Tenth International Symposium on Superalloys
Technical Program

Sponsored by: The Minerals, Metals & Materials Society (TMS)
Program Organizers: Kenneth A. Green, Rolls-Royce Corporation, Indianapolis, IN 46206 USA; Hiroshi Harada, National Research Institute for Metals, High Temperature Materials, Tsukuba Science City, Ibaraki 305-0047 Japan; Tim Howson, Wyman-Gordon, N. Grafton, MA 01536-8001 USA; Tresa M. Pollock, University of Michigan, Materials Science and Engineering Department, Ann Arbor, MI 48109-2136 USA; Roger C. Reed, The University of British Columbia, Department of Metals and Materials Engineering, Vancouver, British Columbia V6T 1Z4 Canada; John J. Schirra, Pratt & Whitney, East Hartford, CT 06108 USA; Scott Walston, GE Aircraft Engines, Cincinnati, OH 45215 USA

Sunday, September 19, 2004

Symposium Keynote Address

Sunday PM Room: Exhibit Hall
September 19, 2004 Location: Seven Springs Mountain Resort

Session Chairs: Tresa Pollock; Kenneth A. Green

8:00 PM
Opening Remarks – Tresa Pollock, Symposium Chairman
Kenneth A. Green, Program Chairman

8:15 PM
Aero-Engine Business and Material Technologies in Japan: *Yukiya G. Nakagawa*[1]; [1]Ishikawajima-Harima Heavy Industries Co., Ltd., R&D, 1 Shin Nakahara, Isogo-ku, Yokohama, Kanagawa 235-8501 Japan

Monday, September 20, 2004

Alloy Development - Blades

Monday AM Room: Exhibit Hall
September 20, 2004 Location: Seven Springs Mountain Resort

Session Chairs: Hiroshi Harada – National Research Institute for Metals, Japan; Malcolm McLean- Imperial College London

8:30 AM
Joint Development of a Fourth Generation Single Crystal Superalloy: *Scott Walston*[1]; Alan Cetel[3]; Rebecca MacKay[4]; Kevin O'Hara[2]; David Duhl[3]; Robert Dreshfield[4]; [1]GE Aircraft Engines, 1 Neumann Way, M85, Cincinnati, OH 45215 USA; [2]GE Aircraft Engines, 1000 Western Ave., M/D 36807, Lynn, MA 01910 USA; [3]Pratt & Whitney, 400 Main St., MS 114-43, E. Hartford, CT 06108 USA; [4]NASA Glenn Research Center, 21000 Brookpark Rd, MS 49-3, Cleveland, OH 44135 USA

8:55 AM
Development of a New Alloy for Directional Solidification of Large Industrial Gas Turbine Blades: *Ralf Bürgel*[1]; Jörn Grossmann[2]; Oliver Lüsebrink[2]; Hael Mughrabi[3]; Florian Pyczak[3]; Robert F. Singer[3]; Andreas Volek[3]; [1]University of Applied Sciences, Engrg. & Computer Scis., Albrechtstrasse 30, Osnabrück D-49076 Germany; [2]Doncasters Precision Castings-Bochum, PO Box 102550, Bochum D-44725 Germany; [3]University of Erlangen-Nuremberg, Martensstrasse 5, Erlangen D-91058 Germany

9:20 AM
Development of Next-Generation Ni-Base Single Crystal Superalloys: *Yutaka Koizumi*[1]; Toshiharu Kobayashi[1]; Tadaharu Yokokawa[1]; Jianxin Zhang[1]; Makota Osawa[1]; Hiroshi Harada[1]; Yasuhiro Aoki[2]; Mikiya Arai[2]; [1]National Institute for Materials Science, High Temp. Matls. Grp., 1-2-

1 Sengen, Tsukuba Science City, Ibaraki 305-0047 Japan; [2]Ishikawajima-Harima Heavy Industries, Matls. Tech. Dept., 3-5-1 Mukodai-cho, Nishi-Tokyo, Tokyo 188-8555 Japan

9:45 AM

Improved Single Crystal Superalloys, CMSX-4® (SLS)[La+Y] and CMSX-486®: Ken Harris[1]; *Jacqueline B. Wahl*[1]; [1]Cannon-Muskegon Corporation, Box 506, Muskegon, MI 49443-0506 USA

Interactive Session I: Alloy Development & Creep Behavior

Monday AM Room: Exhibit Hall Annex
September 20, 2004 Location: Seven Springs Mountain Resort

10:10 AM – 11:10 AM

Development of Ni-Based Single Crystal Superalloys for Power-Generation Gas Turbines: *Ryokighi Hashizume*[1]; Akira Yoshinari[2]; Takamasa Kiyono[3]; Yoshinori Murata[4]; Masahiko Moringa[4]; [1]The Kansai Electric Power Company Inc., Power Engrg. R&D Ctr., 11-20 Nakouji 3-chome, Amagasaki, Hyougo Pref. 661-0974 Japan; [2]Hitachi Company, Ltd., Hitachi Rsch. Lab., 7-1-1 Ohmika-cho, Hitachi, Ibaraki 319-1292 Japan; [3]Hitachi Company, Ltd., Thermal & Hydroelectric Sys. Div., 6 Kanda-Surugadai 4-Chome, Chiyoda-ku, Tokyo 101-8010 Japan; [4]Nagoya University, Dept. of Matls. Sci. & Engrg., Grad. Sch. of Engrg., Furo-cho, Chikusa, Nagoya 464-8603 Japan

Thermal Stability Study on a New Ni-Cr-Co-Mo-Nb-Ti-Al Superalloy: *Shuangqun Zhao*[1]; Jianxin Dong[1]; Xishan Xie[1]; Gaylord D. Smith[2]; Shailesh J. Patel[2]; [1]Universtiy of Science and Technology Beijing, High Temp. Matls. Rsch. Labs., Beijing 100083 China; [2]Special Metals Corporation, Huntington, WV 25705 USA

Gamma/Gamma-Prime Microstructure Formed by Phase Separation of Gamma-Prime Precipitates in a Ni-Al-Ti Alloy: *Minoru Doi*[1]; Daisuke Miki[1]; Tomokazu Moritani[1]; Takao Kozakai[1]; [1]Nagoya Institute of Technology, Dept. of Matls. Sci. & Engrg., Gokiso-cho, Showa-ku, Nagoya 466-8555 Japan

Alternate Material for Elevated Temperature Turbine Cooling Plate Applications: *Jon Raymond Groh*[1]; David P. Mourer[2]; [1]GE Aircraft Engines, AEED-MPED, One Neumann Way, M/D M85, Evendale, OH 45215 USA; [2]GE Aircraft Engines, AEED-MPED, 1000 Western Ave., Lynn, MA 01910 USA

Microstructure Control of Ni Base Alloys with High Volume Fraction of $D0_{22}$ Compound: *Akane Suzuki*[1]; Takashi Matsuo[1]; Masao Takeyama[1]; [1]Tokyo Institute of Technology, Dept. of Metall. & Ceram. Sci., 2-12-1 Ookayama, Meguro-ku, Tokyo 152-8552 Japan

On the Role of Tertiary Gamma Precipitates in the Creep Behaviour at 700°C of a PM Disk Superalloy: *Didier Locq*[1]; Pierre Caron[1]; Sonia Raujol[2]; Florence Pettinari-Sturmel[2]; Armand Coujou[2]; Nicole Clement[2]; [1]Onera, DMMP, 29, Ave. de la Div. Leclerc, BP72, Châtillon 92322 France; [2]CEMES/CNRS, 29, rue Jeanne Marvig, Toulouse 31055 France

