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Fifth International Special Emphasis Symposium on Superalloys 718, 625, 706, and Derivatives

Technical Program

Fifth International Special Emphasis Symposium on Superalloys 718, 625, 706, and Derivatives

Welcoming Reception

6:45 PM, Sunday, June 17, 2001

7:45 PM Invited Overviews

Introduction by: R. L. Kennedy, Vice President, Allvac, An Allegheny Technologies Company, Inc.

8:00 PM
Application of Alloy 718 in GE Aircraft Engines-Today and Next Five Years: *Robert E. Schafrik*[1]; Douglas D. Ward[1]; Jon Groh[1]; [1]GE Aircraft Engines, Matls. & Proc. Eng. Dept., One Neumann Way, MD H85, Cinncinnati, OH 45215-1988 USA

The evolution of quality and cost improvements has ensured continued usage in GEAE designs. Investment cast 718 has been extensively utilized in GEAE structural designs to reduce the cost of traditionally fabricated components. To continue to increase Alloy 718's application base, engine design engineers need an affordable derivative with higher temperature capability. Success hinges on a well-coordinated effort with government, university, and industry participants that develops the physical and data driven models and analysis techniques to realize this objective of a higher temperature Alloy 718 derivative within the decade.

8:30 PM
Alloy 706 Use, Process Optimization, and Future Directions for GE Gas Turbine Rotor Materials: *Peter W. Schilke*[1]; Robin C. Schwant[1]; [1]GE Power Systems, Schenectady, NY 12345 USA

The use of Alloy 706 in GE Gas Turbines from the initial application in the first F class machines to today's Advanced F class machines is described. This includes compositional optimization, processing refinements, and improvements in ultrasonic inspection techniques. The future directions for Heavy Duty Industrial Gas Turbine rotor material and processes is also outlined. This work has contributed to the achievement of the most reliable F class gas turbine in the world and will provide growth capability for the next generation of GE machines.

Status Reports, Melting and Solidification

Monday AM
June 18, 2001
Room: Salon B&C

Session Chairs: Gernant E. Maurer, Special Metals Corporation, New Hartford, NY 13413-5317 USA; Alec Mitchell, University of British Columbia, Adv. Met. & PE Lab., Vancouver, British Columbia V6T 1Z4 Canada

8:30 AM Invited
Alloy 718 at Pratt & Whitney–Historical Perspective and Future Challenges: *Daniel F. Paulonis*[1]; John J. Schirra[2]; [1]Pratt & Whitney, Matls. & Proc. Eng., MS 163-04, 400 Main St., E. Hartford, CT 06108 USA; [2]Pratt & Whitney, Structl. Matls. & Proc. Dev., MS 140-40, 400 Main St., E. Hartford, CT 06108 USA

8:50 AM Invited
Alloy 625–Impressive Past/Significant Presence/Awesome Future: *G. D. Smith*[1]; S. J. Patel[1]; [1]Special Metals Corporation, 3200 Riverside Dr., Huntington, WV 25705 USA

9:10 AM Invited
Uses of Alloy 718 in the Oil and Gas Industry: *Rashmi Bhavsar*[1]; Anthony Collins[2]; [1]Schlumberge Completion Systems, 14910 Airline Rd., Rosharon, TX 77583 USA; [2]Schlumberge SPC Formation Evaluation, 110 Schlumberger Dr., MD4, Sugerland, TX 77478 USA

9:30 AM Invited
Large Diameter Alloy 718 Ingots for Land Based Gas Turbines: *S. V. Thamboo*[1]; R. C. Schwant[1]; L. Yang[1]; L. Jackman[2]; B. Bond[2]; R. L. Kennedy[2]; [1]GE Power Systems, Bldg. 55/165, 1 River Rd., Schenectady, NY 12345-6000 USA; [2]Allvac, Ltd., Monroe, NC USA

9:50 AM
Making of Alloy 706 ESR Ingot for Gas Turbine Parts: *Sou Ueda*[1]; M. Fumazaki[1]; J. Taira[1]; H. Yamada[2]; [1]The Japan Steel Works, Ltd., Muroran Plant, Steel Melting Dept., 4 Cnatsu-machi, Muroran, Hokkaido, Japan; [2]The Japan Steel Works, Ltd., Rsrch. Lab., Hokkaida, Japan

