

Table of Contents

Preface & Committees

Chapter 1: Keynote Lecture

Forty-Five Years of Superplastic Research: Recent Developments and Future Prospects T.G. Langdon	3
Superplasticity of Metallic Alloys: Some Current Findings and Open Questions J.J. Blandin	13
Advances in Superplasticity of Ultrafine-Grained Alloys: Recent Research and Development R.Z. Valiev and I.P. Semenova	23
Improvement of Superplasticity in Fine-Grained Oxide Ceramics Based on the Concept of Grain Boundary Plasticity H. Yoshida, K. Morita, B.N. Kim, K. Matsui, Y. Ikuhara and T. Sakuma	34

Chapter 2: Mechanism of Superplasticity

Direct Observation of Two-Dimensional Grain Boundary Sliding and Switching in ODS Ferritic Steel E. Sato, H. Masuda, Y. Sugino and S. Ukai	43
Description of the Superplastic Flow Process by Deformation Mechanism Maps in Ultrafine-Grained Materials M. Kawasaki and T.G. Langdon	51
Texture Change during Superplastic Deformation in Fine-Grained Magnesium Alloys H. Watanabe, T. Uesugi, Y. Takigawa and K. Higashi	59
Superplastic Deformation Mechanisms in High Magnesium Contenting Aluminum Alloy O.A. Yakovtseva, A.V. Mikhaylovskaya, A.G. Mochugovskiy, V.V. Cheverikin and V.K. Portnoy	66
Changes in Crystallographic Orientation Distribution during Superplastic Deformation in Aluminum Alloys Y. Takayama, E. Kimijima, E. Harunari and H. Watanabe	72
Unification of Physics during Super Plastic Flow in Advanced Materials J.D. Muñoz-Andrade	78
Universality of the Phenomenology of Structural Superplasticity S. Sripathi and A. Padmanabhan	84
Effect of Grain Boundary Segregation on Shear Deformation of Nanocrystalline Binary Aluminum Alloys at Room Temperature R. Babicheva, S.V. Dmitriev, Y. Zhang, S.W. Kok and K. Zhou	89
The Role of a Threshold Stress on the Superplasticity of Ceramics Revisited C. Retamal, M. Lagos, B.M. Moshtaghioun and D. Gómez-García	95
Two-Dimensional Observation of the Core–Mantle Model for Superplastic Flow in an ODS Ferritic Steel H. Masuda, H. Tobe, E. Sato, Y. Sugino and S. Ukai	100
Strain-Rate Sensitivity Enhanced by Grain-Boundary Sliding in Creep Condition for AZ31 Magnesium Alloy at Room Temperature T. Matsunaga, H. Somekawa, H. Hongo and M. Tabuchi	106
Modelling and Analysis of High Strain Rate Deformation at Elevated Temperature in Friction Stirring of Aluminum Alloys K. Kumai, H. Fukushige and Y. Takayama	110
Effect of Solute Elements on Grain Refinement during Friction Stir Processing in High-Purity Aluminum T. Uesugi, H. Iwami, Y. Takigawa and K. Higashi	116

Enhanced Plasticity of Pure Nickel Processed by HPT Consolidation of Rapid Quenched Ribbons A.P. Zhilyaev	122
Research on Superplasticity of Supplied 5A06 Aluminium Alloy Sheet B.P. Bi and Y. Wang	127

