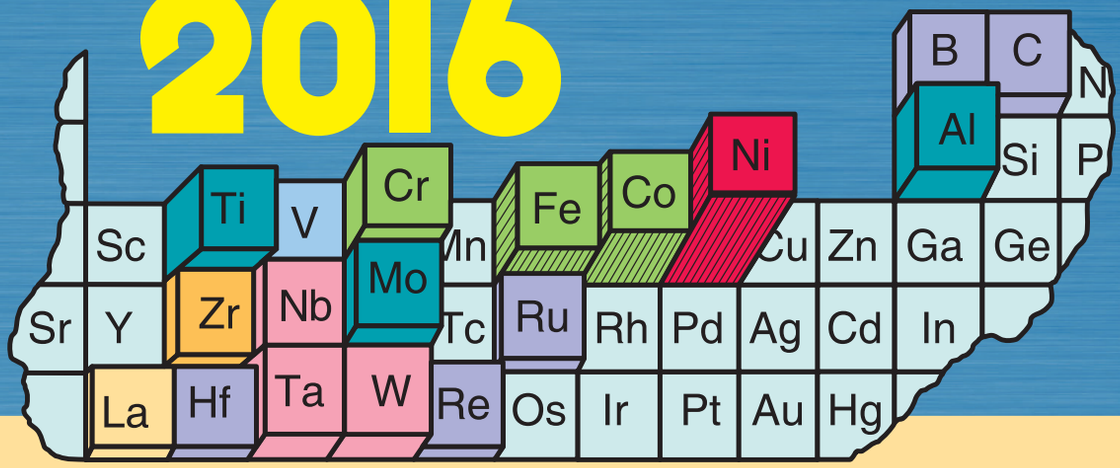
TMS THE MINERALS, METALS & MATERIALS SOCIETY PRESENTS:

SUPERALLOYS 2016



13TH INTERNATIONAL SYMPOSIUM ON SUPERALLOYS

September 11-15, 2016
Seven Springs Mountain Resort • Seven Springs, Pennsylvania

FINAL PROGRAM

Superalloys 2016 is sponsored by the Seven Springs International Symposium Committee in cooperation with TMS, the TMS High Temperature Alloys Committee, and ASM International, and is co-sponsored by IOM³.

TMS

IOM³ The Institute of Materials, Minerals and Mining

www.tms.org/Superalloys2016

ORGANIZING COMMITTEE

SEVEN SPRINGS INTERNATIONAL SYMPOSIUM 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:
Eric Huron, GE Aviation, US

Secretary:
Tony Banik, ATI

Treasurer:
Gern Maurer, Carpenter Technology, Retired

Program Chair:
Mark Hardy, Rolls-Royce plc - UK

Program Committee:
Uwe Glatzel, University Bayreuth - Germany
Brian Griffin, Alcoa Howmet
Beth Lewis, Wyman Gordon/PCC
Cathie Rae, University of Cambridge - UK
Venkat Seetharaman, Pratt & Whitney
Sammy Tin, Illinois Institute of Technology
Eric Huron, GE Aviation, US

Publications Chair:
Venkat Seetharaman, Pratt & Whitney

Arrangements Chair:
David Novotnak, Carpenter Technology Corp.

U.S. Publicity:
Jacqui Wahl, Cannon–Muskegon Corp.

International Publicity:
Akihiro Sato, IHI-Japan
Jian Zhang, IMR-China

Student Coordinator:
Michael Mills, The Ohio State University

Awards Chair:
Roger Reed, University of Oxford - UK

Awards Committee:
Tresa Pollock, University of California, Santa Barbara
Ken Green, Rolls-Royce Corporation (retired)

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 committee was assisted greatly by TMS in the planning and execution of the conference. In particular, we would like to thank Trudi Dunlap, Jennifer Booth, Caron Gavrish, Christina Raabe Eck, and Louise Wallach.

