

Table of Contents

Preface

Chapter 1: Microstructure of Alloys

The 3D Imaging and Metrology of Microstructural Elements in Innovative Materials for Clean Energy Systems and Aeronautics A. Kruk and A. Czyrska-Filemonowicz	3
Metallography Evaluation of Cast and Wrought Ni-Base Superalloys J. Belan, A. Vaško, L. Kuchariková and E. Tillová	9
Effect of Long-Term Aging on Microstructural Restoration in Cast Nickel Base Superalloy, GTD-111 C. Paa-Rai, J. Norachan, P. Wangyao, S. Polsilapa and G. Lothongkum	15
Effect of Temperature Dropping during Solution Treatment in Rejuvenation Heat Treatment and its Long-Term Heating Simulation on Microstructures of Nickel Base Alloy, Udimet 520 K. Saelor and P. Wangyao	22
Long-Term Gamma Prime Phase Stability after Various Heat Treatment Conditions with Temperature Dropping during Solution Treatment in Cast Nickel Base Superalloy, Grade Inconel-738 S. Polsilapa, A. Promboopha and P. Wangyao	30
Effect of Precipitation Aging Temperatures on Reheat Treated Microstructures and its Phase Stability after Long-Term Exposure in Cast Nickel Base Superalloy, Grade Inconel 738 N. Kontikame, S. Polsilapa and P. Wangyao	36
Effect of Solution Treatment Temperature on the Grain Growth Behavior of Fine Grained FGH96 Superalloy Y.F. Feng, X.M. Zhou, J.W. Zou, X.F. Wang, G.F. Tian and W.X. Wang	41
Effect of Strain Hardening on Precipitation Kinetics in ATI 718Plus B. Hassan, Y. Jansen, S. Nouveau and J. Corney	49
Oxidation Behavior of a Disk Powder Metallurgy Superalloy K.X. Dong, C. Yuan, S. Gao and J.T. Guo	55
Morphology Evolution of Grain Boundary Carbides in Highly Twinned Inconel Alloy 600 H. Li, J.R. Ma, X.R. Liu, S. Xia, W.Q. Liu and B.X. Zhou	64
Morphological Evolution of Carbides in DZ125 Superalloy during Heat Treatment L.R. Liu, S. Han, Y.F. Pu, Z.J. Peng and M.J. Zhang	70
Microstructure and Property Calculation of Three Typical Second Generation Single Crystal Superalloys X.D. Yue, J.R. Li, X.G. Wang and Z.X. Shi	76
The Precipitation Behavior of γ' Phase in Single Crystal Ni-Based DD6 Superalloy for Turbine Blade Y.P. Xue, J.R. Li, J.Q. Zhao and J.C. Xiong	83
A Review of Rafting in Nickel-Based Single Crystal Superalloys Z.Y. Yu, Z.F. Yue, W. Cao and X.M. Wang	94
The Influence of γ/γ' Morphology on the Rafting and Stress Distribution of Nickel-Based Superalloys Loaded in $[0\ 0\ 1]$ Direction X.M. Wang, M.Y. Cao, S.W. Li, Z.Y. Yu and Z.F. Yue	103

Chapter 2: Mechanical Behaviour and Deformation Modelling

Small Ring Testing of High Temperature Materials C.J. Hyde, T.H. Hyde and W. Sun	111
Stabilities of Microstructure and Mechanical Properties during Long-Term Aging on FGH95 Superalloy X.Q. Wang, G.J. Ma and Z.C. Peng	119

