg, T. Ebel, R. Frykholm, E. Carreño-Morelli and F. Pyczak	80
<b>Effects of Open Atmosphere Solutionizing Treatment on the Microstructural and Mechanical Properties of Porous 60NiTi Parts</b> K. Khanlari, M. Ramezani, P. Kelly, M.D. Hayat, P. Cao and T.R. Neitzert	87
<b>Mechanical Alloying of Ti-Based Materials</b> H. Chikwanda and L. Mahlatji	95
<b>Effects of Environment on the Wear Behavior of P/M Ti-47Al-2Cr-0.2Mo</b> J.W. Qiu, D. Pan, Y. Liu, I. Baker and W.D. Zhang	106
<b>Preparation, Microstructure and Properties of Ti-6Al-4V Rods by Powder Compact Extrusion of <math>\text{TiH}_2/\text{Al}_{60}\text{V}_{40}</math> Powder Mixture</b> Y.F. Luo, Y.H. Xie, J.M. Liang and D.L. Zhang	116
<b>Fabrication and Compressive Properties of Titanium Foam for Bone Implant Applications</b> Z.F. Li, C. Wu, G. Chen, P. Tan, S.Y. Zhao, Y. Ge and J.G. Yin	126

## **Chapter 3: Additive Manufacturing of Titanium Alloys**

<b>From Powder to Solid: The Material Evolution of Ti-6Al-4V during Laser Metal Deposition</b>	135
P. Surrey, M. Möller, C. Emmelmann, M. Heilemann and J. Weber	
<b>Physical and Tensile Properties of NiTi Alloy by Selective Electron Beam Melting</b>	148
M.D. Hayat, G. Chen, N. Liu, S. Khan, H.P. Tang and P. Cao	
<b>The Challenges Associated with the Formation of Equiaxed Grains during Additive Manufacturing of Titanium Alloys</b>	
D.H. St John, S.D. McDonald, M.J. Bermingham, S. Mereddy, A. Prasad and M. Dargusch	155
<b>Additive Manufacturing of Ti-6Al-4V with Added Boron: Microstructure and Hardness Modification</b>	
B. Jackson, R. Torrens, L. Bolzoni, F. Yang, M. Fry and A. Mukhtar	165
<b>Optimizing HIP and Printing Parameters for EBM Ti-6Al-4V</b>	
A. Eklund, M. Ahlfors, F. Bahbou and J. Wedenstrand	174
<b>Microstructure and Mechanical Properties of Ti-6Al-4V Alloy Samples Fabricated by Selective Laser Melting</b>	
J.B. Gao, X.L. Zhao, J.K. Yue, M.C. Qi and D.L. Zhang	179

## **Chapter 4: Metal Injection Moulding of Titanium Alloys**

<b>Powder Injection Molding of Ti-6Al-4V Alloy for Defect-Free High Performance Titanium Parts with Low Carbon/Oxygen Contents</b>	189
D.G. Lin, J.M. Park, T.G. Kang, S.T. Chung, Y.S. Kwon and S.J. Park	
<b>Comparative Rheology Techniques for Assessment of MIM Titanium Metal Powder Feedstocks</b>	
P.D. Ewart, C.J. Verbeek and S.Y. Ahn	195
<b>Study of a Binder System for Ti-MIM: A Potential Low Temperature Backbone Polymer</b>	
H.Z. Zhang, M.D. Hayat, X.H. Qu, P.P. Jadhav, X.G. Wang and P. Cao	206

## **Chapter 5: Theoretical Approaches in Design of Titanium Alloys**

<b>The Molecular Orbital Approach to Titanium Alloy Design</b>	217
M. Morinaga	
<b>First Principle Study of Ti<sub>50</sub>Al<sub>50</sub> Alloys</b>	224
R. Modiba, H. Chauke and P. Ngoepe	
<b>Advances in Ti-Based Systems as High Temperature Shape Memory Alloys</b>	
H. Chauke, M. Mashamaite, R. Modiba and P. Ngoepe	230

## **Chapter 6: Miscellaneous Manufacturing Processes for Titanium Materials**

<b>Preparation of TiO<sub>2</sub> Coating on Pure Ti with Sodium Borate Glass as Catalyst</b>	241
Z. Lu, G.X. Wang, Y.M. Wang and Y.F. Yan	
<b>Joint Effect of Steel Addition and Press-and-Sinter on the Properties of Low-Cost PM Ti Alloys</b>	
L. Bolzoni, E.M. Ruiz-Navas and E. Gordo Odériz	248
<b>A Simple and Economical Device to Process Ti Cylinders with Elongated Porosity by Freeze-Casting Techniques: Design and Manufacturing</b>	
P.T. Muñoz, J.R.B. Suárez, A.M. Beltrán, J.A. Rodríguez-Ortiz, Y.T. Hernández, J.J.P. Palacio, E.A. Álvarez and D.C. Dunand	255
<b>Optimization of Milling Parameters for Titanium Alloys Based on Support Vector Machine (Machine Learning) and Ant Colony Optimization Algorithm</b>	
X.X. Zhang, Z.C. Wang and H.Y. Chen	262