SYMPOSIUM DEDICATION

Louis W. Lherbier

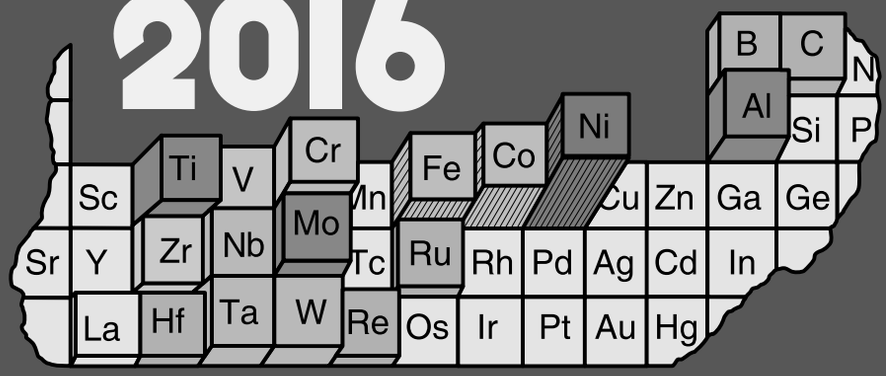
The 13th International Symposium on Superalloys is dedicated to Louis W. Lherbier for his substantial contributions to our field, in particular related to powder metallurgy (P/M) and cast & wrought (C&W) superalloys for gas turbine disk applications.

Lherbier's career has spanned 60 years with several firms in the superalloys industry. Given the theme of emphasizing impact on industrial applications and economies through collaborative working, Lherbier is a very appropriate honoree.

Lherbier recognized that the advances of P/M for high-speed steels could be leveraged to superalloys, and was a leader in the collaboration between Universal Cyclops and Pratt & Whitney to introduce IN100 superalloy powder in jet engines. He has made significant contributions to C&W IN718, to P/M consolidation and processing, and more recently, to the emerging technology of additive manufacturing. He holds several awards and patents, and has been an author, lecturer, and most important, a mentor to other metallurgists on the subject of superalloys.

Join us at a banquet ceremony in Louis W. Lherbier's honor on Tuesday at 6:00 p.m. in the Grand Ballroom.

SUPERALLOYS 2016



WELCOME TO THE 13TH INTERNATIONAL SYMPOSIUM ON SUPERALLOYS

On behalf of the Superalloys 2016 Committee, it is our pleasure to welcome you to Seven Springs and the 13th International Conference on Superalloys. This year's theme emphasizes collaboration between academia, producers, and users to achieve superalloy advancements with industrial relevance. Our keynote presentation on Sunday evening, our dedicatee, and many of the papers will emphasize this theme. Our technical courses (new this year) also support this focus. Our global attendees representing many nations, industrial firms, academic and governmental organizations, will hopefully foster collaboration here and in the future. And the Seven Springs venue and the social events in the program will allow you to build and sustain many productive relationships in the superalloys community. We encourage you to take advantage of every presentation, oral and interactive, along with every event and the facilities provided by the resort. We trust that you will have an enjoyable and educational experience.