Influence of Dynamic Strain Ageing and Long Term Ageing on Deformation and Fracture Behaviors of Alloy 617	
G.C. Chai, M. Calmunger, S. Johansson, J. Moverare and J. Odqvist	124
Influences of W and Al on the Microstructure and Stress-Rupture Property of Re-Free Ni-Based Single Crystal Superalloys	
J.Y. Chen, Q. Li, M.J. Zhang, X. Tang and C.B. Xiao	130
Long Time High Temperature Stress Rupture Strength Behavior and Structure Stability Study on Ni-Base Superalloy Nimonic 80A	
X.F. Chen, Z.H. Yao, M.C. Zhang, X.S. Xie, Q.Y. Yu, J.J. Song, L.F. Ding and H.W. Shen	136
Degradation of the Strength of Grains and Grain Boundaries of Ni-Base Superalloy under Creep and Creep-Fatigue Loadings	
T. Murakoshi, H. Sakamoto, T. Shinozaki, K. Suzuki and H. Miura	141
Creep Processes in MAR-M247 Nickel-Base Superalloy	
M. Kvapilová, K. Kuchařová, K. Hrbáček and V. Šklenička	145
Microstructure Evolution and Stress Rupture Properties of DD6 Single Crystal Superalloy after Overheating	
S.Z. Liu, Z.X. Shi, M. Han and J.R. Li	149
Microstructure Evolution and Creep Properties of a Single Crystal Nickel-Based Superalloy with Various Orientations	
S.G. Tian, Y. Su, H.C. Yu and D.L. Shu	155
High Temperature Rupture Life of Nickel-Based Superalloy under Directional Solidification with High Temperature Gradient	
W.G. Zhang, Z.J. Liu, S.K. Feng, F.Z. Yang and L. Liu	161
Creep Behavior of a Ru-Free Nickel-Based Single Crystal Superalloy at Medium Temperatures	
S. Liang and Z.X. Liu	169
Mechanical Behaviour of Materials during Creep with Changing Loads	
G. Angella, R. Donnini, D. Ripamonti and M. Maldini	175
Interaction of Creep and High Cycle Fatigue of IN 713LC Superalloy	
V. Horník, M. Šmíd, P. Hutař, L. Kunz and K. Hrbáček	181
Failure Assessment of the First Stage High Pressure Turbine Blades	
C. Wang, D.Q. Shi and X.G. Yang	185
Fatigue Crack Initiation in Nickel-Based Superalloy MAR-M247 at High Temperature	
I. Šulák and K. Obrtlík	190
Effect of Maximum Temperature on the Thermal Fatigue Behavior of Superalloy GH536	
J. Chen, D.Q. Shi, G.L. Miao and X.G. Yang	194
Characteristics of Microscopic Inclusions and their Influence on Fatigue Crack Propagation in FGH96 Superalloy	
J. Hou and J.X. Dong	199
Initiation and Propagation Behaviors of Small Crack in a Polycrystalline Ni-Base Superalloy under Thermo-Mechanical Fatigue Loading	
Y. Yamazaki	211
Effect of Frequency on the Fatigue Behavior of IN718 Superalloy	
J.H. Du, X.D. Lu and Q. Deng	217
Surface Roughness Effects on the Fatigue Behavior of As-Machined Inconel718	
H. Javadi, W. Jomaa, D. Texier, M. Brochu and P. Bocher	225
Crystal Plasticity Simulations of Haynes 230, an Analysis of Single Crystal and Polycrystalline Experiments	
P.G. Luccarelli, S. Foletti, G. Pataky and H. Sehitoglu	229
Fatigue Crack Propagation in Haynes 230: A Comparison between Single and Polycrystal Crack Closure Levels	
S. Beretta, S. Foletti, S. Rabbolini and H. Sehitoglu	233
Fatigue Crack Growth in Flow Formed INCONEL 718	
C. Coleman, M.R. Bache and C. Boettcher	239

Chapter 3: Solidification and Processing

Effect of Hot Isostatic Pressing on Microstructures and Mechanical Properties of IN738LC Superalloy	
Q.G. He, J. Liu, L.X. Li, Z.H. Gao, X.Y. Shi and G.X. Yang	247
Effects of HIP Process on the Microstructure and Mechanical Properties of a Cast Superalloy	
J.X. Yang, Y. Sun and D.L. Zhou	253
Microstructure Study of Nickel-Based Superalloys after Deep Cold Rolling	
B. Nagarajan and S. Castagne	257
Analysis of Deformation and Internal Defect in Flat-Wedge Cross-Wedge Rolling of GH4169 Superalloy	
Y. Chen, H.Y. Gan, S.H. Zhang, M. Cheng and H.W. Song	263
A Novel Unified Dislocation-Density Based Model for Hot Deformation Behavior of a Nickel-Based Superalloy	
Y.C. Lin and D.X. Wen	269
Hot Deformation Behavior of AA-FGH720Li Superalloy	
X.Q. Wang, Z.C. Peng and M.C. Zhang	274
The Addition of Zr in Nickel-Based Inconel 718 Superalloy to Prevent Hot Cracks Propagation	
H. Zhao, Q.B. Liu, G. Lee and D.W. Yao	280
Precision Casting of GTD222 Component with Complex Thin-Wall Structure	
G.L. Zhu, W. Wang, R. Wang, G.X. Wang, A.P. Dong, D.H. Wang, Z. Shi, Y. Li and G. Zhang	286
Early Instability Phenomena of IN792 DS Superalloy	
R. Montanari, O. Tassa and A. Varone	290
Simulation and Experimental Studies on Grain Selection Behavior of DD5 Single Crystal Superalloy	
Y.H. Yan, J.W. Liu, Z.H. Jia, S. Qiu, Z. Guo, K. Liu, A.L. Ma and L. Xu	296
Microstructures of Low Angle Boundaries of a Third Generation Single Crystal Superalloy DD9	
W.P. Yang, J.R. Li, S.Z. Liu, J.Q. Zhao, Z.X. Shi and X.G. Wang	305
The Effect of Process Parameters in Interdendritic-Melt Solidification Control Technique on the Microstructure and Properties of a Ni-Base Superalloy	
L. Zheng, G.Q. Zhang, D. Daisenberger, Z. Li and C.B. Xiao	314
Effect of Low-Angle Boundary on Microstructure and Stress Rupture Property of a Third Generation Single Crystal Superalloy DD10	
H.F. Li, L.J. Liu, M. Xue and L.M. Cao	320
Study on the Formation of Stray Grains during Directional Solidification of Nickel-Based Superalloys	
M.R. Ridolfi, O. Tassa and G. de Rosa	327