10:10 AM Break

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Precipitation and Solidification in IN718: *A. Mitchell*[1]; T. Wang[1]; E. Lae[1]; [1]University of British Columbia, Adv. Matls. & Proc. Eng. Lab., Vancouver, British Columbia V6T 1Z4 Canada

10:50 AM
The Tendency for Freckle Formation in Alloy 718: *Koki Morita*[1]; Takaaki Taketsuru[1]; Toshio Suzuki[2]; David G. Evans[3]; Wanhong Yang[4]; [1]Daido Steel Company, Ltd., Shibukawa Plant, 500 Ishihara Shibukawa, Gunma, 377-0007 Japan; [2]Daido Steel Company, Ltd., R&D Dept., 2-30 Daido-cho, Minami-ku, Nagoya, 457-8545 Japan; [3]Special Metals Corporation, New Hartford Plant, 4317 Middle Settlement Rd., New Hartford, NY 13413-5392 USA; [4]West Virginia University, Dept. of Mech. & Aeros. Eng., PO Box 6106, Morgantown, WV 26506-6106 USA

11:10 AM
Freckles in Remelted Niobium Containing Superalloys: *Wanhong Yang*[1]; Wei Chen[1]; Keh-Minn Chang[1]; Sarwan Mannan[2]; John deBarbadillo[2]; Koki Morita[3]; [1]West Virginia University, Dept. of Mech. & Aeros. Eng., PO Box 6106, Morgantown, WV 26506-6106 USA; [2]Special Metals Corporation, Huntington, WV USA; [3]Daido Steel Company, Inc., Shibukawa Plant, 500 Ishihara Shibukawa, Gunma, 377-0007 Japan

11:30 AM
Advances in the Solidification of IN718 and RS5 Alloys: *L. Nastac*[1]; J. J. Valencia[2]; M. L. Tims[2]; F. R. Dax[1]; [1]Concurrent Technologies Corporation, 425 6th Ave., Regional Enterprise Tower, 28th Fl., Pittsburgh, PA 15219 USA; [2]Concurrent Technologies Corporation, 100 CTC Dr., Johnstown, PA 15904-1935 USA

Advances in Processing

Monday PM
June 18, 2001
Room: Salon B&C

Session Chairs: David Furrer, Ladish Company, Cudahy, WI 53110 USA; L. A. Jackman, Allvac, Allegheny Technologies Co., Monroe, NC 28111-5030 USA

1:30 PM
Superalloy 706 Large Forgings by ESR: *Takashi Shibata*[1]; Tatsuya Takahashi[1]; Junichi Taira[2]; Terutaka Kure[2]; [1]The Japan Steel Works, Ltd., Muroran Rsrch. Lab., 4 Chatsu-machi, Muroran, Hokkaido 051-8505 Japan; [2]The Japan Steel Works, Ltd., Muroran Plant, 4 Chatsu-machi, Muroran, Hokkaido 051-8505 Japan

1:50 PM
Manufacturing and Properties of a Large Alloy 706 Disc Made by the Open Die Forging Process: *K. H. Schönfeld*[1]; M. G. Cambi[2]; S. V. Thamboo[2]; M. P. Manning[2]; [1]Saarschmiede, GmbH Frieformschmiede, Völklingen, Germany; [2]GE Power Systems, Bldg. 55/165, 1 River Rd., Schenectady, NY 12345-6000 USA

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Full Scale Gatorizing of Fine Grain Inconel 718: *Prabir Bhowal*[1]; John J. Schirra[1]; [1]Pratt & Whitney, E. Hartford, CT 06108 USA

2:30 PM
Improving Microstructural Evolution of Nickel Base Alloy 706 During Close Die Forging, Using a Finite Element Model Which Incorporates Metallurgical Parameters: *J. Huez*[1]; J.-L. Noyes[1]; J.-F. Uginet[1]; [1]Fortech, BP 173, 09102 Pamiers, Cedex, France