Creep Deformation Mechanisms in Some Modern Single Crystal Superalloys: *Jianxin Zhang*[1]; Takao Murakumo[1]; Hiroshi Harada[1]; Yutaka Koizumi[1]; Toshiharu Kobayashi[1]; [1]National Institute for Materials Science, High Temp. Matls. 21 Project, 1-2-1 Sengen, Tsukuba, Ibaraki 305-0047 Japan

Primary Creep in Nickel-Base Superalloys: *Dilip M. Shah*[1]; Sarah Vega[1]; Shiela Woodard[1]; Alan Cetel[1]; [1]Pratt & Whitney, Matls. & Process Engrg., 400 Main St., M/S114-43, E. Hartford, CT 06108 USA

Thickness Debit in Creep Properties of PWA 1484: *Venkat Seetharaman*[1]; Alan D. Cetel[1]; [1]Pratt & Whitney, Matls. & Processes Engrg., 400 Main St., M/S 114-41, D Bldg., E. Hartford, CT 06108 USA

ETA Phase Formation During Thermal Exposure and its Effect on Mechanical Properties in Ni-Base Superalloy GTD 111: *Baig Gyu Choi*[1]; In Soo Kim[1]; Doo Hyun Kim[1]; Seong Moon Seo[1]; Chang Yong Jo[1]; [1]Korea Institute of Machinary and Materials, High Temp. Matls. Grp., 66 Sangnam-dong , Changwon, Kyungnam 641-010 Korea

Deformation Mechanisms at Intermediate Creep Temperatures in René88 DT: *G. B. Viswanathan*[1]; *Peter Sarosi*[1]; *Michael F Henry*[2]; *Deborah A. (DeMania) Whitis*[3]; *Michael J Mills*[1]; [1]Ohio State University, Dept. of Matls. Sci. & Engrg., 477 Watts Hall, 2041 College Rd., Columbus, OH 43210 USA; [2]General Electric Global Research Center, Niskayuna, NY 12309; [3]GE Aircraft Engines, Cincinnati OH 45215 USA

Mechanical Behavior - Creep

Monday AM Room: Exhibit Hall
September 20, 2004 Location: Seven Springs Mountain Resort

Session Chairs: Malcolm McLean – Imperial College London; Hiroshi Harada – National Research Institute for Metals, Japan

11:10 AM
Single Crystal Superalloys: The Transition from Primary to Secondary Creep: G. L. Drew[1]; R. C. Reed[2]; K. Kakehi[3]; *Catherine Mary Rae*[1]; [1]Cambridge University, Rolls-Royce UTP, Dept. of Matls. Sci. & Metall., Pembroke St., Cambridge CB2 3QZ UK; [2]University of British Columbia, 309-6350 Stores Rd., Vancouver, BC V6T 1Z4 Canada; [3]Tokyo Metropolitan University, Dept. of Mechl. Engrg., Minami Osawa 1-1, Hachioji, Tokyo 192-0397 Japan

11:35 AM
Mechanisms of High Temperature Creep of Nickel-Base Superalloys Under Low Applied Stress: *Alexander Epishin*[1]; *Thomas Link*[2]; [1]Federal Institute of Materials Research and Testing, V.1, Unter den Eichen 87, Berlin D-12205 Germany; [2]Technical University Berlin, BH 18, Ernst Reuter-Platz 1, Berlin D-10578 Germany

12:00 PM
A Study on Bending Deformation Behavior of Ni-Based DS and SC Superalloys: *Hideki Tamaki*[1]; Koichi Fujita[1]; A. Okayama[1]; Noriaki Matsuda[1]; Akira Yoshinari[1]; Koji Kakehi[2]; [1]Hitachi, Ltd., Hitachi Rsch. Lab., Dept. of Matls. Rsch. for Power Plants, MD#840 7-1-1 Ohmika, Hitachi, Ibaraki 319-1292 Japan; [2]Tokyo Metropolitan Institute of Technology, 6-6 Asahigaoka, Hino, Tokyo 191-0065 Japan

12:25 PM
Creep Strength of Ni-Base Single Crystal Superalloys on gamma/gamma prime Tie Line: *Takao Murakumo*[1]; *Yutaka Koizumi*[1]; *Toshiharu Kobayashi*[1]; *Hiroshi Harada*[1]; [1]National Institute for Materials Science, High Temperature Materials Group, 1-2-1 Sengen, Ttsukuba Science City, Ibaraki 305-0047 Japan

Alloy Development - Disks

Monday PM Room: Exhibit Hall
September 20, 2004 Location: Seven Springs Mountain Resort

Session Chairs: Xiaofeng Sun – Institute of Metal Research, China; Kenneth A. Green – Rolls-Royce Corporation

6:30 PM
The Influence of Grain Boundary Elements on Properties and Microstructure of P/M Nickel Base Superalloys: *Eric S. Huron*[1]; Kenneth R. Bain[1]; David P. Mourer[1]; J. J. Schirra[2]; P. L. Reynolds[2]; E. E. Montero[2]; [1]General Electric, GE Aircraft Engines, Mail Drop G50, 1 Neumann Way, Cincinnati, OH 45215 USA; [2]Pratt & Whitney, E. Hartford, CT USA

6:55 PM
Developing Damage Tolerance and Creep Resistance in a High Strength Nickel Alloy for Disc Applications: *Mark Christopher Hardy*[1]; Brian Zirbel[2]; Gangshu Shen[2]; Ravi Shankar[2]; [1]Rolls-Royce plc, Matls., Moor Ln., PO Box 31, Derby, Derbyshire DE24 8BJ UK; [2]Ladish Co., Inc., PO Box 8902, 5481 S. Packard Avenue, Cudahy, WI 53110-8902 USA

7:20 PM
Role of Chemistry in 718-Type Alloys - Allvac® 718Plus™ Alloy Development: *Wei-Di Cao*[1]; Richard L Kennedy[1]; [1]Allvac, R&D, 2020 Ashcraft Ave., PO Box 5030, Monroe, NC 28111 USA

Interactive Session II: Coatings and Environmental Effects & Modeling

Monday PM Room: Exhibit Hall Annex
September 20, 2004 Location: Seven Springs Mountain Resort

7:45 PM – 8:45 PM

Oxidation Behavior of Two Nickel-Base Superalloys Used as Elevated Temperature Valves in Spark Ignited Engines and Diesel Exhaust Recirculation (EGR) Applications: *Shubhayu Sinharoy*[1]; Sundaram L Narasimhan[1]; [1]Eaton Corporation, Engine Air Mgmt. Ops., 19218 B Dr. S., Marshall, MI 49068 USA

Thermal Stability of INCONEL Alloy 783 at 593°C and 704°C: *Sarwan Kumar Mannan*[1]; Gaylord Darrell Smith[1]; Shailesh J. Patel[1]; [1]Special Metals Corporation, Tech., 3200 Riverside Dr., Huntington, WV 25705-1771 USA

The Formation of SRZ for the Fourth Generation Single Crystal Superalloy Applied with Aluminide Coating: *Yuki Matsuoka*[1]; Y. Aoki[1]; K. Matsumoto[1]; A. Satou[1]; T. Suzuki[1]; K. Chikugo[1]; K. Murakami[1]; [1]Ishikawajima-harima Heavy Industries Co., Rsch. Lab., 1, Shin-nakahara-cho, Isogo-ku, Yokohama, Kanagawa 235-8501 Japan

Low Coefficient of Thermal Expansion (CTE) Nickel Base Superalloys for Interconnect Application in Intermediate Temperature Solid Oxide Fuel Cells (SOFC): *David E. Alman*[1]; Paul D. Jablonski[1]; [1]U.S. Dept. of Energy, Albany Rsch. Ctr., 1450 Queen Ave., SW, Albany, OR 97321 USA

