

Table of Contents

Preface, Committees	iii
Opening Session Keynote	
A Pathway to Achieving High-Performance and Low-Cost Ti Simultaneously Z.Z. Fang and P. Sun.....	3
Session 1: Powder Metallurgy Consolidation	
Characterization of the Microstructure, Tensile, Fatigue, and Creep Behavior of Powder Metallurgy Processed Rolled and Extruded Ti-6Al-4V-1B Alloys W. Chen and C. Boehlert	7
Optimization of a Harmonic Structured Ti-24Nb-4Zr-8Sn Alloy through Combined Microstructural and Mechanical Investigations B. Fer, D. Tingaud, F. Prima and G. Dirras	8
Enhancing Wear Resistance of Titanium Alloys: Insights from Tribological Testing I. Montealegre-Meléndez, C.M. Arévalo, E. Neubauer and E.M. Perez-Soriano	10
Improvement of the Mechanical Properties of a P/M Ti-6Al-4V Alloy with Additions of Carbon and Silicon N. Burgos and J.M. Martin	11
Sintered Titanium Sponge T. Hutsch, J. Trapp and T. Weißgärber.....	13
Correlations between Microstructures and Tensile Properties of Ti- 6Al- 2Sn- 4Zr- 2Mo- 0.1Si- (0,0.5)Y (Wt.%) Alloys Fabricated by Thermomechanical Powder Consolidation D.L. Zhang, X.G. Wu, B.W. Zhang and H.Z. Niu.....	15
Session 2: Titanium Aluminide	
An Overview on Sintering of Titanium-Aluminides T. Ebel.....	19
TiAl Powder Based Fused Granular Fabrication W. Limberg, M.W. Rackel, J.D.H. Paul, F. Pyczak and T. Ebel.....	21
Development of TiAl Alloys for Gas Turbine Engines S.W. Kim.....	22
Sintering Titanium Aluminides with Co Addition L. Quaglio, W.A. Monfardini and J. Soyama	23
Session 2 - Posters	
The Effect of Container on the Microstructure and Properties of Powder Metallurgy TiAl Alloys J. Wu, Z.G. Lu, L. Xu, D. Liu and R. Yang.....	27

Preparation and Properties of Ti-47Al-2Cr-2Nb-0.15B Alloy by Powder Metallurgy Route	
L. Xu, J. Wu, Y.Y. Cui and R. Yang	28
Powder Densification Process Analysis of γ-TiAl Alloys through Hot Isostatic Pressing	
Z.G. Lu, J. Wu, L. Xu and R. Yang	29
Microstructure and Mechanical Properties of Ti-43Al-9V-Y Alloy Prepared by Hot Isostatic Pressing	
F.T. Kong	30
Mechanical Alloying Process of Ti-Al Powders through Milling and Additive Manufacturing	
A. Riquelme, V. Bonache and P. Rodrigo	31
Characterization and Thermal Treatment of γ-TiAl Intermetallic Alloy for Enhanced Microstructural Properties	
B. Ruiz-Palenzuela, I. Sabirov and E.M. Ruiz-Navas	33
 Session 3: Additive Manufacturing Deposition Techniques	
Large Titanium Preform Manufacture by Cold Spray	
C. Doblin, S. Gulizia, M. Faizan-ur-Rab, A. Vargas-Uscategui, A. Yousefiani, S.H. Zahiri and B. Zamorano	37
High Strength and Ductility in as-built Ti-Cu-Fe-Al Alloys Produced via Direct Energy Deposition	
R. Brooke, D.Y. Zhang, D. Qiu, M.A. Gibson and M. Easton	38
Cold Spray Additive Manufacturing of Ti to Reduce the Cost of PEM Electrolyzers	
J. Sánchez, V. Albaladejo, M. Sarret, A. Garfias, R. Vaz, T. Andreu and I.G. Cano	39
Manufacturing of a Ti6Al4V Aerospace Component by Metallic Wire Based Laser Beam Directed Energy Deposition	
E. Vaamonde, P. Rey and M. Salgueiro	40
 Session 3 - Posters	
Optimizing Titanium-Boron Carbide Composites for Aerospace Manufacturing via Plasma Metal Deposition	
C.M. Arévalo, E.M. Perez-Soriano, M. Kitzmantel and I. Montealegre-Meléndez	45
 Session 4: Powder-Bed Additive Manufacturing - I	
<i>In Situ</i> Alloying of Copper-Coated Titanium Powder via Laser Powder Bed Fusion	
D.M. Xu, P. Cao and W.X. Yang	49
Developing near Beta Ti-30Nb-4Sn Alloy through <i>In Situ</i> Alloying in Additive Manufacturing Processes	
J.F.Q. Rodrigues, M. Sangali, L.F. Starck, G.V. Prandi, M. Valentim, R. Caram and R.J. Contieri	50
A Novel Compositional Design Strategy for As-Printed Ti Alloys with Equiaxed Microstructure and Excellent Mechanical Performance	
Y.F. Yang and S.F. Li	52

