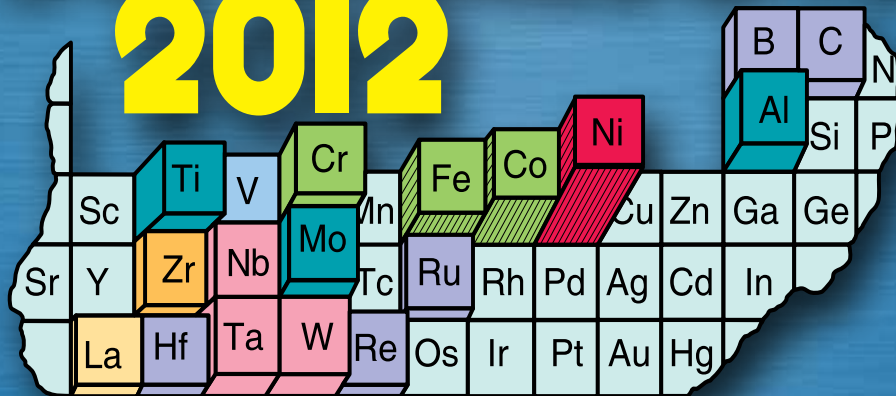


12th International Symposium on Superalloys

SUPERALLOYS 2012



September 9-13, 2012 • Seven Springs Mountain Resort
Seven Springs, Pennsylvania



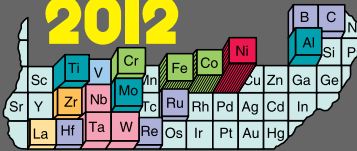
FINAL PROGRAM

In cooperation with

TMS

The Minerals, Metals & Materials Society

SUPERALLOYS 2012



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IHI	Banquet Cocktails
Institute of Metal Research (IMR)	Banquet Wine
Pratt & Whitney	Monday Meet and Greet
Rolls-Royce Corporation	Student Support
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Special Metals and Wyman Gordon	Monday Meet and Greet
Thermo-Calc Software	Student Support

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Special Events and Schedule

Opening Session: Sunday, 8 p.m.

Introductory Remarks: Roger Reed (Symposium Chair) and Eric Huron (Program Chair)

Keynote Introduction: Eric Huron (Program Chair)

Keynote Address: Sunday, 8:15 p.m.

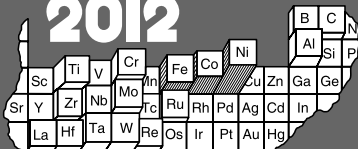
“Application of Materials and Process Modeling to the Design, Development, and Sustainment of Advanced Turbine Engines,” William. J. Gostic, Pratt & Whitney

Sunday

Registration	2 to 9 p.m.	Hotel Lobby
Dinner (at leisure)	4 to 8 p.m.	Slopeside Dining Room
Opening Session/Keynote	8 to 9:30 p.m.	Grand Ballroom
Open Cocktails	9:30 to 10:30 p.m.	Grand Ballroom
Hospitality Committee	10:30 p.m. to 1:30 a.m.	Suite

Monday

Breakfast	7 to 8:30 a.m.	Slopeside Dining Room
Registration	7:30 a.m. to 1 p.m.	Stag Pass
General Session I	8:30 a.m. to 1 p.m.	Exhibit Hall
Interactive Session/Coffee Break	10:10 to 11:20 a.m.	Exhibit Hall Annex
Leisure Activities	1 to 6 p.m.	
TMS High Temperature Alloys Technical Committee Meeting	2:30 to 4:00 p.m.	Wintergreen Room
2014 Superalloys 718 & Derivatives Conference Organizing Committee Meeting	4 to 5:00 p.m.	Wintergreen Room
Dinner (at leisure)	4 to 6:30 p.m.	Grand Ballroom
Registration	6 to 8 p.m.	Stag Pass
General Session II	6:30 to 10 p.m.	Exhibit Hall
Interactive Session/Coffee Break	7:45 to 8:45 p.m.	Exhibit Hall Annex
Beer Party/Entertainment	10 p.m. to 2 a.m.	Ski Lodge



Tuesday

Breakfast	7 to 8:30 a.m.	Slopeside Dining Room
Registration	7:30 a.m. to 12:00 p.m.	Stag Pass
General Session III	8:30 a.m. to 1 p.m.	Exhibit Hall
Interactive Session/Coffee Break	10:10 to 11:20 a.m.	Exhibit Hall Annex
Leisure Activities	1 to 6 p.m.	
Open Cocktails	6 to 7 p.m.	Grand Ballroom
Banquet	7 to 10 p.m.	Grand Ballroom
Hospitality Committee	10 p.m. to 1 a.m.	Suite

Wednesday

Breakfast	7 to 8:30 a.m.	Slopeside Dining Room
General Session IV	8:30 a.m. to 1 p.m.	Exhibit Hall
Interactive Session/Coffee Break	10:10 to 11:20 a.m.	Exhibit Hall Annex
Leisure Activities	1 to 6 p.m.	
Barbecue Dinner (group)	5 to 6:30 p.m.	Grand Ballroom
General Session V	6:30 to 10 p.m.	Exhibit Hall
Interactive Session/Coffee Break	7:45 to 8:45 p.m.	Exhibit Hall Annex

Thursday

Breakfast	7 to 8:30 a.m.	Slopeside Dining Room
General Session VI	8:30 a.m. to 12:10 p.m.	Exhibit Hall
Coffee Break	10:10 to 10:30 a.m.	Exhibit Hall Annex
Shuttle Bus Departure • 1 bus every 30 minutes	12:30 to 2 p.m.	Hotel Lobby

Meeting Information

Accommodations

Meals

The room and registration fee includes breakfast and dinner each day. Additional meal tickets can be purchased at the hotel front desk or from the dining room cashier.

Banquet

Non-symposium attendees who wish to attend the Tuesday night banquet should purchase tickets from the dining room cashier.

Transportation

- Bus transportation to Fallingwater is provided as part of the symposium and departs from the lobby outside of the Grand Ballroom.
- Bus transportation for the Pittsburgh International Airport is provided by the symposium and departs from the main hotel lobby at **12:30 p.m., 1 p.m., 1:30 p.m., and 2 p.m.** on Thursday.
- Alternate transportation may be arranged individually through the hotel bell hop desk by telephoning (814) 452-2223, extension 5.

Communication

A message board is posted near the hotel front desk and in Stag Pass. Symposium committee members are also available to answer attendee questions.

Speaker Breakfast

Breakfast tables have been reserved in the main dining room for session chairs and presenters on the day of their participation.

Policies

Badges

All attendees must wear registration badges at all times during the conference to ensure admission to events included in the paid fee.

Refunds

The deadline for all refunds was August 1, 2012. No refunds will be issued at the conference. Fees and tickets are nonrefundable.