Environmental Behavior of Low Thermal Expansion INCONEL® Alloy 783: *Eric A. Ott*[1]; Jon R. Groh[1]; Sarwan K. Mannan[2]; [1]GE Aircraft Engines, Matls. & Process Engrg., 1 Neumann Way, MD M89, Cincinnati, OH 45215 USA; [2]Special Metals Corporation, 3200 Riverside Dr., Huntington, WV 25705 USA

Simulation of the Thermal History Dependence of Primary Spacing During Directional Solidification: *Hongbiao Dong*[1]; Wei Wang[2]; Peter D Lee[1]; [1]Imperial College London, Dept. of Matls., Prince Consort Rd., London SW7 2BP UK; [2]Alcoa Technical Center, 100 Techl. Dr., Alcoa Ctr., PA 15069 USA

Phase-Field Modeling with CALPHAD and CVM for Microstructural Evolution of Ni-Base Superalloy: *Jincheng Wang*[1]; Makoto Osawa[1]; Tadaharu Yokokawa[1]; Hiroshi Harada[1]; Masato Enomoto[2]; [1]National Institute for Materials Science, High Temp. Matls. 21 Project, 1-2-1 Sengen, Tsukuba Science City, Ibaraki 305-0047 Japan; [2]Ibaraki University, Dept. of Matls. Sci., 4-12-1, Nakanarusawa, Hitachi, 316-8511 Japan

The Application of Neural Network to the Development of Single Crystal Superalloys: *Young-Soo Yoo*[1]; In-Soo Kim[1]; Doo-Hyun Kim[1]; H. M. Kim[2]; Chang-Yong Jo[1]; C. Neal Jones[3]; [1]KIMM, Dept. of Matls. Procg., 66 Sangnam-dong, Changwon, Kyungnam 641-010 Korea; [2]KISTEP, 275 Yangjae-dong, Seocho-gu, Seoul 137-130 Korea; [3]Rolls Royce plc, PO Box 31, Derby DB24 8BJ UK

The Sensitivity of Investment Casting Simulations to the Accuracy of Thermophysical Property Values: *Xiaoli Yang*[1]; Peter D. Lee[1]; R. F. Brooks[2]; R. Wunderlich[3]; [1]Imperal College London, Matls., Prince Consort Rd., London SW7 2BP UK; [2]NPL, Matls. Ctr., Teddington, London TW11 2UL UK; [3]Universität Ulm, Albert-Einstein-Allee 47, Ulm D89081 Germany

EBSD Investigation and Modeling of the Microstructural Evolutions of Superalloy 718 During Hot Deformation: *Jean-Philippe Thomas*[1]; Christian Dumont[2]; Frank Montheillet[1]; Etienne Bauchet[1]; [1]Ecole Nationale Supérieure des Mines, Centre SMS - Unité CNRS, 158 cours Fauriel, 42023 Saint-Etienne Cedex 2 France; [2]Aubert & Duval, Service R&D, BP1, 63070 Les Ancizes Cedex France

Integration of Computational Tools for Designing Ni-Base Superalloys: *Shihuai Zhou*[1]; Yi Wang[1]; Jingzhi Zhu[1]; Tao Wang[1]; Long-Qing Chen[1]; Rebecca A. MacKay[2]; Zi-Kui Liu[1]; [1]Pennsylvania State University, Dept. of Matls. Sci. & Engrg., 107 Steidle Bldg., State College, PA 16802 USA; [2]NASA Glenn Research Center, Matls. Div., 21000 Brookpark Rd., Cleveland, OH 44135 USA

3D-FEM Calculations of Rafting in Ni-Base Superalloys Based on High Temperature Elastic and Lattice Parameters: *Makoto Osawa*[1]; H. Shiraishi[1]; Tadaharu Yokokawa[1]; Hiroshi Harada[1]; Toshiharu Kobayashi[1]; [1]National Institute for Materials Science, High Temp. Matls. 21 Project, 1-2-1 sengen, Tsukuba, Ibaraki 305-0047 Japan

Panel Presentation and Discussion – Perspectives on Collaborative Efforts

Monday PM Room: Exhibit Hall
September 20, 2004 Location: Seven Springs Mountain Resort

Session Chairs: Kenneth A. Green – Rolls-Royce Corporation; Tresa Pollock – University of Michigan

Panel Moderator: Jim Williams, Ohio State University

Panel: Leo Christodoulou, DARPA
Rollie Dutton, AFRL
Tasadduq Khan, ONERA
AJ Misra, NASA
Robert Schafrik, GE Aircraft Engines
Malcolm Thomas, Rolls-Royce
Xishan Xie, University of Science & Technology Beijing

8:45 PM – 10:00 PM

Tuesday, September 21, 2004

Mechanical Behavior - Fatigue

Tuesday AM Room: Exhibit Hall
September 21, 2004 Location: Seven Springs Mountain Resort

Session Chairs: Masakazu Okazaki – Nagaoka University of Technology; Tim Howson – Wyman-Gordon

8:30 AM
Microstructural Variables Controlling Time-Dependent Crack Growth in a P/M Superalloy: *Jack Telesman*[1]; Pete Kantzos[2]; John Gayda[1]; P. J. Bonacuse[3]; Anthony Prescenzi[4]; [1]NASA Glenn Research Center, MS 49-7, 21000 Brookpark Rd., Cleveland, OH 44135 USA; [2]Ohio Aerospace Institute, Brookpark, OH USA; [3]US Army Research Laboratory, Cleveland, OH 44135 USA; [4]Ohio State University, Columbus, OH, USA

8:55 AM
A Comparative Study of Thermo-Mechanical Fatigue of Two Ni-Base Single Crystal Superalloys: *Hao Zhou*[1]; M. Osawa[1]; Hiroshi Harada[1]; Tadaharu Yokokawa[1]; Y. Koizumi[1]; T. Kobayashi[1]; M. Waki[1]; *Yoshikazu Ro*[1]; Ikuo Okada[2]; [1]National Institute for Materials Science, HTM21 Project, 1-2-1 Sengen, Tsukuba-shi, Ibaraki 305-0047 Japan; [2]Mitsubishi Heavy Industries, Takasago R&D Ctr., 2-1-1 Shinhama Arai-cho, Takasago, Hyogo 676-8686 Japan

9:20 AM
The Effect of Partial Vacuum on the Fatigue Crack Growth of Nickel Base Superalloys: *Andrew Henry Rosenberger*[1]; [1]Air Force Research Laboratory, Matls. & Mfg. Direct., AFRL/MLLMN, 2230 Tenth St., Ste. 1, WPAFB, OH 45433-7817 USA

9:45 AM
Hold-Time Effect on Low-Cycle Fatigue Behavior of HASTELLOY® X Superalloy at High Temperatures: *Y. L. Lu*[1]; L. J. Chen[1]; G. Y. Wang[1]; M. L. Benson[1]; P. K. Liaw[1]; S. A. Thompson[2]; J. W. Blust[2]; P. F. Browning[2]; A. K. Bhattacharya[2]; J. M. Aurrecoechea[2]; D. L. Klarstrom[3]; [1]University of Tennessee, Dept. of Matls. Sci. & Engrg., Knoxville, TN 37996-2200 USA; [2]Solar Turbines Inc., 2200 Pacific Hwy., PO Box 85376, MZ R-1, San Diego, CA 92186-5376 USA; [3]Haynes International, Inc., 1020 W. Park Ave., PO Box 9013, Kokomo, IN 46904-9013 USA

Interactive Session III: Disk Alloys & Fatigue

Tuesday AM Room: Exhibit Hall Annex
September 21, 2004 Location: Seven Springs Mountain Resort