2:50 PM
The Effectiveness of Direct Aging on IN718 Forgings Produced at High Strain Rates as Obtained on a Screw Press: *W. Horvath*[1]; W. Zechner[1]; J. Tockner[1]; M. Berchthaler[1]; G. Weber[1]; E. Werner[2]; [1]Böhler Schmiedetechnik GmbH & Company KG, Mariazellerstrasse 25, A-8605, Kapfenberg, Austria; [2]Technical University Munich, Boltzmannstrasse 15, D-85747, Garching, Germany

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Structural Investigations of Candidate Materials for Turbine Disc Applications Beyond 700°C: *F. Schubert*[1]; H. J. Penkalla[1]; J. Wosik[1]; [1]Forschungszentrum Juelich, IWV 2, Leo-Brandt-Str., Postfach 1913, 52425 Juelich, Germany

3:55 PM
Microstructure Control of Hammer Forging of 718: *Gangshu Shen*[1]; Dan Kahlkel[1]; Robb Denkenbergerl[1]; David U. Furrer[1]; [1]Ladish Company, Inc., 5481 S. Packard Ave., Cudahy, WI 53110-8902 USA

4:15 PM
Thermal Stability of Alloys 718 and 718-ER™: *Wei-Di Cao*[1]; Richard L. Kennedy[1]; [1]Allvac, Allegheny Tech. Co., 2020 Ashcraft Ave., Monroe, NC 28110 USA

4:35 PM
Effects of Process Variables on the Structure and Properties of Hot Rolled 718 Bar: *L. A. Jackman*[1]; R. S. Minisandram[1]; T. W. Miles[1]; J. M. Moyer[1]; [1]Allvac, An Allegheny Tech. Co., 2020 Ashcraft Ave., Monroe, NC 28111-5030 USA

Processing Effects and Physical Metallurgy

Tuesday AM
June 19, 2001
Room: Salon B&C

Session Chairs: Robin C. Schwant, GE Power Systems, Schenectady, NY 12345-6000 USA; John J. Schirra, Pratt & Whitney Company, E. Hartford, CT 06108 USA

8:30 AM
Compositional Modification of Alloy 706: *Tatsuya Takahashi*[1]; Takashi Shibata[1]; Junichi Taira[2]; Terutaka Kure[2]; [1]The Japan Steel Works, Ltd., Muroran Rsrch. Lab., 4 Chatsu-machi, Muroran, Hokkaido 051-8505 Japan; [2]The Japan Steel Works, Ltd., Muroran Plant, 4 Chatsu-machi, Muroran, Hokkaido 051-8505 Japan

8:50 AM
Grain Size Prediction of Alloy 718 Billet Forged by Radial Forging Machine Using Numerical and Physical Simulation: *Motoi Yamaguchi*[1]; Satoshi Kubota[1]; Takehiro Ohno[2]; Toshiaki Nonomura[2]; Tsuyoshi Fukui[2]; [1]Hitachi Metals, Ltd., Metall. Rsrch. Lab., 2107-2, Yasugi-Cho, Yasugi, Shimane 692-8601 Japan; [2]Hitachi Metals, Ltd., Yasugi Works, 2107-2, Yasugi-cho, Yasugi, Shimane 692-0011 Japan

9:10 AM
Modelling of Delta-Phase Dissolution During Preheating of INCONEL718 Turbine Disks: *Martin Stockinger*[1]; Ernst Kozeschnik[1]; Werner Horvath[2]; B. Buchmayr[1]; [1]Technical University Graz, Inst. for Matl. Sci., Welding & Forming, Kopernikusgasse 24, Graz 8010 Austria; [2]Bohler Schmiedetechnik, Kapfenberg Austria

9:30 AM
Observations on the Development of Delta Phase in IN718: *Fred P. Cone*[1]; [1]Pratt & Whitney, UTC, Matls. & Proc. Eng., PO Box 109600, MS 704-36, W. Palm Beach, FL 33410-9600 USA

9:50 AM
Production of Large-Scale Microcrystalline Forgings for Roll-Forming of Axially-Symmetric Alloy 718 Components: Vener A. Valitov[2]; Oscar A. Kaibyshev[2]; Sh. Kh. Mukhtarov[2]; Bernard P. Bewlay[1]; *Canan U. Hardwicke*[1]; Michael F. X. Gigliotti[1]; [1]General Electric, Corp. R&D, PO Box 8, Schenectady, NY 12301 USA; [2]Institute for Metals Superplasticity Problems, 39 Khalturin St., Ufa, Bashkortostan 450001 Russia