Eric Huron
General Conference Chair
GE Aviation, US

Mark Hardy
Program Chair
Rolls-Royce plc - UK

TABLE OF CONTENTS

SPECIAL EVENTS AND SCHEDULE

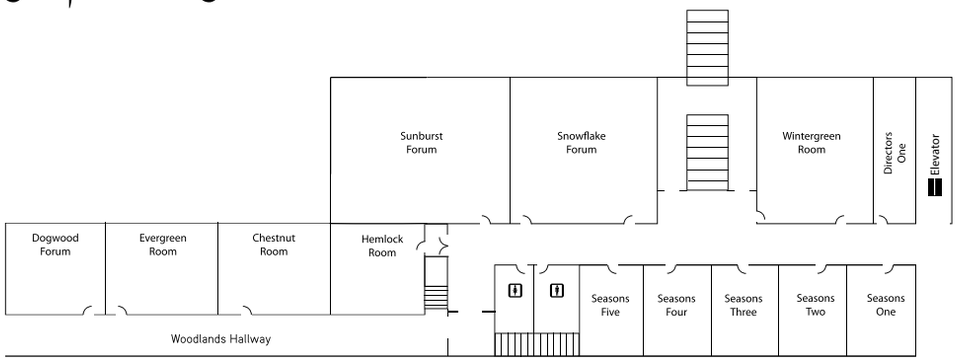
Day	Item	Start time	End time	Location
Sunday, September 11	Registration	Noon	9:30 p.m.	Stag Pass Foyer
	Course: Use of Numerical Modelling for Research and Development of Nickel-Based Superalloys (pre-registration required)	2:00 p.m.	4:00 p.m.	Sunburst Forum
	Course: Melting, Conversion, and Closed Die Forging of Superalloys (pre-registration required)	4:30 p.m.	6:30 p.m.	Sunburst Forum
	Dinner (at leisure)	4:00 p.m.	8:00 p.m.	Slopeside Dining Room
	Opening Plenary Session	8:00 p.m.	9:30 p.m.	Grand Ballroom
	Welcome Reception	9:30 p.m.	10:30 p.m.	Grand Ballroom
Monday, September 12	Registration	7:00 a.m.	Noon	Stag Pass Foyer
	Breakfast	7:00 a.m.	8:30 a.m.	Slopeside Dining Room
	General Session 1	8:30 a.m.	10:10 a.m.	Exhibit Hall
	Interactive Session A and Coffee Break	10:10 a.m.	11:20 a.m.	Exhibit Hall Annex
	General Session 2	11:20 a.m.	1:00 p.m.	Exhibit Hall
	Networking and Leisure Activities	1:00 p.m.	6:00 p.m.	
	Lunch (on your own)	1:00 p.m.	2:30 p.m.	
	TMS High Temperature Alloys Committee Meeting	3:30 p.m.	5:00 p.m.	Wintergreen Room
	Dinner (at leisure)	4:30 p.m.	6:00 p.m.	Grand Ballroom
	Registration	6:00 p.m.	9:30 p.m.	Stag Pass Foyer
	General Session 3	6:30 p.m.	7:45 p.m.	Exhibit Hall
	Interactive Session B and Coffee Break	7:45 p.m.	8:45 p.m.	Exhibit Hall Annex
	General Session 4	8:45 p.m.	10:00 p.m.	Exhibit Hall
	Beer Party Mixer	10:00 p.m.		Foggy Goggle
Tuesday, September 13	Breakfast	7:00 a.m.	8:30 a.m.	Slopeside Dining Room
	Registration	7:30 a.m.	Noon	Stag Pass Foyer
	General Session 5	8:30 a.m.	10:10 a.m.	Exhibit Hall
	Interactive Session C and Coffee Break	10:10 a.m.	11:20 a.m.	Exhibit Hall Annex
	General Session 6	11:20 a.m.	1:00 p.m.	Exhibit Hall
	Networking and Leisure Activities	1:00 p.m.	6:00 p.m.	
	Lunch (on your own)	1:00 p.m.	2:30 p.m.	
	Bus departure for Fallingwater Tour	1:15 p.m.	4:45 p.m.	Hotel Lobby
	Symposium Banquet and Awards Ceremony	6:00 p.m.	10:00 p.m.	Grand Ballroom
	Reception	6:00 p.m.	7:00 p.m.	
	Banquet	7:00 p.m.	10:00 p.m.	

Day	Item	Start time	End time	Location
Wednesday, September 14	Breakfast	7:00 a.m.	8:30 a.m.	Slopeside Dining Room
	Registration	7:30 a.m.	Noon	Stag Pass Foyer
	General Session 7	8:30 a.m.	10:10 a.m.	Exhibit Hall
	Interactive Session D and Coffee Break	10:10 a.m.	11:20 a.m.	Exhibit Hall Annex
	General Session 8	11:20 a.m.	1:00 p.m.	Exhibit Hall
	Networking and Leisure Activities	1:00 p.m.	5:00 p.m.	
	Lunch (on your own)	1:00 p.m.	2:30 p.m.	
	Alpine Slide Open	1:00 p.m.	3:00 p.m.	Alpine Slide
	Barbecue Dinner	5:00 p.m.	6:30 p.m.	Ski Lodge
	Registration	6:00 p.m.	9:30 p.m.	Stag Pass Foyer
	General Session 9	6:30 p.m.	7:45 p.m.	Exhibit Hall
	Interactive Session E and Coffee Break	7:45 p.m.	8:45 p.m.	Exhibit Hall Annex
	General Session 10	8:45 p.m.	10:00 p.m.	Exhibit Hall