10:10 AM – 11:10 AM

Effects of High Temperature Exposures on Fatigue Life of Disk Superalloys: *Tim P. Gabb*[1]; Jack Telesman[1]; Pete Kantzos[2]; James W. Smith[3]; Paul F. Browning[4]; [1]NASA Glenn Research Center, 21000 Brookpark Rd., MS 49-3, Cleveland, OH 44135 USA; [2]Ohio Aerospace Institute, 22800 Cedar Point Rd., Cleveland, OH 44142 USA; [3]QSS Group, Inc., 21000 Brookpark Rd., Cleveland, OH 44135 USA; [4]Solar Turbines Inc., Turbotec , 2200 Pacific Hwy., San Diego, CA 92101 USA

Effect of Boron Concentration on Fatigue Crack Propagation Resistance and Low Cycle Fatigue Properties of Inconel 718: L. Xiao[1]; D. L. Chen[2]; *M. C. Chaturvedi*[1]; [1]University of Manitoba, Dept. of Mech. & Industrial Engrg., Winnipeg, Manitoba R3T 5V6 Canada; [2]Ryerson University, Dept. of Mech. & Industrial Engrg., 350 Victoria St., Toronto, Ontario M5B 2K3 Canada

Fatigue Crack Propagation Behaviors of New Developed Allvac® 718Plus™ Superalloy: *Xingbo Liu*[1]; Shalini Rangarajan[1]; Ever Barbero[1]; Keh-Minn Chang[1]; Wei-Di Cao[2]; Richard Kennedy[2]; Tadeu Carneiro[3]; [1]West Virginia University, Mechl. & Aeros. Engrg., PO Box 6106, Morgantown, WV 26506-6106 USA; [2]Allvac, R&D, 2020 Ashcraft Ave., PO Box 5030, Monroe, NC 28111-5030 USA; [3]Reference Metals Company, 1000 Old Pond Rd., Bridgeville, PA 15017 USA

On TMF Damage, Degradation Effects, and the Associated T^{MIN} Influence on TMF Test Results in ' Alloys: *Douglas James Arrell*[1]; Magnus Hasselqvist[1]; Christoph Sommer[2]; J. Moverare[1]; [1]Demag DeLaval Industrial Turbomachinery AB, Matls. Tech., Slottsvägen, Finspång, Östergötland 612 84 Sweden; [2]Fachhochschule Südwestfalen, University of Applied Sciences, Lindenstr. 53, Meschede D-59872 Germany

Fatigue Crack Growth Behaviour Under Mixed Mode Loading in UDIMET 720 SX: *Mark Richard Joyce*[1]; Philippa Reed[1]; [1]University of Southampton, Matls. Rsch. Grp., Sch. of Engrg. Sci., Highfield, Southampton, Hampshire SO17 1BJ UK

Divergence of Mechanisms and the Effect on the Fatigue Life Variability of René 88DT: Michael J. Caton[1]; *Sushant K. Jha*[2]; Andrew H. Rosenberger[1]; James M. Larsen[1]; [1]Air Force Research Laboratory, Matls. & Mfg. Direct., AFRL/MLLMN, Wright-Patterson AFB, OH 45433-7817 USA; [2]Universal Technology Corporation, 1270 N. Fairfield Rd., Dayton, OH 45432 USA

Development of Ultrasonic Fatigue for Rapid, High-Temperature Fatigue Studies in Turbine Engine Materials: A. Shyam[1]; C. J. Torbet[1]; S. K. Jha[2]; J. M. Larsen[3]; M. J. Caton[3]; C. J. Szczepanski[1]; T. M. Pollock[1]; *J. W. Jones*[1]; [1]University of Michigan, Dept. of Matls. Sci. & Engrg., 2300 Hayward, Ann Arbor, MI 48109 USA; [2]Universal Technlogy Corporation, Dayton, OH 45432 USA; [3]Air Force Research Laboratory, Matls. & Mfg. Direct., AFRB/MLLMN Wright-Patterson AFB, Dayton, OH 45433 USA

Crystallographic Initiation of Nickel-Base Superalloy IN100 at RT and 538 C Under Low Cycle Fatigue Conditions: *Kezhong Li*[1]; Noel E. Ashbaugh[1]; Andrew H. Rosenberger[2]; [1]University of Dayton Research Institute, 300 College Park, Dayton, OH 45469-0128 USA; [2]Air Force Research Laboratory, Matls. & Mfg. Direct., AFRL/MLLMN, 2230 Tenth St., WPAFB, OH 45433-7817 USA

Process Development and Mechanical Properties of Alloy U720LI for High Temperature Turbine Disks: *Raphael Couturier*[1]; Hélène Burlet[1]; S. Terzi[1]; Sophie Dubiez[1]; Laure Guétaz[1]; Gérard Raisson[2]; [1]CEA Grenoble, DRT-DTEN-SMP-LS2M, 17 rue des martyrs, Grenoble 38054 France; [2]Aubert & Duval Holding, Direction Technique, Parc Technologique la Pardieu, 6 rue condorcet, Clermont-Ferrand 63063 France

Development of Gamma-Prime Morphology in P/M Rotor Disc Alloys During Heat Treatment: *Robert John Mitchell*[1]; M. C. Hardy[2]; Michael Preuss[2]; Sammy Tin[1]; [1]Rolls-Royce University Technology Partnership, Dept. of Matls. Sci. & Metall., University of Cambridge, Pembroke St., Cambridge, Cambridgeshire CB2 3QZ UK; [2]Rolls-Royce plc, PO Box 31, Derby DE24 8BJ UK; [2]Manchester Materials Science Centre & UMIST, Grosvenor St., Manchester M1 7HS UK

Ageing Characterization of the Powder Metallurgy Superalloy N18: *Benjamin Flageolet*[1]; Patrick Villechaise[1]; Mustapha Jouiad[1]; José Mendez[1]; [1]LMPM-ENSMA, 1, Ave. Clement Ader BP 40109, Teleport 2, Futuroscope-Chasseneuil 86961 France

Assessment of Russian P/M Superalloy EP741NP: *John Radavich*[1]; David Furrer[2]; [1]Micro-Met Laboratories, 209 North St., W. Lafayette, IN 47906 USA; [2]Ladish Co., Inc., PO Box 8902, Cudahy, WI 53110-8902 USA

Recovery and Recrystallization After Critical Strain in the Nickel-Based Superalloy René 88DT: *Deborah Ann (DeMania) Whitis*[1]; [1]GE Aircraft Engines, MPED, 1 Neumann Way, MD H85, Evendale, OH 45215 USA

Dual Heat Treat Process Development for Advanced Disk Applications: *David P. Mourer*[1]; Jeffrey L. Williams[2]; [1]GE Aircraft Engines, 1000 Western Ave., Lynn, MA 01915 USA; [2]GE Aircraft Engines, MPED, 1 Neumann Way, Cincinnati, OH 45215 USA

The Effect of Powder Cleanliness on the Fatigue Behavior of Powder Metallurgy Ni-Disk Alloy Udimet 720: Pete Bonacuse[4]; Jack Telesman[2]; Pete Kantzos[3]; T. Gabb[3]; R. Barrie[2]; *Anthony Banik*[1]; [1]Special Metals Corporation, Powder Div., 100 Industry Ln., Princeton, KY 41445 USA; [2]NASA Glenn Research Center, 21000 Brookpark Rd., Cleveland, OH 44131 USA; [3]Ohio Aerospace Institute, NASA GRC, 21000 Brookpark Rd., MS 49-7, Cleveland, OH 44135 USA; [4]Army Research Laboratory, NASA GRC, 21000 Brookpark Rd., Cleveland, OH 44135 USA

