

# **Advanced Materials Processing II**

Proceedings of the 2<sup>nd</sup> International Conference  
on Advanced Materials Processing  
Grand Hyatt, Singapore 2<sup>nd</sup>-4<sup>th</sup> December 2002

*Edited by*

**M.O. Lai and L. Lu**

 **TRANS TECH PUBLICATIONS LTD**  
Switzerland • Germany • UK • USA

# Table of Contents

Organizing Committee & Steering Committee & Sponsors	v
Preface	vi

## 1. Keynote

<b>The Alchemy of Today: Functioning of Traditional Ceramics Utilizing Nanostructure</b> H. Hosono .....	1
<b>Cost Effective Synthesis, Processing and Applications of Light-Weight Metallic Materials</b> F.H. Froes .....	7

## 2. Recent Advances in Thin Film Development

<b>Low-Cost Deposition of Highly-Conducting Indium-Tin-Oxide Transparent Films by Chemical Process; Spray CVD and Dip Coating</b> Y. Sawada .....	23
<b>Magneto-Sensitive Dielectric Permeability in Nano-Composite Ferromagnetic Oxide Films Prepared by RF-Sputtering</b> T. Fujii, A. Kajima and M. Inoue .....	27
<b>Preparation of LaNiO<sub>3</sub> Thin Film Electrode Grown by Pulsed Laser Deposition</b> M.H. Ong, L. Lu and M.O. Lai .....	33
<b>Mechanical Properties of Sputtered TiNiCu Shape Memory Alloy Thin Films</b> Y. Fu, H. Du, S. Gao and S. Yi .....	37
<b>Structure and Properties of TiN/TiAlSiN/TiN PVD Coatings on Cemented Carbides and Cermets</b> L.A. Dobrzański, K. Gołombek, J. Kopač and M. Soković .....	41
<b>Dimensional and Microstructural Dependence of the Magnetic Properties of Electrodeposited Co(P) Nanowire Arrays</b> K.H. Lee, Y.J. Kim and W.Y. Jeung .....	45

## 3. Magnetic Properties of Thin Films

<b>Tribological Properties of Plasma Sprayed Fe<sub>3</sub>Al-Al<sub>2</sub>O<sub>3</sub> Graded Coatings</b> J. Zhang, Y. Yin, J. Li, K. Sun and H. Zhang .....	49
<b>Effect of Nanocrystalline Electroplating of NiFe on the Material Permeability</b> S.H. See, H.L. Seet, X.P. Li, J.Y. Lee, K.Y.T. Lee, S.H. Teoh and C.T. Lim .....	53
<b>Effect of pH Values on the Magnetic Properties of Electroplated NiFe Layers</b> X.P. Li, Z.J. Zhao, S. Ang, S.J. Koh, T.B. Oh, J.Y. Lee and W.X. Chen .....	57
<b>Effect of Current Density on the Magnetic Properties of Electroplated NiFe Layers</b> X.P. Li, Z.J. Zhao, S. Ang, T.B. Oh, T.W. Song, W.C. Ng, S.J. Koh and J.Y. Lee .....	61

#### 4. Surface Modification

<b>Effects of Sonication on the Crystal Orientation of the Electrodeposited Palladium Film from Ammonia Bath</b>	
A. Chiba, T. Kabe and W.-C. Wu .....	65
<b>Surface-Layer's Structure of X40CrMoV5-1 Steel Remelted and/or WC Alloyed with HPDL Laser</b>	
L.A. Dobrzański, M. Bonek, A. Klimpel and A. Lisiecki .....	69
<b>Improvement of Tensile Strength of CVD SiC Fiber</b>	
S. Nanlin, L. Kun and Z. Yapei .....	73
<b>Plasma Spray Fe<sub>3</sub>Al-Al<sub>2</sub>O<sub>3</sub> Graded Coatings</b>	
Y. Yin, J. Zhang, H. Zhang and J. Li .....	77
<b>Improved Affinity to Metallization of Graphite/Polymer Composites by Oxygen Plasma Treatment</b>	
M. Mozetič and A. Zalar .....	81