Chapter 4: Welding and Laser Deposition

Thermal Cycle Simulation of Welding Process in INC 738 LC Superalloy	
Z. Bumerzoug and S. Cherif	335
Welding of IN792 DS Superalloy by High Energy Density Techniques	
G. Angella, G. Barbieri, R. Donnini, R. Montanari and A. Varone	340
IN792 DS Superalloy: Optimization of EB Welding and Post-Welding Heat Treatments	
G. Barbieri, P. Soltani, S. Kaciulis, R. Montanari and A. Varone	352
The Microstructure of Inconel Alloys Used for Repair Welding	
D. Jandová, J. Kasl and M. Matějová	358
Linear Friction Welding of IN718 to Ti6Al4V	
P. Wanjara, J. Gholipour, K. Watanabe, K. Nezaki, Y. Tian and M. Brochu	364
Measurement of Residual Stresses in Linear Friction Welded In-Service Inconel 718 Superalloy	
M. Smith, L. Bichler and D. Sediako	370
Investigation of Impact Behavior of TIG Welded Inconel 718 at Aircraft Engine Operating Temperatures	
Y. Uzunonut	377

Crack Growth Studies in a Welded Ni-Base Superalloy A.H.S. Iyer, K. Stiller and M. Hörnqvist Colliander	382
Evaluation on the Corrosion and Wear Resistance of Welding Zone Welded with Plasma Transferred Arc Welding Method J.H. Jeong, K.M. Moon, S.Y. Lee and M.H. Lee	386
Structure Formation in Ni Superalloys during High-Speed Direct Laser Deposition O.G. Klimova-Korsmik, G.A. Turichin, E. Zemlyakov, K. Babkin, P. Petrovsky and A. Travyanov	393
Preliminary Experimental Study of Laser Cladding Repair on Directionally Solidified Blades W. Fu, Q.L. Deng and H.Y. Fang	399
Effect of Build Orientation and Post Processing of a Direct Laser Deposited Nickel Superalloy as Determined by the Small Punch Creep Test S. Jeffs, R.J. Lancaster and S. Davies	407
A Study on the Microstructural Characterization of René 142 Deposited Atop René 125 Processed through Scanning Laser Epitaxy A. Basak and S. Das	416
Brazing Inconel 600 Using the VZ-2150 Filler for Plate Heat Exchanger C.H. Hsu and R.K. Shiue	422
Brazing Inconel 600 to Manufacture the Plate Heat Exchanger H.W. Lu, S.K. Chou and R.K. Shiue	426