Disk Alloys

Tuesday AM Room: Exhibit Hall
September 21, 2004 Location: Seven Springs Mountain Resort

Session Chairs: Tim Howson – Wyman-Gordon; Masakazu Okazaki – Nagaoka University of Technology

11:10 AM
Modeling and Measurement of Residual Stresses in a Forged IN718 Superalloy Disc: *D. Dye*[1]; Sammy Tin[1]; B. A. Roder[2]; M. A. Rist[3]; J. A. James[3]; M. R. Daymond[4]; [1]University of Cambridge, Dept. of Matls. Sci. & Metall., Pembroke St., Cambridge CB2 3QZ UK; [1]Imperial College, Dept. of Matls., Royal Sch. of Mines, Prince Consort Rd., S. Kensington, London SW7 2BP UK; [3]Open University, Dept. of Matls. Engrg., Milton Keynes OX11 0QX UK; [4]ISIS, Rutherford Appleton Lab., Chilton, Didcot OX11 0QX UK

11:35 AM
The Effect of Dual Microstructure Heat Treatment on an Advanced Nickel-Base Disk Alloy: *John Gayda*[1]; T. P. Gabb[1]; P. T. Kantzos[2]; [1]NASA Glenn Research Center, 21000 Brookpark Rd., M.S. 49-3, Cleveland, OH 44135 USA; [2]Ohio Aerospace Institute, 22800 Cedar Point Rd., Cleveland, OH 44142 USA

12:00 PM
Effects of Microstructure on High Temperature Constitutive Behavior of IN100: *Walter W. Milligan*[1]; Erica L. Orth[1]; John J. Schirra[2]; Michael F. Savage[2]; [1]Michigan Technological University, Matls. Sci. & Engrg., Rm 512, M&M Bldg., Houghton, MI 49931 USA; [2]Pratt and Whitney, 400 Main St., MS 114-40, E. Hartford, CT 06108 USA

12:25 PM
Effect of Microstructure (and Heat Treatment) on the 649 C Properties of Advanced P/M Superalloy Disk Materials: *John J. Schirra*[1]; Paul L. Reynolds[1]; Enrique E. Montero[1]; Eric S. Huron[2]; Kenneth R. Bain[2]; David P. Mourer[3]; [1]Pratt & Whitney, 400 Main St., E. Hartford, CT 06118 USA; [2]General Electric Aircraft Engines, Cinncinati, OH USA; [3]General Electric Aircraft Engines, Lynn, MA USA

Wednesday, September 22, 2004

Advances in Processing

Wednesday AM Room: Exhibit Hall
September 22, 2004 Location: Seven Springs Mountain Resort

Session Chairs: Roger Reed – University of British Columbia; Jon Schaeffer – GE Power Systems

8:30 AM
Issues in Processing by the Liquid-Sn Assisted Directional Solidification Technique: *Andrew J. Elliott*[1]; Graeme B. Karney[2]; Michael F.X. Gigliotti[3]; Tresa M. Pollock[1]; [1]University of Michigan, Matls. Sci. & Engrg., 2300 Hayward St., Ann Arbor, MI 48109-2136 USA; [2]Oxford University, Matls. Sci., Parks Rd., Oxford OX1 3PH UK; [3]GE, Corporate R&D, Niskayuna, NY 21309 USA

8:55 AM
Superalloy Lattice Block Structures: *Michael V. Nathal*[1]; J. D. Whittenberger[1]; M. G. Hebsur[1]; P. T. Kantzos[1]; D. L. Krause[1]; [1]NASA Glen Research Center, 21000 Brookpark Rd., Cleveland, OH 44135-3191 USA

9:20 AM
Evaluation of the IN 939 Alloy for Large Aircraft Engine Structures: *Göran Sjöberg*[1]; Dzevad Imamovic[1]; Johannes Gabel[2]; Oscar Caballero[3]; Jeffery W. Brooks[4]; Jean- Pierre Ferte[5]; Ariane Lugan[6]; [1]Volvo Aero; [2]MTU; [3]ITP; [4]QinetiQ; [5]Snecma; [6]TWI

9:45 AM
Micro-Mechanical Behavior Study of Non-Metallic Inclusions in P/M Disk Superalloy Rene'95: *Xishan Xie*[1]; Lina Zhang[2]; Maicang Zhang[1]; Jianxin Dong[1]; Kenneth R. Bain[3]; [1]University of Science and Technology Beijing, High Temp. Matls. Rsch. Labs., Beijing 100083 China; [2]Tsinghua University, Sch. of Matls. Sci. & Engrg., Beijing 100084 China; [3]GE Aircraft Engines, Cincinnati, OH 45215 USA

Interactive Session IV: Processing

Wednesday AM Room: Exhibit Hall Annex
September 22, 2004 Location: Seven Springs Mountain Resort

10:10 AM – 11:10 AM

Metallographic Techniques for Superalloys: *George F. Vander Voort*[1]; Elena P. Manilova[2]; Gabriel M. Lucas[1]; [1]Buehler Ltd., 41 Waukegan Rd., Lake Bluff, IL 60044 USA; [2]Polzunov Central Boiler and Turbine Institute, Dept. for Service Life & Repair Tech., Politecnicheskaya str., 24, St. Petersburg 194021 Russia

An Innovative Device for the Mechanical Testing of Miniature Specimens of the Superalloys: *Bryan Roebuck*[1]; David Cox[2]; Roger Reed[3]; [1]National Physical Laboratory, Queen's Rd., Teddington, London TW11 0LW UK; [2]University of Surrey, Guildford UK; [3]University of British Columbia, Vancouver Canada

Weldability of Directionally Solidified TMS-75 and TMD-103 Superalloys: Y. L. Wang[1]; X. Yu[1]; *Norman L. Richards*[1]; Mahesh C. Chaturvedi[1]; [1]University of Manitoba, Dept. of Mechl. & Industrial Engrg., Winnipeg, Manitoba R3T5V6 Canada

Effects of Segregation in Nickel-Base Superalloys: Dendritic Stresses: *Alexander Epishin*[1]; *Thomas Link*[2]; Udo Brueckner[1]; Bernard Fedelich[1]; *Pedro Portella*[1]; [1]Federal Institute of Materials Research and Testing, V.1, Unter den Eichen 87, Berlin D-12205 Germany; [2]Technical University Berlin, BH 18, Ernst Reuter-Platz 1, Berlin D-10578 Germany

Determination of the Gamma'-Solvus Temperature of Two Commercial Wrought Ni-Base Superalloys by Thermal Expansion Measurements: *Wolfgang Hermann*[2]; Michael Fahrmann[1]; Hans-Georg Sockel[3]; [1]Special Metals Corporation, Tech. Dept., 3200 Riverside Dr., Huntington, WV 25705 USA; [2]Siemens KWU, Matls. Tech., Wiesenstrasse 35, Muehlheim a. d. Ruhr D-45473 Germany; [3]University of Erlangen-Nuernberg, Dept. of Matls. Sci., Germany

A Study of the Effect of Electro-Slag Re-Melting Parameters on the Structural Integrity of Large Diameter Alloy 718 ESR Ingot: *David G. Evans*[2]; Michael Fahrmann[1]; [1]Special Metals Corporation, Tech. Dept., 3200 Riverside Dr., Huntington, WV 25705 USA; [2]Special Metals Corporation, Process Engrg., 4317 Middle Settlement Rd., New Hartford, NY 13413 USA

Design of Nanoporous Superalloy Membranes by Self-Assembly of the Gamma Prime Phase: *Joachim Rösler*[1]; Oliver Näth[1]; Fabian Schmitz[1]; Debashis Mukherji[1]; [1]Technical University Braunschweig, Inst. für Werkstoffe, Langer Kamp 8, Braunschweig 38106 Germany