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Processing and Properties of Microcrystalline, Submicrocrystalline and Nanocrystalline Alloy 718: Vener A. Valitov[2]; Oskar A. Kaibyshev[2]; Sh. Kh. Mukhtarov[2]; *Bernard P. Bewlay*[1]; Michael F. X. Gigliotti[1]; [1]General Electric, Corp. R&D, PO Box 8, K1-MB103, Schenectady, NY 12301-0008 USA; [2]Institute for Metals Superplasticity Problems, Khalturina St., Ufa, Bashkortostan 450001 Russia

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Time-Temperature-Transformation Diagram of Alloy 725: *Sarwan Mannan*[1]; [1]Special Metals Corporation, 3200 Riverside Dr., Huntington, WV 25705 USA

11:10 AM
Microstructure and Properties of Direct-Aged Alloy 625: *M. G. Burke*[1]; W. J. Mills[1]; R. Bajaj[1]; [1]Bechtel Bettis, Inc., Bettis Atomic Power Lab., W. Mifflin, PA 15122 USA

11:30 AM
Influence of Intermetallic Phase Precipitation During Prolonged Service in Alloy 625 on its Properties: *M. Sundararaman*[1]; P. Mokhopadhyay[1]; S. Banerjee[1]; [1]Bhabha Atomic Research Centre, Matls. Sci. Div., Mumbai 400085 India

Physical and Mechanical Behavior

Tuesday PM
June 19, 2001
Room: Salon B&C

Session Chairs: Shailesh J. Patel, Special Metals Corporation, Huntington, WV 25705-1771 USA; Douglas Ward, GE Aircraft Engines, W. Chester, OH 45069 USA

1:30 PM
Alpha Chromium Formation in Alloy 718 and its Effect on Creep Crack Propagation: *Xishan Xie*[1]; John Radavich[2]; Gangshu Shen[3]; Bruce A. Lindsley[4]; [1]University of Science and Technology-Beijing, High Temp. Matls. Rsrch. Labs., Beijing 100083 China; [2]Micro-Met Laboratories, Inc., 209 N. St., W. Lafayette, IN 47906 USA; [3]Ladish Company, Inc., 5481 S. Packard Ave., Cudahy, WI 53110-8902 USA; [4]Special Metals Corporation, 4317 Middle Settlement Rd., New Hartford, NY 13413 USA

1:50 PM
Effect of Residual Strain in Alpha Cr Precipitation in Alloy 718 Fasteners: *J. F. Radavich*[1]; Bruce A. Lindsley[2]; [1]Micro-Met Laboratories, Inc., 209 N. St., W. Lafayette, IN 47906 USA; [2]Special Metals Corporation, 4317 Middle Settlement Rd., New Hartford, NY 13413 USA

2:10 PM
Effect of Processing/Microstructure on the Threshold Fatigue Crack Growth Behavior of Inconel 718 Forging: *Bernard H. Lawless*[1]; A. W. Dix[2]; [1]GE Aircraft Engines, Matls. & Proc. Eng. Dept., Cincinnati, OH USA; [2]GE Aircraft Engines, Matls. & Proc. Eng. Dept., Lynn, MA 45215-6301 USA

2:30 PM
Design of Inconel 706 for Improved Creep Crack Growth Resistance: *J. Röesler*[1]; S. Müller[1]; D. Del Genovese[1]; M. Götting[1]; [1]Technical University Braunschweig, Inst. fuer Werkstoffe, Langer Kamp 8, D-38106 Braunschweig, Germany

2:50 PM
Creep Rupture Behaviour of Nickel Base Alloys for 700°C – Steam Turbines: *C. Berger*[1]; J. Granacher[1]; A. Thoma[1]; [1]Technical University Darmstadt, Inst. fuer Werkstoffkunde, Grafenstr. 2, Postfach 11 14 52, 64229 Darmstadt, Germany