Porous Thin Wall Titanium Alloys Manufactured by Electron Beam Selective Melting

J.H. Liu, F.H. Wang, Y.F. Liang and J.P. Lin 53

Achieving Strong and Uniform Additively Manufactured Titanium through Alloy Design

M. Bermingham, J. Zhang and M. Dargusch..... 54

Session 4 - Posters

Investigating Ti6Al4V Spreadability on Powder Bed Fusion: A Comparative Analysis of Single and Multi-Layer Approaches

S.M. Ashrafzadeh, R. Pelletier, M. Habibnejad-Korayem, L.P. Lefebvre and S. Yue 57

Sandwich Structure of Ti-5553 and Ti-42Nb Prepared by Laser Powder Bed Fusion

F. Kowaski Martins, J.F. Queiroz Rodrigues, R.J. Contieri, J. Soyama and R. Caram..... 58

Laser Powder Bed Fusion Manufacturing of Graded Ti-Nb Alloys: Microstructural and Mechanical Properties for Biomedical Applications

L.A.R. Leão, M. Sangali, J.F.Q. Rodrigues, G.V. Prandi, M. Valentim, L.S. Silva, L.F. Starck, R. Caram and R.J. Contieri 60

Tailored Titanium Mechanical Metamaterials via Additive Manufacturing

H. Lin 62

Investigating Multimaterial Lattices Fabricated via Laser Powder Bed Fusion Using a Reinforcement Layer Strategy

M. Valentim, J.F.Q. Rodrigues, G.V. Prandi, M. Sangali and R. Caram 63

Session 5: Powder Production and Characterisation

Predicting Powder Spreadability for Metal AM

A. Neveu, F. Francqui and G. Lumay 67

Suitability of Novel Titanium Alloys Powders for Metal Injection Moulding Applications

V. Kruzhanov, A. Gonchar, V. Troshchylo, A. Brodskyy, V. Yarovynskyi, O. Chukhmanov and A. Yarovynskyi 68

Effect of Surface on the Properties of Titanium Based Powders

L.P. Lefebvre, C. Charbonneau, T. Anatolie and O. Bergeron..... 69

Offsize Particle Size Utilization for Laser Powder Bed Fusion Processing of Plasma Atomized Ti-6Al-4V Powders: Impact on Fatigue Properties of Produced Parts

M. Habibnejad-Korayem 70

Session 6: Powder-Bed Additive Manufacturing - II

Strong and Ductile Titanium Alloys Containing High Interstitial Elements

M. Qian, S.L. Lu and T.T. Song 73

A Novel Strategy to Tailor Microstructures and Mechanical Properties of Ti upon Understanding of the Powder Oxide Layer

G. Chen, W.W. Ding, W. Cai, Z.M. Guo, M.L. Qin and X.H. Qu 74

Effect of Layer Thickness and Particle Size Distribution on the Microstructure and Properties of Ti6Al4V Processed by Laser Powder Bed Fusion