Cast Structure and Mechanical Properties of Fine Grained Superalloy K4169 by Addition of Refiners: *Lin Liu*[1]; Taiwen Huang[1]; Yuhua Xiong[2]; Aimin Yang[3]; Zhilong Zhao[1]; Rong Zhang[1]; Jinshan Li[1]; [1]Northwestern Polytechnical University, State Key Lab. of Solidification Procg., Xi'an 710072 China; [2]Tsinghua University, Dept. of Mechl. Engrg., Beijing 100084 China; [3]Xi'an Petroleum Institute, Dept. of Mechl. Engrg., Xi'an 710065 China

Welding of Single Crystal Superalloy CMSX-4: Experiments and Modelling: *David Dye*[1]; Kelly T. Conlon[2]; Peter D. Lee[1]; Ronald B. Rogge[2]; Roger C. Reed[3]; [1]Imperial College, Dept. of Matls., Royal Sch. of Mines, Prince Consort Rd., London SW7 2AZ UK; [2]National Research Council of Canada, Chalk River Labs., Chalk River, Ontario K0J 1J0 Canada; [3]University of British Columbia, Dept. of Metals & Matls. Engrg., 309-6350 Stores Rd., Vancouver, BC V6T 1Z4 Canada

Characterisation of Gamma Prime Across Inertia Friction Welded Alloy 720Li: *Michael Preuss*[1]; Joao Quinta da Fonseca[1]; Ioannis Kyriakoglou[2]; Philip J. Withers[1]; Gavin J. Baxter[3]; [1]UMIST, Manchester Matls. Sci. Ctr., Grosvenor St., Manchester M1 7HS UK; [2]University of Birmingham, Sch. of Engrg., Metall. & Matls., Edgbaston, Birmingham B15 2TT; [3]Rolls-Royce plc., PO Box 31, Derby DE24 8BJ UK

Nanoindentations as a Local Probe for the Mechanical Properties and Alloying Influences in Nickel-Base Superalloys and Aluminide Coatings: K. Durst[1]; O. Franke[1]; *Mathias Goeken*[1]; [1]University Erlangen-Nuremnberg, Matls. Sci. & Engrg., Martensstrasse 5, Erlangen 91058 Germany

Analysis of Stray Grain Formation in Single-Crystal Nickel-Based Superalloy Welds: *John M. Vitek*[1]; Suresh Babu[1]; Jin-Woo Park[2]; Stan A. David[1]; [1]Oak Ridge National Laboratory, Metals & Ceram. Div., PO Box 2008, Bldg. 4508, MS 6096, Oak Ridge, TN 37831-6096 USA; [2]Samsung Electro-Mechanic Co, Inc, 314 Maetan-3Dong, Paldal-Gu, Suwon, Kyunggi-Do 442-743 Korea

Weldability and Mechanical Behavior of GTD-141: *Ganjiang Feng*[1]; Arthur Peck[1]; Steve Balsone[1]; Tadeu Carneiro[2]; [1]GE, 300 Garlington Rd., Greenville, SC 29615 USA; [2]Reference Metals Co., 1000 Old Pond Rd., Bridgeville, PA 15017 USA

Mechanical Property and Microstructural Characterization of Vacuum Die Cast Superalloy Materials: *John J. Schirra*[1]; Christopher A. Borg[1]; Robert W. Hatala[1]; [1]Pratt & Whitney, 400 Main St., E. Hartford, CT 06118 USA

Low Cost Powder Metal Turbine Components: *Anthony Banik*[2]; Kenneth A. Green[1]; M. C. Hardy[3]; David P. Mourer[4]; Tiffany Reay[5]; [1]Rolls-Royce, PO Box 420, S/C W05, Indianapolis, IN 46206 USA; [2]Special Metals Corporation, :Princeton, KY 42445 USA; [3]Rolls-Royce plc, Derby UK; [4]GE Aircraft Engines, Lynn, MA 01910 USA; [5]Ladish Co., Inc., Cudahy, WI USA

Microstructure, Macrostructure, and Modelling of the Centrifugal Spray Deposition of Large Diameter NI Superalloy Preforms: *Mark D. Barratt*[1]; R. Mark Ward[1]; Zhifang Peng[2]; Zhusheng Shi[3]; Jiawei Mi[3]; Patrick Grant[3]; Mike H. Jacobs[1]; [1]University of Birmingham, IRC in Matls. Procg., Edgbaston, Birmingham, W. Midlands B15 2TT UK; [2]Wuhan University, Dept. of Matls. Engrg., Wuhan 430072 China; [3]University of Oxford, Dept. of Matls., Parks Rd., Oxford OX1 3PH UK;

Coatings and Environmental Effects

Wednesday PM Room: Exhibit Hall
September 22, 2004 Location: Seven Springs Mountain Resort

Session Chairs: Jon Schaeffer – GE Power Systems; Roger Reed – University of British Columbia

11:10 AM
Coating and Surface Technologies for Turbine Airfoils: *Scott Walston*[1]; [1]GE Aircraft Engines, 1 Neumann Way, M85, Cincinnati, OH 45215 USA

11:35 AM
Application of Ir-Base Alloys to Novel Oxidation Resistant Bond-Coatings: *Hideyuki Murakami*[1]; Aya Suzuki[2]; Feng Wu[3]; P. Kuppusami[4]; Hiroshi Harada[3]; [1]University of Tokyo, Dept. of Matls. Engrg., Faculty of Engrg., 7-3-1, Hongo, Bunkyo-ku, Tokyo 113-8656 Japan; [2]Shibaura Institute of Technology, 3-9-14 Shibaura, Minato-ku, Tokyo, Japan; [3]National Institute for Materials Science, High Temp. Matls. Grp., 1-2-1, Sengen, Tsukuba City, Ibaraki 305-0047 Japan; [4]Indira Gandhi Centre for Atomic Research, Physical Metall. Sect., Kalpakkam India

12:00 PM
The Use of Model Alloys to Understand and Improve the Performance of Pt-Modified Aluminide Coatings: *Bruce A. Pint*[1]; J. Allen Haynes[1]; Karren L. More[1]; Ian G. Wright[1]; [1]Oak Ridge National Laboratory, Metals & Ceram. Div., PO Box 2008, MS 6156, 1 Bethel Valley Rd., Oak Ridge, TN 37831-6156 USA

12:25 PM
The Effects of Water Vapor on the Oxidation of Nickel-Base Superalloys and Coatings at Temperatures from 700 C to 1100 C: *K. Onal*[1]; M. C. Maris-Sida[1]; G. H. Meier[1]; F. S. Pettit[1]; [1]University of Pittsburgh, Dept. of Matls. Sci. & Engrg., Pittsburgh, PA 15261 USA

Blade Alloys I

Wednesday PM Room: Exhibit Hall
September 22, 2004 Location: Seven Springs Mountain Resort

Session Chairs: Scott Walston – GE Aircraft Engines; Maury Gell – University of Connecticut

6:30 PM
High Cycle Fatigue in a Single Crystal Superalloy: Time Dependence at Elevated Temperature: *P. Kennard Wright*[1]; Meenoo Jain[1]; David Cameron[2]; [1]GE Aircraft Engines, MPED, 1 Neumann Way, G50, Cincinnati, OH 45215 USA; [2]Honeywell Engines, Sys. & Serv., Matls. & Process Engrg., M/S 503-115, PO Box 52181, Phoenix, AZ 85072-2181 USA

6:55 PM
Relationships Between Microstructural Instabilities and Mechanical Behaviour in New Generation Nickel-Based Single Crystal Superalloys: Odile Lavigne[1]; Catherine Ramusat[1]; Stefan Drawin[1]; *Pierre Caron*[1]; Denis Boivin[1]; Jean-Louis Pouchou[1]; [1]Onera, DMMP, 29, Ave. de la Div. Leclerc, Châtillon 92322 France