#### 5. Nanostructured Materials

<b>Fully Integrated Hybrid Polymeric Carbon Nanotube Composites</b>	
F.D.S. Marquis .....	85
<b>Equal Channel Angular Pressing of Metallic Powders</b>	
H.S. Kim, M.H. Seo, C.-S. Oh and S.-J. Kim .....	89
<b>Structure and Properties of Nanocrystalline Composite Materials</b>	
R. Nowosielski, L.A. Dobrzański, S. Griner and J. Konieczny .....	93
<b>The Origin of High Strength and High Ductility in Nanostructured Mg-5%Al-x%Nd Alloys</b>	
L. Lu, M.O. Lai, S.K. Tan and K. Raviprasad .....	97
<b>Microstructure and Mechanical Properties of a Mg-5Al Alloy Synthesized by Mechanical Alloying</b>	
X. Gao, J.F. Nie, M.O. Lai and L. Lu .....	101
<b>Influence of High Energy Ball Milling on the Carbothermic Reduction of Ilmenite</b>	
F. Pan, K. Li, A. Tang, Y. Wang, J. Zhang and Z.X. Guo .....	105

#### 6. Properties of Materials

<b>A Newly Devised Single Shear Test for Metal Powder Compact</b>	
K. Dohda, Z. Wang and Y. Taniguchi .....	109
<b>Fabrication and Microstructure of Mechanically Alloyed Mg-Al-Nd Alloys</b>	
C. Yan, L.L. Yan, L. Ye, L. Lu, M.O. Lai and Y.W. Mai .....	113
<b>High Energy Impact Resistance of Sb-Sn Lead-Free SMT Joint</b>	
C.M.L. Wu, N.H. Yeung, W.H. Lam and R.K.Y. Li .....	117

## 7. Injection Moulding

<b>Optimising Gas-Assisted Injection Moulding Process Using the Taguchi Method</b> J. Zhao, C. Ge and V. Ravi .....	121
<b>Process Stability and Capability Studies of Polymer Micro Moulding Process</b> J. Zhao, R.H. Mayes, C. Ge and C.P. Sing .....	125
<b>Investigation on Thermal Debinding of Powder Injection Molding</b> Y.C. Lam, Y. Shengjie, K.H. Lam, J. Ma, K.C. Tam and S.C.M. Yu .....	129
<b>Structure and Properties of the Heat-Treated High-Speed Steel HS6-5-2 and HS12-1-5-5 Produced by Powder Injection Molding Process</b> L.A. Dobrzański, G. Matula, A. Varez, B. Levenfeld and J.M. Torralba .....	133
<b>Thermal Treatment of M2 High-Speed Steel Powder for Rapid Tooling Applications</b> Q.J. Hu, C.M. Choy, Z.D. Chen, J.Y.H. Fuh, Y.S. Wong and L. Lu .....	137

## 8. In Situ Metal-Matrix Composites

<b>In Situ Synthesis, a Alternative Way to Produce Materials?</b> L. Froyen and J. De Wilde .....	141
<b>Effect of Alloying Elements on the Mechanical Properties of Cu-15%Cr In Situ Composites</b> H.G. Suzuki, K. Mihara, S. Sakai, S. Sun and J. Ma .....	145

## 9. Advances in Metal-Matrix Composites

<b>Reactive Products of Carbothermic Reduction of Ilmenite in Mixed Air for Iron-Based Ti(C,N) Composite</b> A. Tang, F. Pan, L. Wang, Y. Lu, K. Li and J. Zhang .....	149
<b>Development of an AZ91A/Cu Hybrid Composite with Improved Mechanical Properties Using the Novel Technique of Disintegrated Melt Deposition</b> K.F. Ho and M. Gupta .....	153
<b>Synthesis of Al/TiC<sub>p</sub> Based Functionally Gradient Materials Using the Novel Technique of Gradient Slurry Disintegration and Deposition: Effect of Particulates Feed Rate</b> S.M.L. Nai and M. Gupta .....	157

## 10. Solid-State Processing of Metal-Matrix Composites

<b>Fabrication of Ti/TiC/SUS304 Laminated Composite through Concurrent Combustion Synthesis and Diffusion Bonding</b> A. Chiba and Y. Morizono .....	161
<b>Processing Metal-Matrix Composites for Superplastic Properties</b> M.J. Tan and X.J. Li .....	165
<b>Al-SiC<sub>p</sub> Composites by Underwater Shock Compression</b> K. Hokamoto, K. Raghukandan, J.S. Lee, M. Fujita and R. Tomoshige .....	169