3:15 PM Break

3:35 PM
Improving Creep Properties of Alloy 718 by Optimizing Al, Ti, P and B Contents: *Wei-Di Cao*[1]; Richard L. Kennedy[1]; [1]Allvac, An Allegheny Tech. Co., 2020 Ashcraft Ave., Monroe, NC 28110 USA

3:55 PM
Influence of Corrosion Pitting on Alloy 718 Fatigue Capability: *Jon R. Groh*[1]; Ron L. Duvelius[1]; [1]GE Aircraft Engines, Matl. & Proc. Eng. Dept., Cincinnati, OH USA

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718 Superalloy Forging Simulation: A Way to Improve Process and Material Potentialities: *N. Späth*[1]; V. Zerrouki[1]; P. Poubanne[1]; J.-Y. Guedou[1]; [1]Snecma Moteurs, Matl. & Proc. Lab., 291 Ave. d'Argenteuil, 92224 Gennevilliers, Cedex, France

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Low Cycle Fatigue Behaviour of Inconel Alloy 718 Disc at Elevated Temperatures: *R. L. Saha*[1]; K. Gopinath[1]; K. K. Sharma[2]; M. Srinivas[2]; [1]Project Office (Materials), Hyderabad, 500 058 India; [2]Defence Metallurgical Research Laboratory, Hyderabad 500 058 India

P/M Technology, Mechanical Behavior and Applications

Wednesday AM
June 20, 2001
Room: Salon B&C

Session Chairs: Jean-Yves Guedou, Snecma Moteurs, Moissy, Cramayel 77550 France; Gaylord Smith, Special Metals Corporation, Huntingdon, WV 25705 USA

8:30 AM
HIP P/M Superalloy 718: *Ulrike Habel*[1]; [1]Crucible Research, 6003 Campbell Run Rd., Pittsburgh, PA 15205 USA

8:50 AM
Precipitation in Spray-Formed IN 718: *Saied Azadian*[1]; Liu-Ying Wei[1]; Fredrik Niklasson[2]; Richard Warren[3]; [1]Luleå University of Technology, Div. of Eng. Matls., SE-97187 Luleå, Sweden; [2]Volvo Aero Corporation, SE-46181 Trollhättan, Sweden; [3]Malmö University, Tech. & Soc., SE-20506 Malmö, Sweden

9:10 AM
Orientational Effects and Influence of Delta Phase on Fatigue Crack Growth Rates in a Forged Disc of Inconel 718 Superalloy: Ponnelle Sylvain[1]; *Brethes Bruno*[2]; Pineau Andre[1]; [1]Ecole des Mines de Paris, Centre des Materiaux, BP 87, Evry, Cedex 91003 France; [2]SNECMA Moteurs, YKOM1, Etablissement de Villaroche, Moissy Cramayel 77550 France

9:30 AM
Fatigue Fracture Surface Morphology for Alloy 718: *W. J. Mills*[1]; C. M. Brown[1]; [1]Bechtel Bettis, Inc., Bettis Atomic Power Lab., W. Mifflin, PA 15122-0079 USA

9:50 AM
Characterization of Vacuum Die Cast Inconel 718 and PWA 1472: *Christopher A. Borg*[1]; Robert W. Hatala[1]; John J. Schirra[1]; [1]Pratt & Whitney, 400 Main St., E. Hartford, CT 06108 USA

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Effect of Thermal Exposure on Microstructural Evolution in Alloy 718 Fasteners: *J. F. Radavich*[1]; B. H. Lawless[2]; [1]Micro-Met Laboratories, Inc., 209 N. St., W. Lafayette, IN 47906 USA; [2]GE Aircraft Engines, M&PED Dept. MD, Cincinnati, OH 45215-6301 USA

10:50 AM
Microstructure Comparison of High Strength Inconel 718 Nuts: *Daniel P. Dennies*[1]; [1]Boeing, 5301 Bolsa Ave., MC H021-F224, Huntington Beach, CA 92647 USA

11:10 AM
Application of Process Modeling and Rapid Prototype Patterns in the Development of Thin Wall IN 718 Investment Castings: *Clay Carlson*[1]; [1]Howmet Research Corporation, 1500 S. Warner St., Whitehall, MI 49461-1895 USA