7:20 PM
High Temperature Creep Behaviours of Ru-Bearing Ni-Based Single Crystal Superalloys: *An-Chou Yeh*[1]; Cathie M Rae[1]; Sammy Tin[1]; [1]Cambridge University, Matls. Dept., Pembroke St., Cambridge UK

Interactive Session V: Blade Alloys

Wednesday PM Room: Exhibit Hall Annex
September 22, 2004 Location: Seven Springs Mountain Resort

7:45 PM – 8:45 PM

Influence of Solidification Conditions on TCP Phase Formation, Casting Porosity and High Temperature Mechanical Properties in a Re-Containing Nickel-Base Superalloy with Columnar Grain Structure: Andreas M. Volek[1]; *Robert F. Singer*[1]; [1]University of Erlangen, Dept. of Matls. Sci., WTM Inst., Martensstrasse 5, Erlangen 91058 Germany

The Effects of Different Alloying Elements on Thermal Expansion Coefficients, Lattice Constants and Misfit of Nickel-Based Superalloys Investigated by X-Ray Diffraction: *Florian Pyczak*[1]; Bastian Devrient[2]; Hael Mughrabi[1]; [1]University Erlangen-Nuernberg, Inst. for General Matls. Prop., Martensstrasse 5, Erlangen, Bavaria D-91058 Germany; [2]Framatome ANP, Freyeslebenstrasse 1, Erlangen, Bavaria D-91058 Germany

Defect Grains in the Melt-Back Region of CMSX-4 Single Crystal Seeds: *Nicole Stanford*[1]; Aleksander Djakovic[1]; Barbara A. Shollock[1]; Malcolm McLean[1]; Neil D'Souza[2]; Paul Jennings[3]; [1]Imperial College London, Dept. of Matls., Exhibition Rd., London SW7 2AZ UK; [2]Rolls-Royce plc, Precision Casting Facility, PO Box 31, Derby DE24 8BJ UK; [3]Rolls-Royce plc, Company R&D Foundry, PO Box 3, Filton, Bristol BS34 7QE UK

Hot Tearing in Directionally Solidified Ni-Based Superalloys: *Jian Zhang*[1]; [1]Chinese Academy of Sciences, Inst. of Metal Rsch., Superalloys Div., Wenhua Rd. 72, Shenyang, Liaoning 110016 China

Atomic Partitioning of Ruthenium in Ni-Based Superalloys: *Sammy Tin*[1]; A. C. Yeh[1]; A. P. Ofori[1]; R. C. Reed[2]; S. S. Babu[3]; M. K. Miller[3]; [1]University of Cambridge, Dept. of Matls. Sci. & Metall., Pembroke St., Cambridge CB2 3QZ UK; [2]University of British Columbia, 309-6350 Stores Rd., Vancouver V6T 1Z4 Canada; [3]Oak Ridge National Laboratory, Metals & Ceram. Div., PO Box 2008, Oak Ridge, TN 37831-6136 USA

Abnormal Phases in High W Content Nickel Base Superalloys and Phase Control: *Yunrong Zheng*[1]; S. Li[1]; L. Zheng[2]; Y. Han[1]; H. Harada[3]; [1]Beijing University of Aeronautics and Astronautics, Beijing 100083 China; [2]Beijing Institute of Aeronautics and Astronautics, Beijing 100095 China; [3]National Institute for Materials Science, 1-2-1 Sengen, Tsukuba, Ibaraki 305-0047 Japan

Elastic Properties of Multi-Component Nickel Solid Solutions: *Kuiying Chen*[1]; Linruo Zhao[1]; Prakash C. Patnaik[1]; John S. Tse[2]; [1]National Research Council Canada, Struct., Matls. & Propulsion Lab., Inst. for Aeros. Rsch., M-13 Bldg., Montreal Rd., Ottawa, Ontario K1A 0R6 Canada; [2]Steacie Institute for Molecular Sciences, Natl. Rsch. Council Canada, Ottawa, Ontario K1A 0R6 Canada

A New Method of Metal Temperature Estimation for Service-Run Blades and Vanes: *Keith A. Ellison*[1]; Joseph A. Daleo[1]; Khalid Hussain[1]; [1]BWD Turbines Ltd., 1-601 Tradewind Dr., Ancaster, Ontario L9G 4V5 Canada

New Phases in Ruthenium-Containing Single-Crystal Superalloys: *Q. Feng*[1]; T. K. Nandy[2]; L. J. Rowland[1]; B. Tryon[1]; D. Banerjee[2]; T. M. Pollock[1]; [1]University of Michigan, Matls. Sci. & Engrg., 2300 Hayward St., 3062 H. H. Dow, Ann Arbor, MI 48109 USA; [2]Defense Metallurgical Research Laboratory, Hyderabad 500 258 India

An Influence of Microstructure on the Mechanical Properties of the Corrosion Resistant Superalloy ChS88U: *Elena V. Monastyrskaia*[1]; Evgenii V. Petrov[1]; Vjacheslav E. Belyaev[1]; Alexander M. Dushkin[1]; [1]FSUE MMPP "Salut", OGK-5, 16, Budionny Ave., Moscow 105118 Russia

A TEM Study of the Effect of Platinum Group Metals in Advanced Single Crystal Nickel-Base Superalloys: *Anthony Paul Ofori*[1]; Colin J. Humphreys[1]; Sammy Tin[1]; C. Neil Jones[2]; [1]University of Cambridge, Matls. Sci. & Metall., New Museums Site, Pembroke St., Cambridge, Cambridgeshire CB2 3QZ UK; [2]Rolls-Royce plc, Technology - Metallurgy, PO Box 31, Derby DE24 8BJ UK

Some Effects of Carbon in the Production of Single Crystal Superalloy Castings: John R. Mihalisin[2]; John Corrigan[1]; *Michael G. Launsbach*[1]; Eric Leonard[1]; Robert Baker[3]; Brian Griffin[4]; [1]Howmet Castings, Corporate Engrg., 111 Rsch. Dr., Hampton, VA 23666 USA; [2]Howmet Dover Alloy, Dover, NJ USA; [3]Howmet Hampton Casting, Hampton, VA USA; [4]Howmet Research Corporation, Whitehall, MI USA

The Effects of Re, W and Ru on Microsegregation Behaviour in Single Crystal Superalloy Systems: *Rick M. Kearsey*[1]; J. C. Beddoes[2]; K. M. Jaansalu[3]; W. T. Thompson[3]; P. Au[1]; [1]Carleton University, Dept. of Mechl. & Aeros. Engrg., 1125 Colonel By Dr., Ottawa, Ontario K1S 5B6 Canada; [2]Carleton University, Dept. of Mechl. & Aeros. Engrg., Ottawa, ON Canada; [3]Royal Military College of Canada, Dept. of Chmst. & Chem. Engrg., Kingston, ON Canada

Partitioning of Elements in High Refractory Content Single Crystals Nickel Based Superalloys: *Eric C. Caldwell*[1]; Fermin J. Fela[1]; Gerhard E. Fuchs[1]; [1]University of Florida, MSE Dept., PO Box 116400, 116 Rhines Hall, Gainesville, FL 32611-6400 USA

Mechanism of Raft Formation of Gamma-Prime Precipitate in Single Crystal Ni-Base Superalloys: *Haruki Shiraishi*[1]; Makoto Osawa[1]; Tadaharu Yokokawa[1]; Hiroshi Harada[1]; [1]National Institute for Materials Science, High Temp. Matls. Grp., 1-2-1 Sengen, Tsukuba Science City, Ibaraki 305-0047 Japan