Photography Notice

By registering for this conference, all attendees acknowledge that they may be photographed by conference personnel while at events and that those photos may be used for promotional purposes.

Audio/Video Recording Policy

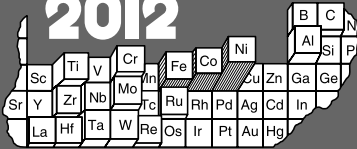
Recording of sessions (audio, video, still photography, etc.) intended for personal use, distribution, publication, or copyright without the express written consent of the Seven Springs International Symposium Committee and the individual authors is strictly prohibited.

Americans With Disabilities Act

The federal Americans with Disabilities Act (ADA) prohibits discrimination against, and promotes public accessibility for, those with disabilities. In support of, and in compliance with ADA, we ask those requiring specific equipment or services to contact the Seven Springs International Symposium Committee in advance.

Cell Phone Use

In consideration of attendees and presenters, we kindly request that you minimize disturbances by setting all cell phones or PDAs on "silent" while in meeting rooms.



12th International Symposium on Superalloys Committee

The symposium committee is comprised of individuals from various industrial companies, institutions and universities that study, make, use or sell materials used in high-temperature, high-strength applications. The primary function of the committee is to arrange an international symposium on superalloys, held every four years.

General Chair	Roger Reed , <i>University of Birmingham</i>
Secretary	Sammy Tin , <i>Illinois Institute of Technology</i>
Treasurer	Gern Maurer , <i>ASM International</i>
Program Chair	Eric Huron , <i>GE Aviation</i>
Program Committee	Roger Reed , <i>University of Birmingham</i>
	Mark Hardy , <i>Rolls-Royce plc</i>
	Mike Mills , <i>Ohio State University</i>
	Rick Montero , <i>Pratt & Whitney</i>
	Pedro Portella , <i>BAM</i>
	Jack Telesman , <i>NASA Glenn Research Center</i>
Publications Chair	Rick Montero , <i>Pratt & Whitney</i>
Arrangements Chair	David Novotnak , <i>Carpenter Technology Corp.</i>
U.S. Publicity	Jacqueline Wahl , <i>Cannon-Muskegon Corp.</i>
International Publicity/Student Relations	Cathie Rae , <i>University of Cambridge</i>
Asian Publicity	Akihiro Sato , <i>IHI Corporation</i>
Awards Chair	Ken Green , <i>Rolls-Royce Corporation</i>
Awards Committee	Tresa Pollock , <i>University of California-Santa Barbara</i>
	Bob Stusrud , <i>Rolls-Royce Corporation</i>
	Bob Kissinger , <i>GE Aviation</i>

The symposium committee would like to express its gratitude to the organizations that employ its volunteer members for supporting their efforts to arrange the conference.

The Seven Springs International Symposium Committee works in cooperation with The Minerals, Metals & Materials Society (TMS) and its High Temperature Alloys Committee.

For information about TMS, visit www.tms.org.

The 12th International Symposium for Superalloys is dedicated to Dr. Anthony Giamei, for his substantial and pioneering contributions to our field, in particular related to directional solidification of single crystal turbine blade alloys.

Dr. Giamei's career extended over 35 years. Given the theme of this year's symposium, which seeks to highlight advances in superalloys made possible by practical application of modeling and simulation, Dr. Giamei is a most appropriate honoree.

Dr. Giamei's career began with practical experiments in blade casting technology, leading to a key superalloy technology of directional solidification, and in particular, he led the development of effective processing techniques to grow single crystals to turn this idea into reality, and he ultimately led the P&W computational modeling group, and was a pioneer in use of computer modeling in casting and other metallurgical applications.



The 12th International Symposium
for Superalloys Dedicattee

Dr. Anthony Giamei

**Join us at a banquet ceremony in Dr. Giamei's honor on
Tuesday at 6 p.m. in the Grand Ballroom.**

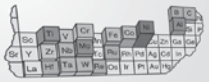
Note to the Speakers

Speakers with oral presentations should prepare their presentation files in advance of their session.

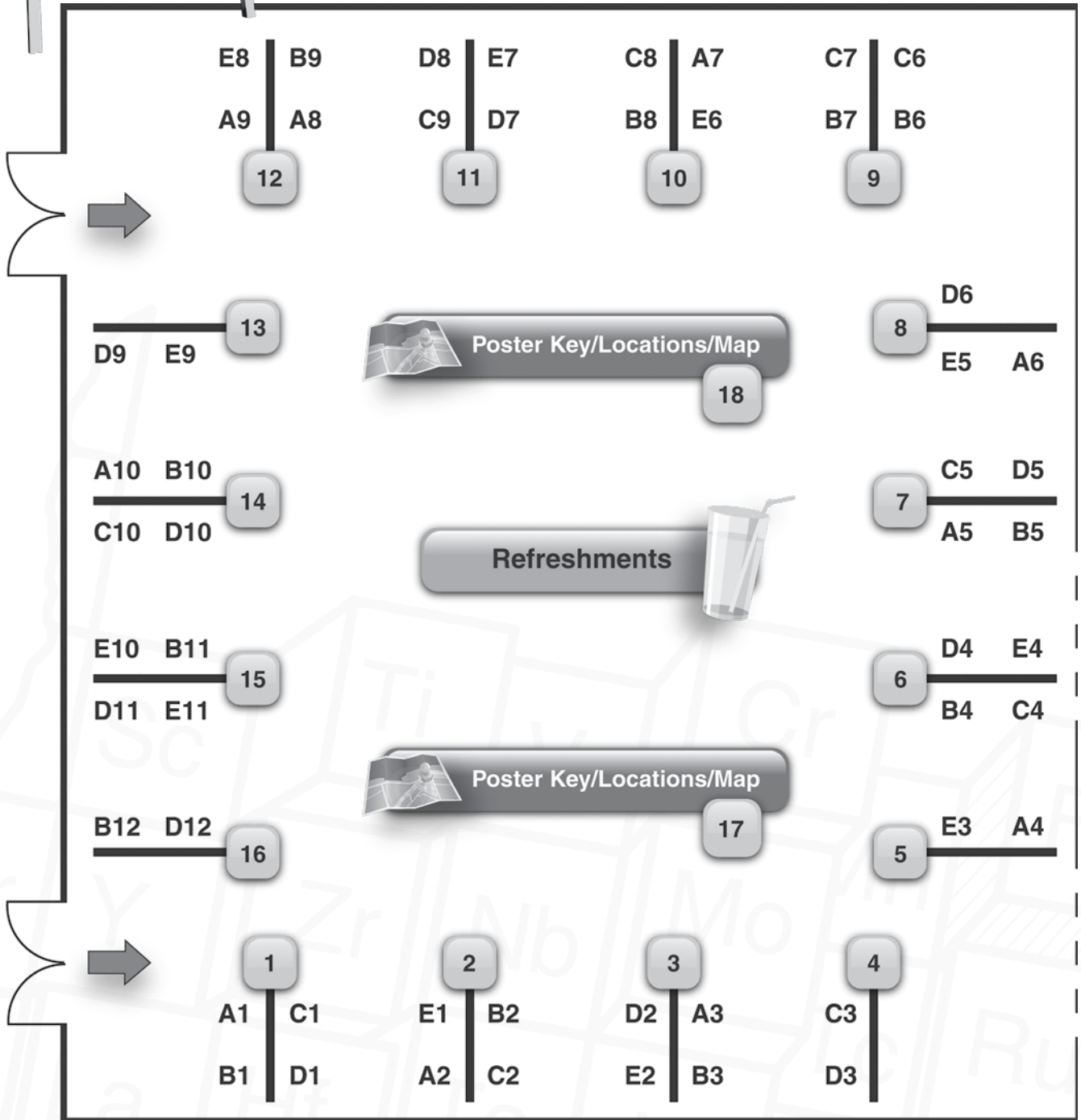
If your talk is scheduled from:	Then set up your computer for presentation:
8:30 to 9:45 a.m.	the morning before the session
11:20 a.m. to 12:35 p.m.	during the interactive session beforehand
6:30 to 7:20 p.m.	the afternoon before the evening session begins
8:45 to 9:35 p.m.	during the evening interactive session