**Effect of Powder Characteristics on Microstructural Development in Bodies Produced by Pressureless Sintering of Al/TiO<sub>2</sub> Composite Powder**

C.Z. Han, I.W.M. Brown and D.L. Zhang ..... 173

## 11. Characteristics of Materials

**Preparation and Properties of Iron Oxide Nanoparticles in a Na-Y Zeolite Matrix**

M. Yee and I.I. Yaacob ..... 177

**Aging Characteristics of ICA for SMD on Flex**

C.M.L. Wu and M.L. Chau ..... 181

**Study of the Reinforcement Percentage of Mg-Al-SiC MMC in Relation to the Mechanical Properties and Machinability**

X.P. Li and L. Lu ..... 185

**Investigations into Erosion Wear Performance of Functionally Graded Chromium Oxide – Alumina Titania Ceramic Composite Deposits**

K. Vijayakumar, M.M. Mayuram and R. Krishnamurthy ..... 189

## 12. Characterization of Thin Films

**Oxide and Nitride Thin Films: Processing and Characterization**

H. Chen ..... 193

**Precision Thickness Measurement of Ultra-Thin Films via XPS**

S. Geng, S. Zhang and H. Onishi ..... 195

**Properties of PVD Coatings on a Brass Substrate**

L.A. Dobrzański, K. Lukaszkoicz and L. Cunha ..... 199

**The Effect of Annealing in High Vacuum on the Oxidation and Photoluminescence of Zinc/Silicon Nanoparticles in Thin Films**

P.P. Ong and Y. Zhu ..... 203

**Environmental Effects on the Frictional Behaviour of an Unhydrogenated Diamond-Like Carbon Coating**

J. Jiang and S.Z. Shangyong ..... 207

**A Study of the Corrosion Resistance of Electroplated Nanocrystalline and Polycrystalline Nickel Coatings**

J.H. Qiu ..... 211

## 13. Modeling of Processing of Metal-Matrix Composites

**A Study on Hot Working of Al/SiC Composites – Part I**

R. Karthikeyan, S. Ramanathan and B.C. Pai ..... 215

**A Study on Hot Working of Al/SiC Composites – Part II**

S. Ramanathan, R. Karthikeyan and B.C. Pai ..... 219

**Modeling of Secondary Processing Parameters of 6061-AlSiC<sub>p</sub> Composite**

K. Mahadevan, K. Raghukandan, A. Venkatraman, B.C. Pai and U.T.S. Pillai ..... 223

**Formability Analysis of Al/15% SiC<sub>p</sub> Composites**

G. Ganesan, K. Raghukandan, R. Karthikeyan and B.C. Pai ..... 227

## 14. Polymeric Materials

<b>Preparation and Characterization of PMMA-Based Transparent Solid Polymer Electrolyte with Li Imide and Li Triflate</b> F.M. Yusof and I.I. Yaacob .....	231
<b>Rotational Moulding of Particulate Reinforced Polymeric Shell Structures</b> W. Yan, R.J.T. Lin, S. Bickerton and D. Bhattacharyya .....	235
<b>Thermal Conductivity, Thermo-Mechanical and Rheological Studies of Boron Nitride-Filled Polybutylene Terephthalate</b> H.Ye. Ng, S.K. Lau and X. Lu .....	239

## 15. Advanced Materials Processing

<b>Advanced Materials Processing with Infrared</b> R.Y. Lin, J. Li, P. Deshpande, J. Seok and Y. Wang .....	243
<b>Selective Laser Melting of <math>\text{Li}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot \text{SiO}_2</math> (LAS) Glass Powders</b> G. Manob, L. Lu, J.Y.H. Fuh and Y.B. Cheng .....	249
<b>Two Novel Techniques for Forming Regularly Spaced Deep Recesses on Aluminium Sheet Panels</b> S. Thirumarudchelvan and M.J. Tan .....	253
<b>Microstructure Analysis of Pd/CeO<sub>2</sub> Mixed Oxides Prepared by Deposition-Precipitation Method</b> A. Hadi and I.I. Yaacob .....	257
<b>A Modified Explosive Welding Technique Using Regulated Underwater Shock Wave</b> K. Hokamoto, Y. Ujimoto, S. Tanaka and M. Fujita .....	261
<b>Effect of Heat Treatment on Structure and Properties of Experimental Hot-Work Tool Steel 47CrMoWVTiCeZr16-26-8</b> L.A. Dobrzański, J. Mazurkiewicz and E. Hajduczek .....	265