Thursday, September 15	Breakfast	7:00 a.m.	8:30 a.m.	Slopeside Dining Room
	Registration	7:30 a.m.	Noon	Stag Pass Foyer
	General Session 11	8:30 a.m.	10:10 a.m.	Exhibit Hall
	Coffee Break	10:10 a.m.	10:40 a.m.	Exhibit Hall Annex
	General Session 12	10:40 a.m.	12:20 p.m.	Exhibit Hall
	Shuttle Bus Departure to Pittsburgh Int'l Airport	1:00 p.m. and 3:00 p.m.		Pre-Registration Required

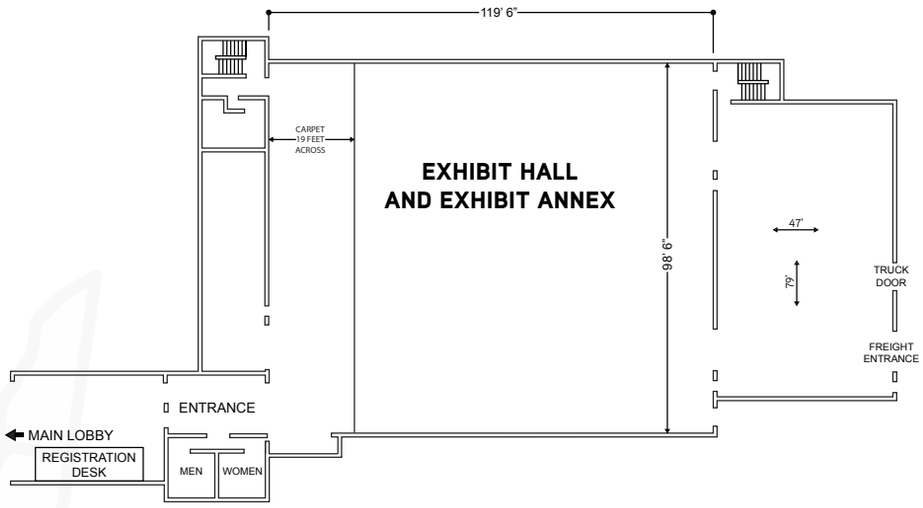
VENUE FLOORPLANS

Conference Center | LEVEL TWO

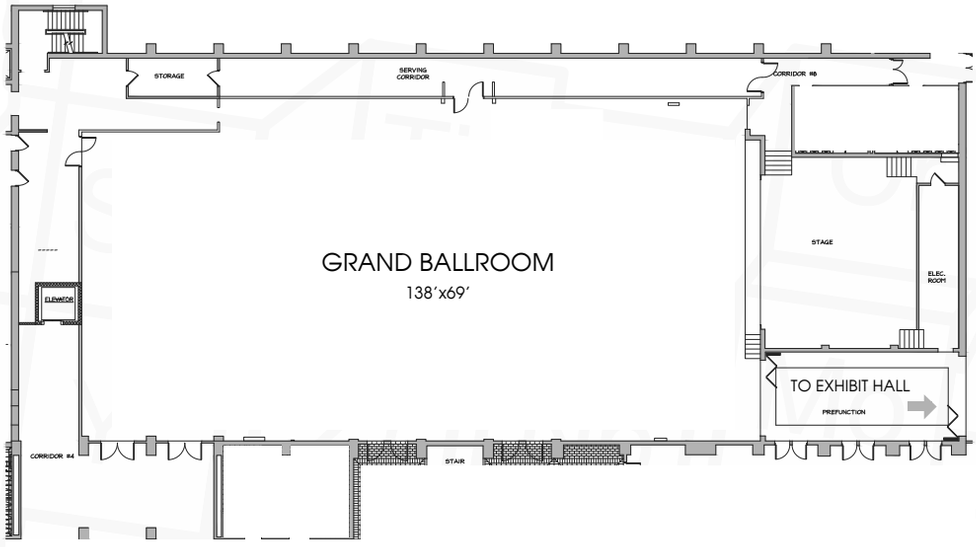


Please note, maps are not to scale.