Each presenter is asked to pre-load his or her presentation onto his or her computer. Any non-standard adaptors are the responsibility of the speaker. Alternatively, a presentation may be loaded onto a CD or a flash drive for use with the single laptop computer provided by the Conference. Speakers are encouraged to familiarize themselves with the presentation arrangements before their session.

Speakers with interactive presentations are expected to be present at their poster for the duration of the session to review their work with interested audience members. The posters for interactive sessions should be set up on Sunday by 10:30 p.m. and left in place until Thursday morning. Posters should be removed on Thursday by the end of the conference. Unclaimed posters will be discarded.



Poster Layout for Interactive Sessions



Keynote

Sunday PM
September 9, 2012

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chair: Eric Huron, GE Aviation; Roger Reed, University of Birmingham

8:00 PM Introductory Remarks: Roger Reed, Symposium Chair and Eric Huron, Program Chair

8:15 PM

Application of Materials and Process Modeling to the Design, Development, and Sustainment of Advanced Turbine Engines: *William Gostic*¹; ¹Pratt & Whitney

Mechanisms/Models for Mechanical Behavior I

Monday AM
September 10, 2012

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chair: Eric Huron, GE Aviation; Xishan Xie, University of Science & Technology, Beijing

8:30 AM

Mechanical Behavior and Damage Processes of Udimet 720Li: Influence of Localized Plasticity at Grain Boundaries : *Patrick Villechaise*¹; Jonathan Cormier¹; Thomas Billot²; Jose Mendez; ¹ENSMA/P¹ Institute - UPR CNRS 3346; ²Snecma - SAFRAN Group

8:55 AM

Deformation Mechanisms Coupled with Phase Field and Crystal Plasticity Modeling in a High-temperature Polycrystalline Ni-based Superalloy: *Hallee Deutchman*¹; Patrick Phillips¹; Ning Zhou¹; Mahendra Samal¹; S Ghosh²; Yunzhi Wang¹; Michael Mills¹; ¹Ohio State University; ²Johns Hopkins University

9:20 AM

Controlling the Deformation Mechanism in Disk Superalloy at Low and Intermediate Temperatures: *Yong Yuan*¹; Yue Gu¹; Zhi Zhong¹; Toshio Osada¹; Tadaharu Yokokawa¹; Hiroshi Harada¹; ¹National Institute for Materials Science

9:45 AM

Characterization of Strain Accommodation at Grain Boundaries of Nickel-based Superalloys: *Jennifer Carter*¹; Ning Zhou¹; John Sosa¹; Paul Shade²; Adam Pilchak²; Michael Kuper¹; Yunzhi Wang¹; Hamish Fraser¹; Michael Uchic²; Michael Mills¹; ¹The Ohio State University; ²Air Force Research Laboratory

Interactive Session A: Mechanisms/Models for Mechanical Behavior (10:10 AM)

Monday AM
September 10, 2012

Room: Exhibit Hall Annex
Location: Seven Springs Mountain Resort

A1: On the Mechanism of Serrated Grain Boundary Formation in Ni-based Superalloys with Low γ' Volume Fraction: *Hyun Uk Hong*¹; In Soo Kim¹; Baig Gyu Choi¹; Young Soo Yoo¹; Chang Yong Jo¹; ¹Korea Institute of Materials Science

A2: Fatigue Failure Modes of the Grain Size Transition Zone in a Dual Microstructure Disk: *Tim Gabb*¹; Pete Kantzos²; Bonny Palsa³; Jack Telesman¹; John Gayda¹; Chantal Sudbrack¹; ¹NASA Glenn Research Center; ²Honeywell Engine Systems; ³McGraw-Hill Companies, Inc.

A3: Understanding and Modeling of Grain Boundary Pinning in Inconel 718: *Andrea Agnoli*¹; Marc Bernacki¹; Roland Logé¹; Jean-Michel Franchet²; Johanne Laigo²; Nathalie Bozzolo¹; ¹Cemef; ²Snecma Gennevilliers

A4: Nanoindentation and Nano-compression Testing of Ni3Al Precipitates: *Bin Gan*¹; Hideyuki Murakami²; Robert Maaß³; Lucas Meza³; Julia Greer³; Takahito Ohmura²; Sammy Tin¹; ¹Illinois Institute of Technology; ²National Institute for Materials Science; ³California Institute of Technology

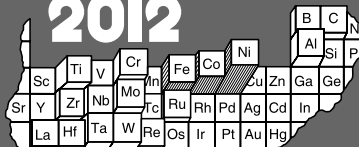
A5: Local Fracture Toughness and Residual Stress Measurements on NiAl Bond Coats by Micro Cantilever and FIB-based Bar Milling Tests: *Ralf Webler*¹; Markus Krottenthaler¹; Steffen Neumeier¹; Karsten Durst¹; Mathias Göken¹; ¹University Erlangen-Nuremberg

A6: The Localization of Strain in Low Solvus High Refractory (LSHR) Nickel Superalloy: *Samuel Kuhr*¹; Gopal Viswanathan²; Jaimie Tiley²; Hamish Fraser¹; ¹The Ohio State University; ²Air Force Research Laboratory

A7: Coupled Analysis of Microstructure Evolution with Creep Deformation in Nickel-based Superalloys by the Phase-field Method: *Yuhki Tsukada*¹; Yoshinori Murata²; Toshiyuki Koyama¹; Nobuhiro Miura³; Yoshihiro Kondo³; ¹Nagoya Institute of Technology; ²Nagoya University; ³National Defense Academy