N. Belsure, R. Sandberg, P. Harlin, E. Hryha, G. Soundarapandiyam and F. Deirmina 75

Investigation of the Effect of Oxygen Homogeneity on the Processability of Ti-6Al-4V: Addition of out of Spec Powders	
M. Habibnejad-Korayem	76
Dwell Fatigue of Ti-6Al-4V Alloys Processed by Laser Powder Bed Fusion	
C. Romero Villarreal, A. Santos, P. Rodrigo, B. Torres and J. Rams	77
Session 6 - Posters	
Effects of Thermal Induced Porosity on High-Cycle Fatigue Behaviors of Selective Laser Melted Ti-6Al-4V Titanium Alloy	
R.C. Li, Y.F. Yin, Z.G. Lu and L. Xu.....	81
Session 7: Metal Injection Molding and Sinter-Based Additive Manufacturing	
Interaction of Binder and Powder in Processing of Titanium	
C. Kukla, E. Gordo Odériz, S. Schuschnigg, J. Villemur, P. Luna and C. Holzer	85
TiNb-Based Shape Memory Alloy Scaffolds Produced by Direct Ink Writing	
T. Vilella, G. Fargas, L. Llanes and D. Rodriguez	86
Comparing Lithography-Based Metal Manufacturing for Titanium with Established Processes such as Cold Metal Fusion	
T. Marter	88
Development of Materials and Processes for the Lithography-Based Metal Manufacturing of Ti6Al4V	
S. Cano Cano, L. Vogel, J. Bosters, C. Burkhardt and G. Harakály.....	90
Advances in Lithography Based Metal Manufacturing of Nickel Titanium Alloys	
L. Vogel, R. Moreno Lopez, G. Harakály, S. Cano Cano, A. Baum, M. Zimmermann and C. Burkhardt.....	92
Session 7 - Posters	
Processing of a Beta Titanium Alloy by Metal Injection Molding (MIM)	
V. Henriques, R.O.P. de Lima, J.G.J. Salvo, A.M. Gama and M.H. Lapena	97
Additive Manufacturing and Hot Isostatic Pressing Formability Contrast of GH4169	
Y.F. Yin, Z.G. Lu, J. Wu and L. Xu	99
Enhancing Sintering Performance of Ti-6Al-4V through Phenomenological Simulation and Predeformation	
T. Marter	100
Innovative Thermal Approach for Consolidation of AM-MEX Ti64-Based Components Using Sustainable Colloidal Feedstock	
C. Chirico, A.J. Sanchez-Herencia and B. Ferrari	102
Fabrication and Properties of Extrusion-Based 3D Printing of Ti-6Al-4V Alloys	
Y.J. Su, J. Villemur, E.M. Ruiz-Navas and E. Gordo Odériz.....	103
Session 8: Sustainability and Recycling	
Ways to Improve Carbon Footprint in the Additive Manufacturing Process Chain	
M. Dopler and A. Köll	107

Exploitation of FAST/SPS to Recycle Surplus Metal Powder for Sustainable Solutions and near Net Shape Components	
M. Jackson	108
On the Effectiveness of the Processing Parameters of Titanium Ti-6Al-4V by PBFL/m and the Effect of Powder Recycling on the Material Properties	
Á. Nieto, A. Perrián, J. Santaolaya and C. Galleguillos.....	109
3D Printing of Ti-6Al-4V Parts from Waste Material	
M. Grande-Molina, L. Calvo, L. Poudelet, R. Cardona, C. Chirico and B. Ferrari.....	111
Session 9: Titanium Matrix Composites	
Progress of Titanium Matrix Composites via Powder Metallurgy and Additive Manufacturing Based on the Newly Developed Nano-TiBw Reinforced Titanium Matrix Composites Powder	
S.F. Li, L. Liu, S.L. Li, D.X. Hui, S.D. Wang, X. Zhang and B. Li.....	115
Refined Microstructures and Enhanced Strength of <i>In Situ</i> TiBw/Ti-6.5Al-2.5Zr-1Mo-1V Composites by Selective Laser Melting	
Q. An, L.H. Cui, L.J. Huang and L. Geng	116
Improving Strengthen-Ductility Synergy of Titanium Matrix Composites by Constructing Multi-Scale Network Heterostructure	
D.L. Gong, Q. An and L.J. Huang	117
Microstructure and High-Temperature Performance of Laser Powder Bed Fusion Yttrium Silicide-Modified near α Titanium Alloy	
Z.S. Ma and L.J. Huang	119
Study of Wear Behavior of Ti6Al4V/SiCp Composites Additively Manufactured by Laser-Directed Energy Deposition	
C. Sánchez De Rojas Candela, A. Riquelme, P. Rodrigo and J. Rams.....	120
Recent Developments in Producing Highly Dense Ti Matrix Composites via Hydrogen Assisted Powder Metallurgy	
Y.C. Song, O. Stasiuk, D.G. Savvakina and O. Ivasyshyn.....	121
Session 9 - Posters	
Ti-35Nb-TiC Metal Matrix Composites	
V. Henriques, R.O.P. de Lima, J.G.J. Salvo, A.M. Gama and M.H. Lapena	125
Microstructure Design and Mechanical Behaviors of Dual-Scale TiB Whisker Reinforced Ti64 Composites	
W.Q. Liu, S. Wang and L.J. Huang	127
Synthesis Mechanism and Mechanical Properties of Pelleted Hetero-Structure Titanium Matrix Composites via Interdiffusion and Self-Organization Strategy Based on Powder Metallurgy	
L. Liu, S.F. Li and S.L. Li.....	129
Session 10: Microstructural Development	
Porosity Prediction and Defect Control for the Titanium-Based Metal Additive Manufacturing Processes	
W.X. Yang, D.M. Xu and P. Cao.....	133