11:30 AM
Microstructure and Mechanical Properties of Stress Relieved Electron Beam (EB) Welded Alloy 625: *B. Z. Hyatt*[1]; C. B. Brown[1]; [1]Bechtel Bettis, Inc., Bettis Atomic Power Lab., W. Mifflin, PA 15122 USA

Environmental Effects and Applications

Wednesday PM
June 20, 2001
Room: Salon B&C

Session Chairs: Xishan Xie, University of Science and Technology-Beijing, High Temp. Matls. Rsrch. Labs., Beijing 100083 China; Keh-Minn Cheng, University of West Virginia, Morgantown, WV 26506 USA

1:30 PM
Characterisation of Deformation Microstructure Beneath Machined Surface and its Role on the Dimensional Stability of Alloy 718: *M. Sundararaman*[1]; Lalit Kumar[1]; S. Banerjee[1]; [1]Bhabha Atomic Research Centre, Matls. Sci. Div., Mumbai 400085 India

1:50 PM
Hydrogen Embettlement in Cast Alloy 718: *Goeran P. Sjoeberg*[1]; Daniel Cornu[2]; [1]Volvo Areo Corporation, Mgr. Matls. R&D, 9650 GS, 46181 Trollhätten, Sweden; [2]Snecma Moteurs, Rocket Engine Div., BP 802, 27208 Vernon, Cedex, France

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Mechanism for Oxygen Enhanced Crack Growth in Inconel 718: *Robert P. Wei*[1]; Zhi-Fang Huang[1]; Christopher F. Miller[2]; Gary W. Simmons[2]; [1]Lehigh University, Dept. of Mechl. Eng. & Mechs., 327 Sinclair Lab., 7 Asa Dr., Bethlehem, PA 18015 USA; [2]Lehigh University, Dept. of Chem., 305 Sinclair Lab., 7 Asa Dr., Bethlehem, PA 18015 USA

2:30 PM
Dynamic Embrittlement in IN718: *Charles J. McMahon*[1]; [1]University of Pennsylvania, Dept. of MSE, 3231 Walnut St., Philadelphia, PA 19104 USA

2:50 PM
Thermal Fatigue Resistance of 718 for Aluminum Die Casting Dies: *Michael Mark Antony*[1]; John W. Smythe[1]; [1]Allvac, R&D, 2020 Ashcraft Ave., PO Box 5030, Monroe, NC 28111-5030 USA

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The Effects of 650°C Long Exposure on Alloy 718 DA Disk: *X. Liang*[1]; Y. Yang[1]; G. Zhang[1]; X. Xie[1]; [1]Beijing Institute of Aeronautical Materials, Lab. 3, Beijing 100095 China

4:15 PM
Time-Dependent Crack Growth Behaviors of Five Superalloys: *Xingbo Liu*[1]; Longzhou Ma[1]; Keh-Minn Chang[1]; [1]West Virginia University, Dept. of Mech. & Aeros. Eng., WVU PO Box 6106, Morgantown, WV 26506-6106 USA

Interactive Session

Monday
June 18, 2001

Current Paths During Vacuum Arc Remelting of Alloy 718: *Rodney L. Williamson*[1]; Gregory J. Shelmidine[1]; [1]Sandia National Laboratories, 1835, MS 1134, PO Box 5800, Albuquerque, NM 87185-1134 USA

Evolution of Fraction of Solid During Solidification of Niobium-Containing Superalloys: *Wei Chen*[1]; Wanhong Yang[2]; Keh-Minn Chang[2]; Sarwan Mannan[3]; John deBarbadillo[3]; [1]GE Power Systems, Bldg. 55, Rm. 107, 1 River Rd., Schenectady, NY 12345 USA; [2]West Virginia University, PO Box 6106, Morgantown, WV 26506-6106 USA; [3]Special Metals Corporation, Huntington, WV USA

Study on Constitutive Equation of Alloy In718 in the Hammer Forging Process: *Jianping Hu*[1]; [1]Central Iron & Steel Research Institute, High Temp. Matl. Rsrch. Inst., No. 76 Xueyuan Nan Rd., Beijing 100081 China