A8: New Quantitative Analysis of Contributing Factors to Strength of Disk Superalloys: *Toshio Osada*¹; Yuefeng Gu¹; Nobuo Nagashima¹; Yong Yuan¹; Tadaharu Yokokawa¹; Hiroshi Harada¹; ¹National Institute for Materials Science, Japan

A9: Integration and Automation of Residual Stress and Service Stress Modeling for Superalloy Component Design: *Gangshu Shen*¹; Nate Cooper²; Nathan Ottow²; Robert Goetz²; John Matlik²; ¹Rolls-Royce Corporation; ²Rolls-Royce Corporation



A10: Structural Stability of Topologically Close-packed Phases: Understanding Experimental Trends in Terms of the Electronic Structure: *Thomas Hammerschmidt*¹; Bernhard Seiser²; Miroslav Cak¹; Ralf Drautz²; David Pettifor²; ¹ICAMS, Ruhr-University Bochum; ²University of Oxford

Mechanisms/Models for Mechanical Behavior II

Monday AM
September 10, 2012

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chair: Eric Huron, GE Aviation; Xishan Xie, University of Science & Technology, Beijing

11:20 AM

The Variability of Fatigue in Notched Bars of IN100: *Andrew Rosenberger*¹; Dennis Buchanan²; D'Anthony Ward³; Sushant Jha⁴; ¹AFRL; ²UDRI; ³SOCHÉ; ⁴Universal Technology Corp

11:45 AM

Grain Boundary Deformation and Fracture Mechanisms in Dwell Fatigue Crack Growth in Turbine Disk Superalloy ME3: *Jinesh Dahal*¹; *Kimberly Maciejewski*¹; Hamouda Ghonem¹; ¹University of Rhode Island

12:10 PM

Grain Scale Crystal Plasticity Model with Slip and Microtwinning for a Third Generation Ni-base Disk Alloy: *Jin Song*¹; David McDowell¹; ¹Georgia Institute of Technology

12:35 PM

Influence of γ' Precipitate Size and Distribution on LCF Behavior of a PM Disk Superalloy: *Guylaine Boittin*¹; *Didier Locq*¹; Alain Rafray¹; Pierre Caron¹; Pascale Kanouté¹; Franck Gallerneau¹; Georges Cailletaud¹; ¹Onera

Single Crystal Alloys & Behavior I

Monday PM
September 10, 2012

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chair: Jack Telesman, NASA GRC; Mike Nathal, NASA GRC

6:30 PM

New Single Crystal Superalloys, CMSX®-7 and CMSX®-8: *Jacqueline Wahl*¹; Ken Harris¹; ¹Cannon-Muskegon

6:55 PM

Development of an Oxidation-resistant High-strength Sixth-generation Single-crystal Superalloy TMS-238: *Kyoko Kawagishi*¹; An-Chou Yeh¹; Tadaharu Yokokawa¹; Toshiharu Kobayashi¹; Yutaka Koizumi¹; Hiroshi Harada¹; ¹National Institute for Materials Science

7:20 PM

A New Single Crystal Superalloy for Power Generation Applications: *Roger Reed*¹; J. Moverare²; A. Sato¹; F. Karlsson³; M. Hasselqvist³; ¹University of Birmingham; ²Linköping University & Siemens Industrial Turbomachinery AB Materials Technology; ³Siemens Industrial Turbomachinery AB Materials Technology

Interactive Session B: Single Crystal Alloys & Behavior (7:45 PM)

Monday PM
September 10, 2012

Room: Exhibit Hall Annex
Location: Seven Springs Mountain Resort

B1: Influence of Ruthenium on Topologically Close Packed Phase Precipitation in Single-crystal Ni-based Superalloys: Numerical Experiments and Validation: *Ralf Rettig*¹; Robert Singer¹; ¹University of Erlangen

B2: Deformation and Damage Mechanisms during Thermomechanical Fatigue of a Single-crystal Superalloy in the <001> and <011> Directions: *Mikael Segersäll*¹; Johan Moverare¹; Kjell Simonsson¹; Sten Johansson¹; ¹Linköping University

B3: The Effect of Crystal Orientation and Temperature on Fatigue Crack Growth of Ni-based Single Crystal Superalloy: *Hiroyuki Kagawa*¹; *Yasuhiro Mukai*¹; ¹The Kansai Electric Power Co. Inc

B4: Comparison of the Mechanical Behavior and Evaluation of Different Damage Mechanisms in an Equiaxed and a Single Crystal Superalloys Subjected to Creep LCF and TMF: *Erica Vacchieri*¹; Alessio Costa¹; ¹Ansaldo Energia S.p.A.

B5: Microstructural Evolution of Single Crystal and Directionally Solidified Rejuvenated Nickel Superalloys: *Andrew Rowe*¹; Jon Wells¹; Geoff West²; Rachel Thomson²; ¹RWEnpower; ²Loughborough University

B6: Development of Ni Based DS Superalloy with Excellent Oxidation Resistance and LCF Properties for Power-generation Gas Turbines: *Akira Yoshinari*¹; Osam Tamura²; Yoshinori Murata³; Masahiko Morinaga⁴; ¹Hitachi; ²The Kansai Electric Power Company, Inc.; ³Nayoga University; ⁴Nagoya University

B7: Effect of the Prior Microstructure Degradation on the High Temperature/Low Stress Non-isothermal Creep Behavior of CMSX-4® Ni-based Single Crystal Superalloy: *Rémi Giraud*¹; Jonathan Cormier²; Zéline Hervier³; Denis Bertheau²; Ken Harris⁴; Jacqueline Wahl⁴; Xavier Milhet²; José Mendez²; Antoine Organista³; ¹Turbomeca - Safran Group / Pprime institute; ²Pprime Institut, CNRS - ENSMA - Université de Poitiers, UPR CNRS 3346; ³Turbomeca - SAFRAN Group; ⁴Cannon Muskegon Corporation

B8: A Proposal on Quantitative Treatment of Multiple Cracks Nucleating in Single Crystal Superalloys: *Yasuhiro Mukai*¹; Hiroyuki Kagawa¹; ¹The Kansai Electric Power Co.Inc

B9: Quantitative Analysis of Creep Strengthening Factors in Ni-base Single Crystal Superalloys: *Tadaharu Yokokawa*¹; Hiroshi Harada¹; Kyoko Kawagishi¹; Yutaka Koizumi¹; Toshiharu Kobayashi¹; ¹National Institute for Materials Science

B10: Low Cycle Fatigue of CMSX-4 in Off-axis Orientations and the Effect of a Multi-axial Stress State: *Nicholas Barnard*¹; Duncan MacLachlan²; Neil Jones²; Julian Mason-Flucke²; Stephen Bagnall²; Martin Bache¹; ¹Swansea University; ²Rolls-Royce plc