## 16. Advances in Laser Materials Processing

<b>Effect of Additives on Sinterability and Densification of Laser-Sintered Metal Powder</b> H.H. Zhu, L. Lü and J.Y.H. Fuh .....	269
<b>Formation of Copper-Based Metal Part via Direct Laser Sintering</b> X. Wang, J.Y.H. Fuh, Y.S. Wong, L. Lu, H.T. Loh, Y.X. Tang and H.H. Zhu .....	273
<b>Studies of Femtosecond Laser-Processed Nitinol</b> H.Y. Zheng, A.R. Zareena, H. Huang and G.C. Lim .....	277

## 17. Advances in Processing Technology

<b>The Effect of Nd: YAG Laser Irradiation on the Microstructure of Human Dentin</b> Y.K.E. Arianto, N.P. Bo and S.M. Surono Akbar .....	281
---	-----

<b>A Study on the Prediction of Process Parameters in the Gas Metal Arc Welding of Mild Steel Using Taguchi Method</b>	
I.S. Kim, C.E. Park and P.K.D.V. Yarlagadda .....	285
<b>Zeolite Catalyst Synthesis: Characterization and Their Catalytic Activity for Reduction of Gasoline Exhaust Gases</b>	
N.L.A. Rahman and I.I. Yaacob .....	289
<b>Reactive Sintering of Nickel Aluminide and its Magnetic Responses</b>	
R. Ismail and I.I. Yaacob .....	293

## 18. Metal-Matrix Materials

<b>Sintering and Mechanical Properties of Titanium-Based Metal-Ceramic Composites Produced From Reduction of Titanium Dioxide</b>	
D.L. Zhang and Z.H. Cai .....	297
<b>Laser Reactive Formation of Ti/TiN In Situ Composite</b>	
Y.X. Tang, L. Lu, Y.H.J. Fuh, H.T. Loh, Y.S. Wong and C.H. Ng .....	301

## 19. Properties of Metal-Matrix Materials

<b>Synthesis and Characterization of Magnesium Based Composites Containing Metallic Particulates as Reinforcement</b>	
S.F. Hassan and M. Gupta .....	305
<b>The Fracture Problem of Matrix Crack for in Metallic Materials</b>	
Y. Li, C. Yan and H. Huang .....	309
<b>A Study on Explosively Clad Al-SS-Al Fiber-Reinforced Metal Composites</b>	
K. Raghukandan, A.R. Ramanathan and M. Rathinasabapathi .....	313
<b>Wear and Corrosion Behaviour of Al6061-TiO<sub>2</sub> Composites</b>	
C.S. Ramesh, A.R. Anwar Khan and M. Safiulla .....	317

## 20. Applications

<b>Development of Low Carbon Cold Rolled Steel Sheets for Enameling Application</b>	
I. Muda, A. Manaf and J.W. Fergus .....	321
<b>Performance Evaluation of Treated Grinding Wheels</b>	
S.N. Arul Saravanapriyan, L. Vijayaraghavan and R. Krishnamurthy .....	325
<b>A Study of Pin Joints in Composite Laminated Structures</b>	
M. Haneef and N. Govindaraju .....	329
<b>Organic-Acid-Based Chemical Polishing Solutions for Fe Alloys</b>	
H. Jiang, X. Chen and L. Hong .....	333

## 21. Rheological Forming

<b>Isothermal Rheological Forming of High-Strength Alloying Part with Complicated Curved Surface</b>	
Y. Luo, T. Mori, S. Li and S. Luo .....	337