Chapter 3: Superplastic Materials

Current Assisted Superplastic Forming of Titanium Alloy Bellows G.F. Wang, T. Zhao, M. Yang and X.Y. Zhao	135
The Effect of α-Phase Grains Morphology in Initial Microstructure on Superplasticity of Two-Phase Titanium Alloys M. Motyka and J. Sieniawski	143
Mechanism of Low-Temperature Superplastic Deformation in Aluminum Alloys Containing a Dispersion of Nanoscale $\text{Al}_3(\text{Sc,Zr})$ Particles R. Kaibyshev	150
Hot Forming of Mg AZ31B Alloy Sheet Processed by Warm Rolling A.R. Antoniswamy, A.J. Weldon, E.M. Taleff, L.G. Hector and J.T. Carter	157
High-Temperature Plasticity in Super Hard Boron Carbide Ceramics B.M. Moshtaghion, D. Gómez-García and A. Domínguez-Rodríguez	166
Influence of Superplastic Forming on Reduction of Yield Strength Property for Ti-6Al-4V Fine Grain Sheet and Ti-6Al-4V Standard P. Sartkulvanich, D. Li, E. Crist and K.O. Yu	171
Characterization of a Superplastic Titanium Alloy with an Experimental and Numerical Approach Based on Free-Inflation Tests D. Sorgente, A. Piccininni, V. Piglionico, P. Guglielmi, D. Grossi, G. Palumbo and L. Tricarico	177
Hot Forming Process Analysis of Ti6Al-4V Alloy: Experiment, Behaviour Modelling and Finite Element Simulation V. Velay, H. Matsumoto, V. Vidal, L. Penazzi, F. Nazaret, Y. Marcel and M. Bouillane	183
Superplasticity and Characterization of TIMETAL[®] 54M Sheets Y. Kosaka and P. Gudipati	190
Thermo-Mechanical Modeling of Distortions Promoted during Cooling of Ti-6Al-4V Part Produced by Superplastic Forming M. Rollin, V. Velay, L. Penazzi, T. Pottier, T. Sentenac, L. Iranzo-Perez, A. Dupuy and G. Khelifati	196
Development of Al-Mg Alloys with Different Levels of Mn and Fe for Super-Plastic Forming I. Pushkareva and H.O. Jin	202
Chronicling the Development of a High Strength 5xxx-Based Superplastic Aluminium Alloy S.P. Miller-Jupp	208
Improving the Microstructure and Mechanical Properties of a Cast Mg-9Al-1Zn Alloy Using Friction Stir Processing W.H. Loke, R.N. Ibrahim and S. Lathabai	214
Processing, Superplastic Properties and Friction Stir Welding of Fine-Grained AZ31, AZ91, AE42 and QE22 Magnesium Alloys T. Ryspaev, M. Janecek, R. Kral, V. Wesling and L. Wagner	220
Fabrication of Dense Nanostructured Bulk Ceramics by Means of Spark-Plasma-Sintering (SPS) Processing K. Morita, B.N. Kim, H. Yoshida, K. Hiraga and Y. Sakka	225
Energy Absorption of Superplastic Zn-22Al Alloy Foam Manufactured through Melt Foaming Process S. Ogawa, K. Sekido and K. Kitazono	231
Deformation Mechanism and Characteristics of Thin-Walled Component in Aluminum Alloy K. Liao, F. Chen and Y.P. Liu	237
High-Temperature-Tensile-Deformation Behavior of Ti-6Al-4V Alloy with the Acicular α' Martensite Microstructure T. Nishihara, H. Matsumoto, Y. Iwagaki, T. Shiraishi and Y. Ono	243

Influence of Second-Phase Particles on the Hot Ductility of Al–Mg Solid-Solution Alloys T. Ito, K. Kawasaki and T. Mizuguchi	249
Superplastic Deformation Behavior in Dual-Phase Mg-Ca Alloy T. Yano, N. Ikeo, H. Watanabe and T. Mukai	256
Elimination of Shrinkage Cavities by Liquid Hot Isostatic Pressing in Aluminum Alloys under Superplastic Conditions D. Tagirov and R. Kaibyshev	261
Deformation Characteristics of 6066 and 6069 Aluminum Alloys at Elevated Temperatures S. Koizumi, J. Kobayashi and G. Itoh	267
Tensile Properties of Recrystallized and Unrecrystallized Tungsten at Elevated Temperatures N. Tano, J. Kobayashi, G. Itoh, A. Kurumada and S. Mukae	272
Superplasticity of an AA2519 Aluminum Alloy I. Zuiko, M. Gazizov and R. Kaibyshev	278