B11: Effects of Y and La Additions on the Processing and Properties of a Second Generation Single Crystal Nickel-base Superalloy CMSX-4: *Hon Pang*¹; Ian Edmonds²; Colin Jones²; Howard Stone¹; Catherine Rae¹; ¹Cambridge University; ²Rolls-Royce plc

B12: Influence of Crystallographic Orientation on Creep Behavior of Aluminized Ni-base Single Crystal Superalloys: *Fahamsyah Hamdan Latief*¹; Koji Kakehi¹; Hideyuki Murakami²; Kazuki Kasai³; ¹Tokyo Metropolitan University; ²National Research Institute for Materials Science; ³Shibaura Institute of Technology

Single Crystal Alloys & Behavior II

Monday PM
September 10, 2012
Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chair: Jack Telesman, NASA GRC; Mike Nathal, NASA GRC

8:45 PM
Prediction of Initial Oxidation Behavior of Ni-base Single Crystal Superalloys: A New Oxidation Map and Regression Analysis: *Aya Suzuki*¹; Kyoko Kawagishi¹; Tadaharu Yokokawa¹; Toshiharu Kobayashi¹; Hiroshi Harada¹; ¹National Institute for Materials Science

9:10 PM
Modeling of the Influence of Oxidation on Thin-walled Specimens of Single Crystal Superalloys: Matthias Bensch¹; Atsushi Sato²; Nils Warnken²; Ernst Affeldt³; Roger Reed²; *Uwe Glatzel*¹; ¹University of Bayreuth; ²University of Birmingham; ³MTU Aero Engines GmbH

9:35 PM
Rejuvenation of Ni-based Superalloys GTD444(DS) and René N5(SX): *Luke Reitberg*¹; Masafumi Tsunekane²; Tresa Pollock¹; ¹University of California Santa Barbara; ²Brown University

Creep & Fatigue I

Tuesday AM
September 11, 2012
Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chairs: Pedro D. Portella, Federal Institute of Testing and Materials BAM; Tresa Pollock, University of California Santa Barbara

8:30 AM
Stress Rupture and Fatigue in Thin Wall Single Crystal Superalloys with Cooling Holes: *Eugene Sun*¹; Tab Heffernan¹; Randy Helmink¹; ¹Rolls Royce Corporation

8:55 AM
Evolution of Grain Boundary Precipitates in a Directionally Solidified Ni-base Superalloy during High Temperature Creep: Dong Wang¹; Chang Liu¹; *Jian Zhang*¹; Langhong Lou¹; ¹Institute of Metal Research, Chinese Academy of Sciences

9:20 AM
Thermomechanical Fatigue of Single-crystal Superalloys - Influence of Composition and Microstructure: *Johan Moverare*¹; Mikael Segersäll¹; Atsushi Sato²; Sten Johansson¹; Roger Reed²; ¹Linköping University; ²University of Birmingham

9:45 AM
Processing to Fatigue Properties: Benefits of High Gradient Casting for Single Crystal Airfoils: *Clinique L. Brundidge*¹; Tresa M. Pollock²; ¹University of Michigan; ²University of California Santa Barbara

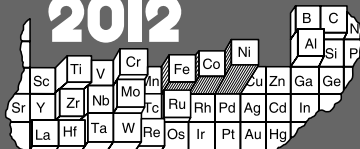
Interactive Session C: Creep & Fatigue (10:10 AM)

Tuesday AM
September 11, 2012
Room: Exhibit Hall Annex
Location: Seven Springs Mountain Resort

C1: Secondary Creep of Thin-walled Specimens Affected by Oxidation: *Matthias Bensch*¹; Ernst Fleischmann¹; Christian Konrad¹; Markus Fried²; Catherine Rae³; Uwe Glatzel¹; ¹University of Bayreuth; ²MTU Aero Engines GmbH; ³University of Cambridge

C2: Sustained Macroscopic Deflected Fatigue Crack Growth in Nickel Based Superalloy 720Li: *Christian Schoettle*¹; Philippa Reed¹; Marco Starink¹; Ian Sinclair¹; Dan Child²; Geoff West²; Rachel Thomson²; ¹University of Southampton; ²Loughborough University

C3: Analysis of Deformation Substructures in a Notched LCF Sample under Dwell Condition in a Ni-based Superalloy: *G. B. Viswanathan*¹; K. Bain²; D. Huber³; S. Jha¹; S. Sam³; J. Tiley¹; C. Woodward¹; H.L. Fraser³; ¹Air Force Research Laboratory; ²GE Aviation; ³The Ohio State University



C4: Effect of Thermal Cycling on High Temperature Creep of Coated CMSX-4: *Raphaël Goti*¹; Bernard Viguier²; Fabrice Crabos³; ¹TURBOMECA-SAFRAN Group / Institut Carnot CIRIMAT, ENSIACET-INPT; ²Institut Carnot CIRIMAT, ENSIACET-INPT; ³TURBOMECA-SAFRAN Group

C5: Relative Contributions of Secondary and Tertiary γ' Precipitates to Intergranular Crack Growth Resistance in IN100 Alloy: *Kimberly Maciejewski*¹; Hamouda Ghonem¹; ¹University of Rhode Island

C6: Fatigue Crack Propagation in Thin-wall Superalloys Component; Experimental Investigation via Miniature CT Specimen: *Motoki Sakaguchi*¹; Takeshi Tsuru¹; Masakazu Okazaki¹; ¹Nagaoka University of Technology

C7: An Analysis of Fatigue Crack Initiation using 2D Orientation Mapping and Full-field Simulation of Elastic Stress Response: *Clayton Stein*¹; Sukbin Lee¹; Anthony Rollett¹; ¹Carnegie Mellon University

C8: Specific Failures of Superalloys with Thermal Barrier Coatings Subjected to Thermo-mechanical Fatigue Loadings with a Thermal Gradient in a Simulated Combustion Environment: *Masakazu Okazaki*¹; Satoshi Yamagishi¹; Motoki Sakaguchi¹; Subramanian Rajivgandhi¹; ¹Nagaoka University Of Technology

C9: Effects of Alloying Elements on Elastic, Stacking Fault and Diffusion Properties of Fcc Ni from First-principles: Implications for Tailoring the Creep Rate of Ni-base Superalloys: *Chelsey Zacher*¹; ShunLi Shang¹; DongEung Kim¹; Yi Wang¹; Zi-Kui Liu¹; ¹The Pennsylvania State University

C10: The Effect of Carbide Decomposition and Reformation on Rupture Lives of IN738LC during Multiple Reheat Treatment and Degradation Cycles: *Siavash Pahlavanyali*¹; Mike Wood¹; Geoff Merchant²; ¹ERA Technology; ²Siemens Industrial Turbomachinery