Chapter 5: Thermal Barrier Coatings

Phase Stability, Structure and Thermodynamics of Modified Ni- and Fe-Aluminides S. Santra	433
Durability of Amorphous and Crystalline BMAS Thermal Barrier Coatings Produced by Plasma Spraying L. Čelko, D. Jech, K. Dvořák, I. Šulák, L. Klakurková and K. Obrtlík	488
Formation of Thermally Sprayed Coatings on Grid-Like Structure Substrate D. Jech, L. Čelko, L. Klakurková, K. Slámečka, M. Horynová and J. Švejcar	492
Research on the Stability of Thermal Barrier Coatings under Thermal Cyclic Loading J. Sun, Y.Q. Xu, W.Z. Li and K. Lv	496
Interdiffusion Databanks of γ, γ' and β Phases in NiAl-Based Ternary Systems L.J. Zhang, J. Chen, W.M. Chen, N. Ta and Q. Li	502
Cyclic Oxidation Performance of Si-Aluminide/MCrAlY Coating on Ni-Base GTD-111 Superalloy K. Shirvani and S.V. Miraboutalebi	533
The Study of High Temperature Oxidation Performance of Thermal Barrier Coatings Prepared by Plasma Spraying and Laser Remelting Y.Q. Hua, W. SHUAI, W. Liu, R.F. Chen and J.D. Cao	539
Diffusion-Controlled Growth and Microstructural Evolution of Aluminide Coatings on Superalloys and Steel A. Paul	546
Sintering Study of NiCrAlY R.J. Takahashi, J.M.K. Assis, F.P. Neto, A.M. Mello and D.A.P. Reis	575
Effect of Double Electron Beam Remelting on Microstructure of HVOF and CGDS Bond Coat P. Gavendová Krajňáková, I. Dlouhy, J. Čížek, J. Čupera and R. Shvab	580
EBSD Analysis and Assessment of Porosity in Thermal Barrier Coatings Produced by Axial Suspension Plasma Spraying (ASPS) U. Klement, J. Ekberg and A. Ganvir	585
Development of the Advanced TBC for High Efficiency Gas Turbine T. Torigoe, Y. Okajima, I. Okada, J. Masada and K. Tsukagoshi	591
Material and Mechanical Aspects of CMAS Damage Progression on Thermal Barrier Coatings and its Non-Destructive Detection Y. Hayashi, S. Lokachari, S. Yamagishi and M. Okazaki	598

Failure Mechanism of Yttria Stabilized Zirconia Atmospheric Plasma Sprayed Thermal Barrier Coatings Subjected to Calcia-Magnesia-Alumino-Silicate Environmental Attack L. Čelko, D. Jech, P. Komarov, M. Remešová, K. Dvořák, I. Šulák, B. Smetana and K. Obrtlík	604
Degradation of YSZ/EUCOR TBC Coating System during High Temperature Low Cycle Fatigue Tests I. Šulák, K. Obrtlík, L. Čelko and P. Gejdoš	610
The Application of the Small Punch Tensile Test to Evaluate the Ductile to Brittle Transition of a Thermally Sprayed CoNiCrAlY Coating G.A. Jackson, W. Sun and D.G. McCartney	614
Measurement of Young's Modulus of Thermal Barrier Coatings by Suspended Coupled Flexural Resonance Method S.Z. Zhang, H.Y. Qi, H.W. Yang, C.C. Zhang and J.Y. Gao	626
The High Temperature Creep Properties of a Thermally Sprayed CoNiCrAlY Coating via Small Punch Creep Testing G.A. Jackson, H. Chen, W. Sun and D.G. McCartney	631
Investigation on Fracture Toughness of Coating/Substrate Interface - Case Study: Thermally Sprayed Nickel Based Superalloy on Variety of Substrates S. Abualigaledari, M. Salimi Jazi and F. Azarmi	643
Thermomechanical and Thermal Gradient Mechanical Fatigue Lifetime of Thermal Barrier Coating Systems Z.J. Zhou, C.P. Li, G. CHEN, X. HUA and Y. Li	647
Thermo-Mechanical and Low Cycle Fatigue Failure Behavior Relevant to Temperature Regime in a TBCed Superalloy Specimen M. Okazaki, S. Yamagishi and Y. Yonaguni	655

Chapter 6: Machining Processes

Specific Cutting Force in Turning of Sintered Nickel Alloy G. Struzikiewicz and K. Rumian	663
Manufacturing of Axisymmetric Components out of Superalloys and Hard-to-Deform Steels by Roll Forming S. Mukhtarov, A. Ganeev, M. Nagimov, R. Shakhov, V. Valitov and F.Z. Utyashev	669
Influence of Coolant Application Direction on the Cutting Performance of Ceramic Tool in High-Speed Air-Jet-Assisted Machining of Inconel 718 T. Obikawa and M. Yamaguchi	675
Experimental Study on the Relationship of Discharge Parameters with Crack Arrest Effects in Inconel 625 Alloy by Electropulsing Treatment J. Yu and Y.C. Liu	682
Machinability of Inconel 625 Aerospace Material Using Cryogenically Treated WEDM A. Goyal, A. Pandey and P. Sharma	689
Experimental Study on Electro-Discharge Machining of Nickel-Based Superalloy Y. Li, J.J. Fu and L.G. Yang	694