2-1/2D Computer Modeling and Verification of Forged Pyromet 718 Ingot: *M. Mohamdein*[1]; J. Schwar[1]; [1]Carpenter Specialty Alloy, 101 Bern St., Reading, PA 19601 USA

Investigation of Hot Ring Rolling Using 3D Finite Element Simulation.: *J. Huez*[1]; J.-l. Noyes[1]; J. Coupu[2]; [1]Fortech, BP 173, 09102 Pamiers, Cedex, France; [2]Irsid (Usinor group), BP 30320, 57283 Maizieres Les Metz, Cedex, France

The Effect of Cooling Rate of Solidification on Microstructure and Alloy Element Segregation of as Cast Alloy 718: *Jingchen Zhao*[1]; *Ping Yan*[1]; [1]Central Iron and Steel Research Institute, High Temp. Matls. Dept., No. 76 Xue Yuan Nan Lu, Beijing 100081 China

Effect of Solutionisation Temperature on the Microstructure and Tensile Properties of P/M (HIP) Processed Superalloy 718: *G. Appa Rao*[1]; Mahendra Kumar[1]; M. Srinivas[1]; D. S. Sarma[2]; [1]Defence Metallurgical Research Laboratory, Kanchanbagh (PO) Hyderabad 500 058 India; [2]Banaras Hindu University, Dept. of Metall. Eng., Inst. of Technology, Varanasi, 221005 India

Atomic Level Characterization of Precipitation in Alloy 718: *Michael K. Miller*[1]; Suresh S. Babu[1]; [1]Oak Ridge National Laboratory, Metals & Cer. Div., PO Box 2008, Oak Ridge, TN 37831-6376 USA

Phase Equilibria Among γ, Ni_3Nb-δ and Fe_2Nb-ε Phases in Ni-Nb-Fe and Ni-Nb-Fe-Cr Systems at Elevated Temperatures: *Masao Takeyama*[1]; Akifumi Yamauchi[2]; Sumio Morita[2]; Mitsuhisa Yamanaka[2]; Takashi Matsuo[1]; [1]Tokyo Institute of Technology, Dept. Metall. & Cer. Sci., 2-12-1 Ookayama, Meguro-ku, Tokyo 152-8552 Japan; [2]Tokyo Institute of Technology

Effects of Precipitation on Serrated Yielding in Inconel 718: *M. L. Weaver*[1]; C. S. Hale[1]; [1]The University of Alabama, Dept. of Metall. & Matls. Eng., Box 870202, Tuscaloosa, AL 35487-0202 USA

Ultrasonic Fatigue Strength in Inconel 718: *Qiang Chen*[1]; N. Kawagoishi[1]; E. Kondo[1]; K. Othubo[1]; M. Sakai[2]; T. Kizaki[2]; [1]Kagoshima University, Dept. of Mech. Eng., 1-21-40 Korimoto, Kagoshima 890-0065 Japan; [2]Ono Sokki Company, Ltd., Sensor & Applic. Div., 1-16-1 Hakusan, Midori-ku, Yokohama 226 Japan

Fatigue Crack Growth in Inconel 718 Foil at Elevated Temperature: John W. Holmes[1]; *Eddy L. Vanswijgenhoven*[1]; [1]Pennsylvania State University, Eng. Sci. & Mechs., Earth & Eng. Sci. Bldg., State College, PA 16803 USA

The Impact of Coating Layers on the Performance of Carbide Tools when Machining Inconel 718 Superalloy: *Ali Soleman Al-Watban*[1]; [1]Riyadh Technical College, PO Box 53699, Riyadh 11593 Saudi Arabia

Influence of the Interlamellar Oxide on the Electrochemical Behaviour of Flame Sprayed Alloy 718 Coatings: *Gilles Rannou*[1]; Bernard Normand[2]; Patrice Berçot[1]; Jacques Pagetti[1]; [1]LCMI Laboratoire de Chimie des Matériaux et des Interfaces, 16, Route de Gray, Besançon 25030 France; [2]LERMPS Laboratoire d'Etudes et de Recherches sur les Matériaux et les Propriétés de Surface, Belfort 90010 France

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