Creep & Fatigue II

Tuesday AM
September 11, 2012

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chairs: Pedro D. Portella, Federal Institute of Testing and Materials BAM; Tresa Pollock, University of California Santa Barbara

11:20 AM
A New Approach to Modeling of Creep in Superalloys: *Ramkumar Oruganti*¹; Mallikarjun Karadge¹; Sachin Nalawade¹; Sivakumar Kelakanjeri¹; Francesco Mastromatteo²; ¹GE Global Research; ²GE Oil and Gas

11:45 AM
Physics-based Modeling of Thermo-mechanical Fatigue in PWA 1484: *Robert Amaro*¹; Stephen Antolovich²; Richard Neu²; Alexander Staroselsky³; ¹NIST; ²Georgia Tech; ³Pratt & Whitney

12:10 PM
Rafting during High Temperature Deformation in a Single Crystal Superalloy: Experiments and Modeling: *Bernard Fedelich*¹; Alexander Epishin²; Thomas Link²; Hellmuth Klingelhoefer¹; Georgia Kunecke¹; Pedro Portella¹; ¹BAM; ²Technical University Berlin

12:35 PM
Cyclic Dwell Fatigue Behavior of Single Crystal Ni-base Superalloys With/Without Rhenium: *Scott Yandt*¹; Xijia Wu¹; Nobuyasu Tsuno²; Akihiro Sato²; ¹National Research Council Canada; ²IHI Corporation

Models for Processes & Properties I

Wednesday AM
September 12, 2012

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chairs: Michael Mills, The Ohio State University; David Furrer, Pratt & Whitney

8:30 AM
Direct Laser Fabrication of INCONEL-718: Effects on Distortion and Microstructure: *Lakshmi Parimi*¹; Moataz Attallah¹; Jean-Christophe Gebelin¹; Roger Reed¹; ¹University of Birmingham

8:55 AM
Effect of Off-stoichiometry and Ternary Additions on Planar Fault Energies in Ni₃Al: *K V Vamsi*¹; S Karthikeyan¹; ¹Indian Institute of Science

9:20 AM
Numerical Simulation of Microstructures Formation during Solidification and Heat Treatments of Ni Base Superalloys: *Luc Rougier*¹; Alain Jacot¹; Charles-André Gandin²; Paolo Di Napoli¹; Pierre-Yvan Théry³; V. Jaquet⁴; ¹EPFL; ²CNRS MINES ParisTech; ³Snecma - Groupe Safran; ⁴Snecma-SAFRAN Group

9:45 AM
Molecular-Dynamics Simulations of Molten Ni-based Superalloys: *Christopher Woodward*¹; James Lill²; Mark Asta³; Dallas Trinkle⁴; ¹Air Force Research Laboratory; ²High Performance Technologies Inc; ³University of California, Berkeley; ⁴University of Illinois, Urbana-Champaign

Interactive Session D: Models for Processes & Properties (10:10 AM)

Wednesday AM
September 12, 2012

Room: Exhibit Hall Annex
Location: Seven Springs Mountain Resort

D1: Prediction of Plastic Strain for Recrystallization during Investment Casting of Single Crystal Superalloys: *Chinnapat Panwisawas*¹; Harshal Mathur²; Jean-Christophe Gebelin¹; Duncan Putman³; Paul Withey³; Nils Warnken¹; Catherine Rae²; Roger Reed¹; ¹PRISM2, The University of Birmingham; ²The University of Cambridge; ³Rolls-Royce plc

D2: Progress of Research on P/M and Spray-formed Superalloy in ISCPM, USTB: *Changchun Ge*¹; Yu Zhang¹; Yi Xu²; Weiping Shen¹; Yuchun Zhang³; Hao Wu⁴; ¹University of Science and Technology Beijing; ²Southwest Jiaotong University; ³Fushun Special Steel Shares Co., Ltd; ⁴Guizhou Anda Aviation Forging Co., Ltd

D3: Weld Solidification Behavior of Ni-base Superalloys for Use in Advanced Supercritical Coal-fired Power Plants: *David Tung*¹; John Lippold¹; ¹The Ohio State University

D4: Sputtered Ni-base Superalloys for Microscale Devices: *Devin Burns*¹; Yong Zhang¹; Timothy Weihs¹; Kevin Hemker¹; ¹Johns Hopkins University

D5: Laser Powder Bed Fabrication of Nickel-base Superalloys: Influence of Parameters; Characterisation, Quantification and Mitigation of Cracking: *Luke Carter*¹; Moataz Attallah¹; Roger Reed¹; ¹University of Birmingham

D6: On Liquefaction and Liquid Phase Oxidation during Linear Friction Welding of Nickel-base IN 738 and CMSX 486 Superalloys: Mark Amegadzie¹; *Oyedele Ola*¹; Olanrewaju Ojo¹; Priti Wanjara²; Mahesh Chaturvedi¹; ¹University of Manitoba; ²National Research Council Canada

D7: Microstructure Development during Controlled Directional Solidification in Alloy 718: *Ashish Patel*¹; Jill Erbrick; Karl Heck; Germant Maurer²; ¹Carpenter Technology Corporation; ²Carpenter Technology Corp

D8: Interfaces in Ni-based Superalloys and Implications for Mechanical Behavior and Environmental Embrittlement: A First-principles Study: *Suchismita Sanyal*¹; Umesh Waghmare²; Timothy Hanlon¹; Ernest Hall¹; PR Subramanian¹; Michael Gigliotti¹; ¹General Electric; ²Jawaharlal Nehru Centre for Advanced Scientific Research

D9: Effects of Hammer Peening and Aging Treatment on Microstructure, Mechanical Properties and Corrosion Resistance of Oil-grade Alloy 718: Ting Chen¹; Hendrik John²; Jing Xu²; Jeffrey Hawk³; *Xingbo Liu*¹; ¹West Virginia University; ²Baker Hughes; ³National Energy Technology Laboratories

D10: Dendrite Bending during Directional Solidification: *John Aveson*¹; Guillaume Reinhart²; Henri Nguyen-Thi²; Nathalie Mangelinck-Noël³; Amina Tandjaoui²; Bernard Billia³; Kevin Goodwin⁴; Tamzin Lafford³; J. Baruchel⁵; Howard Stone¹; Neil D'Souza⁴; ¹University of Cambridge; ²Aix-Marseille University & IM2NP CNRS; ³IM2NP CNRS; ⁴Rolls-Royce plc.; ⁵European Synchrotron Radiation Facility

D11: A Closed Concept to Associate the Hot-forging Process Controlled Microstructure with Fatigue Life: *Michael Stoschka*¹; Martin Stockinger²; Hermann Maderbacher¹; Martin Riedler²; ¹Montanuniversität Leoben; ²Böhler Schmiedetechnik GmbH&Co KG

D12: Polycrystalline γ (Ni)/ γ' (Ni₃Al)- δ (Ni₃Nb) Eutectic Ni-base Superalloys: Chemistry, Solidification and Microstructure: *Mengtao Xie*¹; Randolph Helmink²; Sammy Tin¹; ¹Illinois Institute of Technology; ²Rolls-Royce North American Technologies, Inc.