Chapter 4: Microstructure Refinement

Severe Plastic Deformation under High Pressure for Production of Superplastic Materials Z. Horita	287
Production, Properties and Application of Ultrafine-Grained Titanium Alloys S. Zherebtsov and G. Salishchev	294
Mechanical Behavior and Microstructure Evolution during Superplastic Deformation of the Fine-Grained AlCoCrCuFeNi High Entropy Alloy N. Stepanov, D.G. Shaysultanov, G.A. Salishchev and O.N. Senkov	302
Effects of Initial Microstructure and Deformation Method on Grain Refinement in a Cu-Cr-Zr Alloy I. Shakhova, A. Belyakov and R. Kaibyshev	308
On Regularities of Grain Refinement through Large Strain Deformation A. Belyakov, Z. Yanushkevich, M. Tikhonova and R. Kaibyshev	314
Effect of Natural Aging on RT and HSR Superplasticity of Ultrafine Grained Zn-22Al Alloy M. Demirtas, G. Pürçek, H. Yanar, Z.J. Zhang and Z.F. Zhang	320
Microstructural Evolution of Body-Centred Cubic Fe-Al Alloy by Friction Stir Processing with SiC Particles Addition T. Nagaoka, Y. Kimoto, H. Watanabe, M. Fukusumi, Y. Morisada, H. Fujii and H.K.D.H. Bhadeshia	326
Nanostructurization of Magnesium Alloy via Friction Stir Lap Processing Y. Kimoto, T. Nagaoka, H. Watanabe, M. Fukusumi, Y. Morisada and H. Fujii	332
Superplastic Behavior of Friction-Stir Welded Joints of an Al-Mg-Sc Alloy with Ultrafine-Grained Microstructure S. Malopheyev, S. Mironov, I. Vysotskiy and R. Kaibyshev	338
Effect of Hydrogen on the Development of Superplastic Deformation in the Submicrocrystalline Ti–6Al–4V Alloy G.P. Grabovetskaya, E.N. Stepanova, I.V. Ratochka, I.P. Mishin and O.V. Zabudchenko	344
Experimental and Simulation Modeling of Nickel-Based Superalloy Pressure Welding Process E. Galieva, V. Valitov, R. Lutfullin, S.V. Dmitriev, A. Akhunova and M. Mukhametrakhimov	350
Deformation Nanostructuring and Superplastic Processing of Metallic Materials F.Z. Utyashev and S.K. Mukhtarov	355
Two-Dimensional Molecular Dynamics Simulation for Studying of Grain Refinement J.A. Baimova and S.V. Dmitriev	361
Nanostructuring of 2xxx Aluminum Alloy under Cryorolling to High Strains E. Avtokratova, S.V. Krymskiy, A.V. Mikhaylovskaya, O. Sitdikov and M. Markushev	367
Superplastic Behavior of an AA2139 Subjected to ECAP M. Gazizov and R. Kaibyshev	373
Ultrafine-Grained Structure Produced by FSW and ECAP in Al-Mg-Sc-Zr Alloy: Comparison V. Kulitskiy, S. Malopheyev, Y. Buranova, S.V. Divinski, G. Wilde and R. Kaibyshev	379

Improvement of Microstructure and Mechanical Properties of 7050-T7451 Aluminum by a Novel Double-Sided Friction Stir Processing W.J. Yang, J.Z. Li, X. Wen and H. Ding	385
Ultrafine-Grained Structure and Mechanical Properties of a High-Mn Twinning Induced Plasticity Steel P. Kusakin, A. Belyakov, R. Kaibyshev and D.A. Molodov	392
Submicrocrystalline Austenitic Stainless Steel Processed by Cold or Warm High Pressure Torsion M. Tikhonova, N. Enikeev, R.Z. Valiev, A. Belyakov and R. Kaibyshev	398
Superplastic Behavior of a Cu-Cr-Zr Alloy Subjected to ECAP R. Mishnev, I. Shakhova, A. Belyakov and R. Kaibyshev	404
Formation of Ultrafine-Grained Structures in 304L and 316L Stainless Steels by Recrystallization and Reverse Phase Transformation M. Odnobokova, A. Belyakov, A. Kipelova and R. Kaibyshev	410
Effect of Rolling on Superplastic Behavior of an Al-Mg-Sc Alloy with Ultrafine-Grained Structure A. Dubyna, S. Malopheyev and R. Kaibyshev	416
Low-Temperature Superplasticity in an Al-Mg-Sc Alloy Processed by ECAP D. Yuzbekova, A. Mogucheva and R. Kaibyshev	422
Superplasticity in a 5024 Aluminium Alloy Subjected to ECAP and Subsequent Cold Rolling A. Mogucheva, D. Yuzbekova and R. Kaibyshev	428
Development of Fine-Grained High-Mn Steel by Cold Rolling and Annealing Z. Yanushkevich, A. Belyakov, R. Kaibyshev, C. Haase and D.A. Molodov	434
Austenite Grain Size Refinement of Multi-Microalloyed Low Carbon Steel Using Severe Plastic Deformation at High Temperature X.W. Kong, T.Z. Sui and Z.Y. Hu	440
Microtextural Changes and Superplasticity in an Al-7075 Alloy Processed by High-Pressure Torsion A. Loucif, Y. Huang, A.L. Helbert, T. Baudin, S. Sabbaghianrad and T.G. Langdon	445