The Kinetics of the ' Phase and its Strain in the Nickel Base Superalloy SC16 Studied by In-Situ Neutron and Synchrotron Radiation Diffraction: *Giovanni Bruno*[1]; Haroldo Cavalcanti Pinto[2]; [1]Institute Laue Langevin, Diffraction Grp., 6, rue Horowitz, BP 156, Grenoble F-38042 France; [2]Technical University Berlin, Sekretariat BH 18, Ernst-Reuter-Platz 1, Berlin D-10578 Germany

Soldification Characteristics of Advanced Nickel-Base Single Crystal Superalloys: *Robbie Anthony Hobbs*[1]; S. Tin[1]; C. M.F. Rae[1]; R. W. Broomfield[2]; C. J. Humphreys[1]; [1]University of Cambridge, Matls. Sci. & Metall., Pembroke St., Cambridge, Cambridgeshire CB2 3QZ UK; [2]Rolls-Royce plc, PO Box 31, Derby DB24 8BJ UK

Blade Alloys II

Wednesday PM Room: Exhibit Hall
September 22, 2004 Location: Seven Springs Mountain Resort

Session Chairs: Maury Gell – University of Connecticut; Scott Walston – GE Aircraft Engines

8:45 PM
Femtosecond Laser Micromachining of Single-Crystal Superalloys: *Q. Feng*[1]; Y. N. Picard[1]; H. Liu[2]; S. M. Yalisove[1]; G. Mourou[2]; T. M. Pollock[1]; [1]University of Michigan, Matls. Sci. & Engrg., 2300 Hayward St., 3062 H. H. Dow, Ann Arbor, MI 48109 USA; [2]University of Michigan, Ctr. for Ultrafast Optical Sci., Ann Arbor 48109 USA

9:10 PM
Microstructural Stability and Creep of Ru-Containing Nickel-Base Superalloy: *Laura Jill Rowland*[1]; Qiang Feng[1]; Tresa M. Pollock[1]; [1]University of Michigan, Dept. of Matls. Sci. & Engrg., 3062 H.H. Dow Bldg., 2300 Hayward, Ann Arbor, MI 48109 USA

9:35 PM
Development of Ni Base Superalloy for Industrial Gas Turbine: *Ikuo Okada*[1]; Taiji Torigoe[1]; K. Takahashi[2]; D. Izutsu[2]; [1]Mitsubishi Heavy Industries, Ltd., Takasago R&D Ctr. Matls. & Strength Lab., 2-1-1 , Shinhama, Takasago, Hyogo 676-8686 Japan; [2]Mitsubishi Heavy Industries, Ltd., Takasago Machinery Works, 2-1-1 Shinhama Arai-cho, Takasago, Hyogo 676-8686 Japan

Thursday, September 23, 2004

Modeling and Simulation I

Thursday AM Room: Exhibit Hall
September 23, 2004 Location: Seven Springs Mountain Resort

Session Chairs: Jack Schirra – Pratt & Whitney; Dietmar Helm – MTU

8:30 AM
Modelling the Material Properties and Behaviour of Ni-Based Superalloys: *Nigel Saunders*[1]; Zhanli Guo[2]; Xiuqing Li[2]; Alfred Peter Miodownik[1]; Jean-Philippe Schille[2]; [1]Thermotech Ltd., Surrey Tech. Ctr., Surrey Rsch. Park, Guildford, Surrey GU2 7YG UK; [2]Sente Software Ltd., Surrey Tech. Ctr., Surrey Rsch. Park, Guildford, GU2 7YG UK

8:55 AM
Virtual Gas Turbine System for a New Alloy Design: *Tadaharu Yokokawa*[1]; Hiroshi Saeki[2]; Yoshitaka Fukuyama[3]; Toyoaki Yoshida[3]; Hiroshi Harada[1]; [1]National Institute for Materials Science, High Temp. Matls. Grp., 1-2-1 Sengen, Tsukuba Science City, Ibaraki 305-0047 Japan; [2]Toshiba Corporation, Advd. Thermal Power System Tech. Grp., 2-4 Suehiro-cho, Tsurumi-ku, Yokohama, Kanagawa 230-0045 Japan; [3]National Aerospace Laboratory, High-Temp. Turbine Grp., 7-44-1 Jindaiji-higashi, Chofu, Tokyo 182-8522 Japan

9:20 AM
On the Diffusion of Alloying Elements in the Nickel-Base Superalloys: Chong Long Fu[2]; *Roger C. Reed*[1]; Anderson Janotti[2]; Maja Krcmar[2]; [1]University of British Columbia, Dept. of Metals & Matls. Engrg., 309-6350 Stores Rd., Vancouver, BC V6T 1Z4 Canada; [2]Oak Ridge National Laboratory, Metals & Ceram. Div., PO Box 2008, Oak Ridge, TN 37830 USA

9:45 AM
PrecipiCalc™ Simulations for the Prediction of Microstructure/Property Variations in Aeroturbine Disks: *Herng-Jeng Jou*[1]; Peter Voorhees[2]; Gregory Olson[1]; [1]QuesTek Innovations LLC, 1820 Ridge Ave., Evanston, IL 60201 USA; [2]Northwestern University, Matls. Sci. & Engrg., Evanston, IL 60208 USA

10:10 AM Break

Modeling and Simulation II

Thursday AM Room: Exhibit Hall
September 23, 2004 Location: Seven Springs Mountain Resort

Session Chairs: Dietmar Helm – MTU; Jack Schirra – Pratt & Whitney

10:30 AM
A Fast Spreadsheet Model for the Yield Strength of Superalloys: *Triplicane A. Parthasarathy*[1]; Satish I. Rao[1]; Dennis M. Dimiduk[2]; [1]UES, Inc., 4401 Dayton Xenia Rd., Dayton, OH 45432 USA; [2]Air Force Research Laboratory, AFRL/MLLN, Matls. & Mfg. Direct., 2230 Tenth St., Rm. 058, Wright-Patterson AFB, OH 45433-7817 USA

10:55 AM
A Generic Microstructure-Explicit Model of Creep in Nickel-Base Superalloys: *Hector C. Basoalto*[1]; Sanjay Sondhi[1]; Brian F. Dyson[1]; Malcolm McLean[1]; [1]Imperial College London, Dept. of Matls., Exhibition Rd., London SW7 2AZ UK

11:20 AM
Numerical Simulation of Ring Rolling Process for Ni-Base Articles: *Takanori Matsui*[1]; Hideo Takizawa[2]; Hiroaki Kikuchi[3]; [1]Mitsubishi Materials Co., Ltd, Non-Ferrous Alloys Rsch. & Tech. Labs., 476 Shimoishido-Shimo, Kitamoto, Saitama 364-0023 Japan; [2]Mitsubishi Materials Co. Ltd, Central Rsch. Inst., 1-297 Kitabukuro-cho Omiya-ku, Saitama 330-8508 Japan; [3]Mitsubishi Materials Co. Ltd, Okegawa Plant, 1230 Kamihideya, Okegawa, Saitama 363-8510 Japan

11:45 AM
Modeling of Vacuum Arc Remelting of Alloy 718 Ingots: *Ashish D. Patel*[1]; Ramesh S. Minisandram[2]; David G. Evans[3]; [1]Carpenter Technology Corporation, 101 W. Bern St, Reading, PA 19601 USA; [2]Allvac, An Allegheny Technologies Company, 2020 Ashcraft Ave., Monroe, NC 28111 USA; [3]Special Metals Corporation, 4317 Middle Settlement Rd., New Hartford, NY 13413 USA

12:10 PM
Adjourn Symposium