Models for Processes & Properties II

Wednesday AM
September 12, 2012

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chairs: Michael Mills, The Ohio State University; David Furrer, Pratt & Whitney

11:20 AM

Two Integrated Experimental and Modeling Approaches to Study Strain Distributions in Nickel and Nickel-base Superalloy Polycrystals: *Todd Turner*¹; Paul Shade¹; Jay Schuren¹; Michael Groeber¹; Matthew Miller²; Michael Uchic¹; ¹Air Force Research Laboratory; ²Cornell University

11:45 AM

Development and Application of an Optimization Protocol for Directional Solidification: Integrating Fundamental Theory, Experimentation and Modeling Tools: *Jonathan Miller*¹; Tresa Pollock²; ¹AFRL/RXLM; ²University of California, Santa Barbara

12:10 PM

INCONEL718 Single and Multipass Modelling of Hot Forging: *Julien de Jaeger*¹; Denis Solas²; Thierry Baudin²; Olivier Fandeur³; Jean-Hubert Schmitt¹; Colette Rey¹; ¹MSSMat, Ecole Centrale Paris; ²ICMMO, Univ Paris Sud; ³CEA, Saclay

12:35 PM

Computational Fluid Dynamics Modelling of Heat Treatment of Single Crystal Nickel Based Superalloys for Turbine Blade Application: *Francesco Cosentino*¹; Nils Warnken¹; Jean-Christophe Gebelin¹; Robert Broomfield¹; Roger Reed¹; ¹University of Birmingham

Alloy & Coating Development I

Wednesday PM
September 12, 2012

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

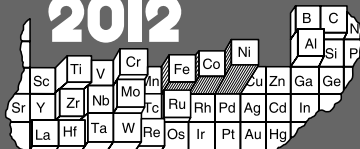
Session Chairs: Mark Hardy, Rolls-Royce plc; Sammy Tin, Illinois Institute of Technology

6:30 PM

Alloying Effects in the γ' Phase of Co-based Superalloys: *Alessandro Mottura*¹; Anderson Janotti¹; Tresa Pollock¹; ¹University of California, Santa Barbara

6:55 PM

Creep Strength and Microstructure of Polycrystalline γ' - Strengthened Cobalt-base Superalloys: Alexander Bauer¹; Steffen Neumeier¹; Florian Pyczak²; *Mathias Göken*¹; ¹University Erlangen-Nürnberg; ²Helmholtz-Zentrum Geesthacht



7:20 PM

Quaternary Alloying Effects and the Prospects for a New Generation of Co-base Superalloys: Hui-Yu Yan¹; Vassili Vorontsov¹; James Coakley²; Nicholas Jones¹; Howard Stone³; *David Dye*¹; ¹Imperial College London; ²Imperial College; ³University of Cambridge

Interactive Session E: Alloy & Coating Development (7:45 PM)

Wednesday PM
September 12, 2012

Room: Exhibit Hall Annex
Location: Seven Springs Mountain Resort

E1: Dynamic Strain Aging in Ni Base Alloys with Different Stacking Fault Energy: *Chuangyong Cui*¹; C. Tian¹; Y. Zhou¹; T. Jin¹; X. Sun¹; ¹Institute of Metal Research

E2: The Effect of Water Vapor and Superalloy Composition on Thermal Barrier Coating Lifetime: *Bruce Pint*¹; James Haynes¹; Kinga Unocic¹; Ying Zhang²; ¹Oak Ridge National Laboratory; ²Tennessee Tech. Univ.

E3: Potential of the Halogen Effect for the Formation of a Protective Alumina Scale on Ni-base Superalloys: *Hans-Eberhard Zschau*¹; Michael Schütze¹; ¹Dechema e. V.

E4: Environmental and Dwell Effects on the Damage Tolerance Properties of ATI 718Plus® Alloy: *Rick Kearsey*¹; Jonathan Tsang¹; Scott Oppenheimer²; Erin McDevitt²; ¹National Research Council of Canada; ²ATI Allvac

E5: Microstructural Characterisation of High Temperature Oxidation of Nickel Base Superalloy RR1000 and the Effect of Shot-peening: Sam Cruchley¹; *Mary Taylor*¹; H. Evans¹; P. Bowen¹; M. Hardy²; S. Stekovic²; ¹University of Birmingham; ²Rolls-Royce plc

E6: Experimental Determination of TTT Diagram for Alloy 718Plus®: Dheepa Srinivasan¹; Leah Lawless²; *Eric Ott*²; ¹GE John F Welch Technology Center; ²GE Aviation

E7: Development of a New 760°C (1400°F) Capable Low Thermal Expansion Alloy: *Michael Fahrman*¹; Krishna Srivastava¹; Lee Pike¹; ¹Haynes International Inc.

E8: Low Cycle Fatigue Behavior of a New Wrought Ni-Co-base Disk Superalloy TMW-4M3: *Zhihong Zhong*¹; Yuefeng Gu¹; Yong Yuan¹; Toshio Osada¹; Tadaharu Yokokawa¹; Hiroshi Harada¹; ¹National Institute for Materials Science

E9: On the Development of Cast ATI 718Plus® Alloy for Structural Gas Turbine Engine Components: *Benjamin Peterson*¹; Dan Frias¹; Dave Brayshaw²; Randy Helmink³; Scott Oppenheimer⁴; Eric Ott⁵; Ray Benn⁶; Michael Uchic⁷; ¹Honeywell Aerospace; ²PCC Structural; ³Rolls-Royce Corp.; ⁴ATI Allvac; ⁵GE Aviation; ⁶Pratt & Whitney; ⁷AFRL/RXLM

E10: Characterization and Modelling of Ni Based Superalloy Materials with a Dual Layered MCrALY Coating System: Yang Liu¹; Mudith Karunaratne¹; Mark Jepson¹; *Rachel Thomson*¹; ¹Loughborough University

E11: The Development and Validation of a New Thermodynamic Database for Ni-based Alloys: *Johan Bratberg*¹; Huahai Mao¹; Lina Kjellqvist¹; Anders Engström¹; Paul Mason²; Qing Chen¹; ¹Thermo-Calc Software AB; ²Thermo-Calc Software Inc

Alloy & Coating Development II

Wednesday PM
September 12, 2012

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chairs: Mark Hardy, Rolls-Royce plc; Sammy Tin, Illinois Institute of Technology

8:45 PM

Alloying Effects on Heat-treated Microstructure in Co-Al-W-base Superalloys at 1300°C and 900°C: *Fei Xue*¹; Meiling Wang¹; Qiang Feng¹; ¹University of Science and Technology Beijing