<b>Shear-Induced Particle Migration in Suspension in a Capillary Pressurized Driven Circular Tube Flow</b>	
K.W. Tan, Y.C. Lam, X. Chen, J. Ma and K.C. Tam .....	341
<b>Particularity Concerning the Use of Nanomagnetic Fluids and the Magnetic Field, to Enhance the Production of Composit Parts Components Made by RTM – MNF</b>	
N. Crainic, D. Bica, V. Ladislau, C.P. Moreira de Sa, A. Torres Marques and N.P. Jorge .....	345
<b>Lubricity of Volatile Lubricants in Ironing Process</b>	
Z. Wang, K. Dohda and Y.-H. Jeong .....	347

## 22. Modeling of Materials Properties

<b>Modelling Mechanical Properties of Nanocrystalline Copper</b>	
H.S. Kim and Y. Estrin .....	351
<b>Simulation of Czochralski Crystal Growth by Using Lattice Boltzmann Method</b>	
Y. Peng, C. Shu and Y.T. Chew .....	355
<b>Application of Neural Networks for Prediction of Hardness and Volume Fractions of Structural Components in Constructional Steels Cooled from the Austenitizing Temperature</b>	
L.A. Dobrzański and J. Trzaskak .....	359

## 23. Modeling and Simulation

<b>Modelling of Explosive Cladding of LCS-Al Plates Using Artificial Neural Network</b>	
K. Raghukandan and K. Hokamoto .....	363
<b>Web-Based Forging Simulation and Virtual Workshop</b>	
B.V. Mehta, V. Rao and S. Konduru .....	367
<b>Experimental Modelling of Cutting Forces as a Function of Tool Wear in End Milling</b>	
P.K.L. Ong and M.A. Mannan .....	371
<b>The Modeling of the Solute Redistribution during Solidification of Ternary Alloys</b>	
W. Jie and R. Zhang .....	375
<b>Finite Element Analysis of Hot Embossing of Polymer Optical Sheet</b>	
C.-R. Lin, R.-H. Chen and C. Hung .....	379
<b>Modelling of Process Parameters in P/M Copper Extrusion for Solid Preforms</b>	
J.M. Ganesan, K. Raghukandan and T. Senthilvelan .....	383
<b>Finite Element Simulation of Axisymmetrical Tube Hydroforming Processes</b>	
Y.T. Keum and Y.S. Kim .....	387
<b>A Discussion of the Dynamic Specific Heat during Solidification</b>	
A.E.W. Jarfors .....	391
<b>Finite Element Analysis of Fastener Joints in Metallic and Orthotropic Structures</b>	
M. Haneef, N. Govindaraju and H. Asdaque .....	395



## 24. Advanced Ceramics Processing

<b>On the Processing of Nanostructured Ceramics</b> B.H. Kear and W.E. Mayo .....	399
<b>The Role of nc-TiN Surface Coverage by a-Si<sub>3</sub>N<sub>4</sub> for the Control of Room Temperature and In-Dry-Air Oxidation Resistance of nc-TiN/a-Si<sub>3</sub>N<sub>4</sub>/a- and nc-TiSi<sub>2</sub> Nanocomposites</b> K. Moto, T. Bolom and S. Veprek .....	403
<b>Metastable Phase Formation in Rapidly Solidified ZrO<sub>2</sub>-Al<sub>2</sub>O<sub>3</sub> Powders</b> X. Zhou, R.K. Sadangi, B.H. Kear and W.R. Cannon .....	407
<b>Synthesis of Ceramic Compounds Utilizing Woody Waste Materials and Rice Husk</b> R. Tomoshige, T. Ashitani, H. Yatsukawa, R. Nagase, A. Kato and K. Sakai .....	411
<b>Rapid Manufacturing of Y-TZP Ceramic Punch Using Powder Injection Moulding Technology</b> Z.D. Chen, M.H. Myo and C.M. Choy .....	415
<b>Organic-Inorganic Nanocomposites with Core-Shell Structure Via Sol-Gel Process</b> N. Sharifi-Sanjani, N. Naderi and M. Soltan-Dehghan .....	419
<b>Processing and Property Assessment of Porous Alumina and Mullite-Alumina Ceramics</b> H. Deng, B. Latella, T. Liu, Y. Ke and L. Zhang .....	423