Martensite Decomposition during Heating of the Ti-6Al-4V Alloy Manufactured by Laser Powder Bed Fusion	
Y. Lakroune, D. Connetable, J. Hugues, P. Hermantier, P. Barriobero-Vila and M. Dehmas	134
High-Temperature “Inverse” Hall-Petch Relationship and Fracture Behavior of TA15 Alloy	
S.L. Li and S.F. Li.....	135
Exploring Layered Materials Using Laser Powder Bed Fusion of Titanium Alloys	
J.F.Q. Rodrigues, M. Sangali, G.V. Prandi, M. Valentim, L.F. Starck and R. Caram	136
Session 10 - Posters	
Evolution of Microstructure and Mechanical Properties of Powder Metallurgy TC18 Prepared by Hot Isostatic Pressing	
T. Chang, A. Li, Y. Liu, Q.X. Wang and Z.H. Qu.....	139
Mechanical Behaviour and Structural Investigation of Ti-Pt-Ru High Temperature Shape Memory Alloys	
M. Mashamaite, H.R. Chauke and P.E. Ngoepe.....	140
Session 11: Applications of Powder Metallurgy and Additive Manufacturing Titanium Alloys	
Ti and Co-Cr-Mo Alloy Dissimilar Joint Obtained by Additive Manufacturing	
G. Assumpção, A.F. Ramirez and J.B. Fogagnolo	143
Infiltration with Polymeric Biocomposite of Porous Ti6Al4V Implants Obtained through Laser Sintering to Enhance Osteointegration and Antimicrobial Activity	
E.M. Perez-Soriano, E.J. Delgado-Pujol, I. Montealegre-Meléndez, C.M. Arévalo, D. Fera, A. Periñán, A. Alcudia, F. Lasagni, J.E. González and Y. Torres.....	144
Comparison between TiN Coating on Porous Ti-6Al-4V Produced by EBM or PM for Bipolar Plates in PEM Fuel Cells	
J. Villemur, C. Romero Villarreal, J.M. Crego, J.R. Blasco Puchades and E. Gordo Odériz.....	145
Powder Metallurgy Technologies for Low-Cost Titanium-Based Laminated Armor	
S.V. Prikhodko, P.E. Markovsky, D.G. Savvakina, O.M. Ivasishin, O. Stasyuk and D. Oryshych	146
Session 11 - Posters	
Obtention of Functionally Graded Ti-13Nb-(10-X)Zr-XFe Biomedical Alloy through Additive Manufacturing	
G.V. Prandi, J.F.Q. Rodrigues, L.S. Silva, L.F. Starck, M. Sangali, M. Valentim and R. Caram.....	151
Assessment of Microstructural Homogeneity and Composition Gradients in SLM-Manufactured Ti-30Nb-4Sn Alloy for Biomedical Applications	
M. Sangali, J.F.Q. Rodrigues, L.F. Starck, G.V. Prandi, M. Valentim, L.S. Silva and R. Caram.....	153

Fabrication of Porous Titanium Scaffolds with Enhanced Biofunctional Behavior by Combining Stereolithography Technique and Infiltration of Composite Biopolymers with Osteoinductive and Bactericidal Properties

M. Vozarova, L. Vály, I. Montealegre-Meléndez, C.M. Arévalo, E.M. Perez-Soriano, E.J. Delgado-Pujol, A. Alcudia, Y. Torres, M. Kitzmantel and E. Neubauer 155

PMEMEL-H2: Opportunities for the Development and Application of Powder Metallurgy in Enhanced Performance Ion Exchange Electrolysers for Green H₂

A. Illana, J. Villemur, C. Romero Villarreal, E.M. Ruiz-Navas, E. Gordo Odériz, B. Torres, J. Rams, L.M. Fraga and J.C. Suarez 156

Keyword Index 159