9:10 PM

High Temperature Creep of New L1₂-Containing Cobalt-base Superalloys: *Michael Titus*¹; Akane Suzuki²; Tresa Pollock¹; ¹University of California, Santa Barbara; ²GE Global Research

9:35 PM

Polycrystalline γ - γ' - δ Ternary Eutectic Ni-base Superalloys: *Sammy Tin*¹; Alejandro Rodriguez¹; Alex DiScuillo-Jones¹; Randolph Helmink²; Mark Hardy²; ¹Illinois Institute of Technology; ²Rolls-Royce

Modeling & Behavior of Disk Alloys I

Thursday AM
September 13, 2012

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chairs: Rick Montero, Pratt & Whitney; Anthony Banik, ATI Allvac/Allegheny Technologies

8:30 AM

Dwell Notch Low-cycle Fatigue Performance of Powder Metal Alloy 10: *Daniel Greving*¹; Pete Kantzos¹; Jim Neumann¹; Derek Rice¹; Harry Kington¹; ¹Honeywell

8:55 AM

Dwell Notch Low Cycle Fatigue Behavior of a Powder Metallurgy Nickel Disk Alloy: *Jack Telesman*¹; Tim Gabb¹; Yoshiki Yamada²; Louis Ghosn¹; Doug Hornbach³; N. Jayaraman³; ¹NASA GRC; ²Ohio Aerospace Institute; ³Lambda Research

9:20 AM

Oxidation and the Effects of High Temperature Exposures on Notched Fatigue Life of an Advanced Powder Metallurgy Disk Superalloy: *Chantal Sudbrack*¹; Susan Draper¹; Timothy Gorman²; Jack Telesman¹; Tim Gabb¹; David Hull¹; ¹NASA Glenn Research Center; ²NASA USRP (Univ. of Dayton)

9:45 AM

Grain Boundary Engineering Alloy 706 for Improved High Temperature Performance: *Andrew Detor*¹; Andrew Deal¹; Tim Hanlon¹; ¹General Electric Global Research

Modeling & Behavior of Disk Alloys II

Thursday AM
September 13, 2012

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chairs: Rick Montero, Pratt & Whitney; Anthony Banik, ATI Allvac/Allegheny Technologies

10:30 AM

Residual Stress Evolution during Manufacture of Aerospace Forgings: *James Rolph*¹; Michael Preuss¹; Naveed Iqbal¹; Michael Hofmann²; Stan Nikov³; Mark Hardy³; Michael Glavicic⁴; Ranga Ramanathan⁵; Alex Evans⁶; ¹University of Manchester; ²FRM-II, München; ³Rolls-Royce plc.; ⁴Rolls-Royce Corporation; ⁵ATI Ladish; ⁶Institut Laue-Langevin

10:55 AM

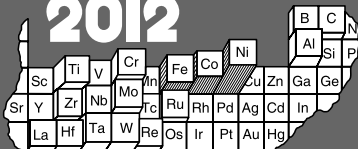
Characterization and Computational Modeling of Minor Precipitate Phases in Alloy LSHR: *Herng-Jeng Jou*¹; Gregory Olson²; Timothy Gabb³; Anita Garg⁴; Derek Miller⁵; ¹QuesTek Innovations LLC; ²Northwestern University; ³NASA Glenn Research Center; ⁴University of Toledo; ⁵Michigan State University

11:20 AM

An Advanced Cast-and-Wrought Superalloy (TMW-4M3) for Turbine Disk Applications Beyond 700°C: *Yuefeng Gu*¹; Z. Zhong¹; Y. Yuan¹; T. Osada¹; C. Cui¹; T. Yokokawa¹; H. Harada¹; ¹NIMS

11:45 AM

AD730TM - A New Nickel-based Superalloy for High Temperature Engine Rotative Parts: *Alexandre Devaux*¹; Benjamin Picque¹; Marie-France Gervais¹; Eric Georges¹; Thibault Poulain¹; Philippe Heritier¹; ¹Aubert & Duval



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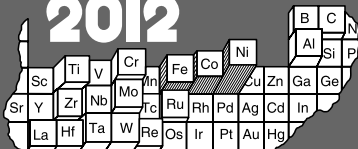
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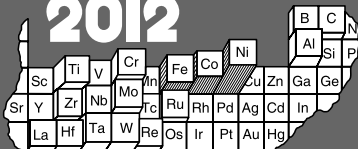
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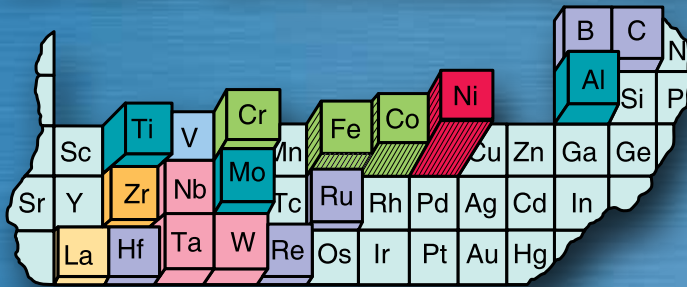
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SUPERALLOYS



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A project of The Minerals, Metals & Materials Society with support from the International Symposium on Superalloys Committee

Schedule At-A-Glance

	EXHIBIT HALL	EXHIBIT HALL ANNEX
Sunday PM	Symposium Keynote Address 8:00 – 9:40 PM	
Monday AM	Mechanisms/Models for Mechanical Behavior I 8:30 – 10:10 AM	Interactive Session A: Mechanisms/Models for Mechanical Behavior 10:10 – 11:20 AM
	Mechanisms/Models for Mechanical Behavior II 11:20 AM – 1:00 PM	
Monday PM	Single Crystal Alloys & Behavior I 6:30 – 7:45 PM	Interactive Session B: Single Crystal Alloys & Behavior 7:45 – 8:45 PM
	Single Crystal Alloys & Behavior II 8:45 – 10:00 PM	
Tuesday AM	Creep & Fatigue I 8:30 – 10:10 AM	Interactive Session C: Creep & Fatigue 10:10 – 11:20 AM
	Creep & Fatigue II 11:20 AM – 1:00 PM	
Wednesday AM	Models for Processes & Properties I 8:30 – 10:10 AM	Interactive Session D: Models for Processes & Properties 10:10 – 11:20 AM
	Models for Processes & Properties II 11:20 AM – 1:00 PM	
Wednesday PM	Alloy & Coating Development I 6:30 – 7:45 PM	Interactive Session E: Alloy & Coating Development 7:45 – 8:45 PM
	Alloy & Coating Development II 8:45 – 10:00 PM	
Thursday AM	Modeling & Behavior of Disk Alloy I 8:30 – 10:10 AM	
	Modeling & Behavior of Disk Alloys II 10:30 AM – 12:10 PM	