## 25. Development of Lightweight Alloys

<b>The Influence of Process Parameters on Forged Magnesium Alloys</b> C.F. Chan, M.S. Yong, C.J. Tay and H.M. Shang .....	427
<b>Investigation of Microstructure of Magnesium AZ91HP Alloy for Semi-Solid Forming</b> S.X. Zhang, B.H. Hu, B.W. Chua and L. Lu .....	431
<b>Evaluation on the Formability of Magnesium Alloy, AZ31</b> M.S. Yong, B.H. Hu, C.M. Choy and A.V. Kreijj .....	435
<b>Effect of Compaction Parameters on the Properties of P/M Aluminium Preforms</b> P. Manikandan, K. Raghukandan and T. Senthilvelan .....	439
<b>Microstructure of Composite Cementation Layer on Two-Phase TiAl-Based Alloy and Its Effects on Oxidation Resistance</b> W. Liang, X.X. Ma, L.P. Bian, X.G. Zhao, J. Zhang and D.X. Zou .....	443
<b>Wear of Magnesium Composites with Continuous, Interconnected Wire Reinforcement</b> C.Y.H. Lim, S.C. Lim and M. Gupta .....	447
<b>Mechanical Properties and Fracture Behaviour of Ti<sub>x</sub>Al<sub>y</sub>(O)/Al<sub>2</sub>O<sub>3</sub> Composites</b> Z.H. Cai and D.L. Zhang .....	451
<b>Effects of Additional Rolling and Annealing on the Cube Texture in the High-Purity Aluminum Foils for Capacitors</b> F. Pan, J. Peng, A. Tang, J. Zhang, Q. Liu and Z.X. Guo .....	455

## 26. Characterization

<b>The Use of Modern Microscopic Techniques in Evaluation of Polyphthalamide and Polybutylene Terephthalate Injection Moulded Parts for Electroless Plating</b> M. Dębowski, P. Glendenning, A. Spowage and I. Annergren .....	459
<b>The Strain Measurement in Spot Welded Joints Using the ESPI Method</b> B.S. Sung, I.S. Kim, C.E. Park, J.G. Lee and Y.H. Cha .....	463
<b>Diamond-Like Carbon Films for Electrochemical Sensor</b> A. Zeng, E. Liu, S. Zhang, S.N. Tan, L.X. Liu and J. Gao .....	467

## 27. Development & Applications of Functional Materials

<b>Preparation and Thermoelectric Properties of Melt-Spun Fe<sub>2</sub>Si<sub>5</sub> Based Alloys</b> T.-J. Zhu, X.B. Zhao and L. Lu .....	471
<b>Influence of Process Parameters on Reaction Products during Self-Propagating High-Temperature Synthesis of Porous NiTi</b> A.E.W. Jarfors, G.C. Sim and T.E. San .....	475
<b>Study of the Parameters of Electroplating of Ferromagnetic Materials in Relation to Material Permeability</b> H.L. Seet, S.H. See, X.P. Li, J.Y. Lee, K.Y.T. Lee, S.H. Teoh and C.T. Lim .....	479
<b>Doping and Grain-Size Effects on Ferroelectric and Mechanical Properties of PZT Ceramics</b> Z. He, J. Ma, R. Zhang and Y. Chen .....	483
<b>Electrophoretic Deposition and Characterization of a FGM Piezoelectric Monomorph Actuator</b> Y.H. Chen and J. Ma .....	487
<b>Study of Piezoelectric Tubular Transducers</b> T. Li and J. Ma .....	491
<b>Magnetic Properties Study of Coal Oxidation Process</b> Supiyanto B. Kurniawan, Sunarno I. Sugihartono, J. Jamaludin, L. Hermanto S. Soejati, Nukman S. Soeyati and S. Poertadji .....	495
<b>Formation and Characterization of Self-Ordered Ferromagnetic Nanowires by AC Electroforming</b> K.H. Lee, G.H. Kim, Y.J. Kim and W.Y. Jeung .....	499

## 28. Machining Techniques

<b>Surface Finish and Residual Stresses in Facing of Age-Hardened INCONEL 718</b> R.M. Arunachalam and M.A. Mannan .....	503
<b>Modification of Torsional Characteristics of Workpiece Drive System in Cylindrical Grinding</b> R.A. Qureshi, M.A. Mannan and B.J. Stone .....	507
<b>Author Index</b> .....	xvii
<b>Keyword Index</b> .....	xxi