Chapter 5: Industrial Application

Constitution of ISO and JIS for Method of Tensile Testing of Superplastic Materials K. Kitazono, Y. Takayama, Y. Motohashi and F. Ono	453
Heat Assisted Dieless Drawing Process of Superplastic Metal Microtubes - From Zn22Al to β Titanium Alloys T. Furushima and K. Manabe	459
The Mechanics of Superplastic Forming - How to Incorporate and Model Superplastic and Superplastic-Like Conditions O.I. Bylya, R.A. Vasin and P.L. Blackwell	468
About Formability of Ultra-Fine Grained Metallic Materials I. Sabirov, E. Moreno-Valle, M.Y. Murashkin and R.Z. Valiev	476
A New Lead-Free Solder Joint Utilizing Superplastic Al-Zn Eutectoid Alloy for Next Generation SiC Power Semiconductor Devices J. Onuki, A. Saitou, A. Chiba, K. Tamahashi, Y. Motohashi and Y. Kawamata	482
Titanium Superplastic Forming by Aurock: A Complete Integrated Solution from CAD File to Final Part O. Barrau, F. Nazaret, M. Le Fournier, E. Lebard and Y. Lemaoult	488
Superplastic Forming of a Complex Shape Automotive Component with Optimized Heated Tools D. Sorgente, G. Palumbo, L.D. Scintilla, R. Brivio, G. Carozzi and L. Tricarico	494
Efficient Diffusion Bonding of Large Scale Parts S. Jahn, F. Gemse, U. Broich and S. Saendig	500
Research on Work Hardening Type Superplastic Deformation Behavior of FSW Titanium Alloy M.J. Fu, X.H. Li, X.Q. Han and H.Y. Xu	506
Constitutive Modeling for the Simulation of the Superplastic Forming of AA5083 F. Jarrar, R. Jafar, O. Tulupova, F. Enikeev and N. Al-Huniti	512

Effect of Sn Addition on Superplastic Properties of Zn-22mass%Al Eutectoid Alloy T. Itoi, F. Sato, Y. Takabayashi and M. Hirohashi	518
Research of Solid Compound Formation during Thermal Deformation Effect on Intermetallic Ni₃Al-Alloy with a Heat-Resistant Alloy EP975 and Influence on the Physical, Mechanical and Performance Properties V. Valitov, K. Povarova, O. Bazyleva, A. Drozdov, S. Ovsepyan and E. Galieva	523
Effect of Different Proportion of Coarse and Fine Grain Microstructure on Superplastic Forming Characteristics V. Pancholi, K. Rohit and A. Raja	528
Hybrid Superplastic Forming of Non-Superplastic AZ31 Mg Alloy M.L. Guo, M.J. Tan, X. Song and B.W. Chua	534
An Analysis of Superplastic Forming in a Re-Entrant Shape G. Kumaresan and K. Kani	540
Formabilities of C-Si-Al-Mn Transformation-Induced Plasticity-Aided Martensitic Sheet Steel J. Kobayashi, Y. Nakashima, K.I. Sugimoto and G. Itoh	546
Characterization of Superplastic Materials by Results of Free Bulging Tests S.A. Aksenov, I.Y. Zakhariev, A.V. Kolesnikov and S.A. Osipov	552
Superplastic Behavior of ATI 718Plus Superalloy S.K. Mukhtarov and F.Z. Utyashev	557
Hot Forming and Superplastic Forming: Presses Evolution and New Applications in the Aerospace Industry G. Sana, A. Petiot and A. Giraudet	563
The Superplastic Properties and Microstructures Evolution of High Nb Ti₃Al Based Alloy X.Q. Han and M.J. Fu	568
Production of a Superplastic Vibration-Damping Steel Sheet Composite Using Friction Stir Forming H. Mofidi Tabatabaei, T. Hara and T. Nishihara	574
Topology Optimization and Process Validation of a SPF/DB Cylinder Structure J. Shao, Z.Q. Li, H.Y. Xu, X.Q. Han and R.X. Zhang	581
The Influence of Ti-6-4 Alloy Interlayer on Ti3Al Alloy DB Quality and Interface Mechanical Properties H.Y. Xu, M.J. Fu, X.Q. Han, J. Shao and Z.Q. Li	586
Superplasticity Effect Demonstrated by Gas Forming Hot Bent AA5XXX Sheets into V-Shaped Trough Containing Uneven Concavities C.H. Chen, J.Y. Wang, Y.K. Fuh, S. Lee, C. Liu and C.L. Chu	592
Development of Superplastic Dieless Drawing Apparatus for 3Y-TZP Zirconia Ceramic Tube T. Furushima, Y. Hirose, K. Tada and K. Manabe	597
Innovative Methods for Investigating Key Process Variables in the Manufacture of Superplastically Formed Aero-Engine Components N. Zuelli, C. Fleming, M. Farrell, R. Zante and L. Robinson	603
Promises of Low-Temperature Superplasticity for the Enhanced Production of Hollow Titanium Components A. Kruglov, R. Lutfullin, R. Mulyukov, M. Mukhametrakhimov, O. Rudenko and R. Safiullin	610
New Technologies Development and Equipment for Local Shape-Forming of the Complicated Parts Made of Heat-Resistant Alloys under Superplastic Deformation Conditions F.Z. Utyashev, R. Mulyukov, R. Sukhorukov and V. Valitov	615
Finite Element Analysis and Validation of the Superplastic Forming of Multi-Sheet Structures P. Anderson	621