Conference Center | LEVEL THREE



Please note, maps are not to scale.



Please note, maps are not to scale.

REGISTRATION HOURS

The conference registration desk will be located in the Stag Pass foyer.

Sunday	Noon to 9:30 p.m.
Monday	7:00 a.m. to Noon 6:00 p.m. to 9:30 p.m.
Tuesday	7:30 a.m. to Noon
Wednesday	7:30 a.m. to Noon 6:00 p.m. to 9:30 p.m.
Thursday	7:30 a.m. to Noon

Your paid full-conference registration includes the following:

- Admittance to technical sessions and interactive sessions
- Conference proceedings book and DVD set
- Sunday opening plenary session and welcome reception
- Morning and afternoon refreshment breaks
- Monday networking mixer

Note: Guests staying off-property who would like to attend the Symposium Awards Reception, Banquet, and/or Barbecue will need to purchase tickets separately for those events at the Seven Springs Mountain Resort front desk.

SHORT COURSES

Use of Numerical Modelling for Research and Development of Nickel-Based Superalloys*
2:00 p.m. to 4:00 p.m.
Room: Sunburst Forum

Melting, Conversion, and Closed Die Forging of Superalloys*
4:30 p.m. to 6:30 p.m.
Room: Sunburst Forum

**Pre-Registration Required*

TECHNICAL AND INTERACTIVE SESSIONS

The Sunday Opening Plenary Session and Tuesday Banquet and Awards Ceremony will be held in the Grand Ballroom. All other oral presentations will be held in the Exhibit Hall. The interactive sessions will be held in the Exhibit Hall Annex.

INFORMATION FOR ORAL PRESENTERS:

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

Set up your computer for presentation based on the times below:

Presentation Time: **8:30 a.m. to 9:45 a.m.**
Set Up: At least 15 minutes before the start of the session.

Presentation Time: **11:20 a.m. to 12:35 p.m.**
Set Up: At least 15 minutes before the start of the session.

Presentation Time: **6:30 p.m. to 7:20 p.m.**
Set Up: At least 15 minutes before the start of the session.

Presentation Time: **8:45 p.m. to 9:35 p.m.**
Set Up: At least 15 minutes before the start of the session.

Each presenter is asked to pre-load his or her presentation onto his or her computer. Any nonstandard 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.

INFORMATION FOR INTERACTIVE PRESENTERS:

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 morning by 10:10 a.m. Unclaimed posters will be discarded.

Please see the interactive session floorplan on page 23.

SPECIAL EVENTS

OPENING PLENARY SESSION AND WELCOME RECEPTION

Date: Sunday, September 11
Time: 8:00 p.m. to 10:30 p.m.
Location: Grand Ballroom

BEER PARTY MIXER

Date: Monday, September 12
Time: 10:00 p.m.
Location: Foggy Goggle

SYMPOSIUM BANQUET AND AWARDS CEREMONY

Date: Tuesday, September 13
Time: 6:00 p.m. to 10:00 p.m.
Location: Grand Ballroom

SYMPOSIUM BARBECUE DINNER

Date: Wednesday, September 14
Time: 5:00 p.m. to 6:30 p.m.
Location: Ski Lodge

ABOUT THE VENUE

Seven Springs is a full-service mountain resort located in the heart of western Pennsylvania's most colorful region—the Laurel Highlands. The natural beauty of the area provides many scenic opportunities. The pleasant fall weather makes September one of the most comfortable months to visit. Daytime temperatures average in the mid- to high 70s, with nights cooling to the mid- to low 60s.

Leisure activities will be available for group and individual participation, including:

- Golf
- Tennis
- Racquetball
- Swimming
- Alpine Slide

For more information, contact the hotel front desk.

INTERNET ACCESS

Complimentary wireless internet access is available at the Seven Springs Mountain Resort. Connecting to Wayport in the hotel area does not require a password. To connect in the meeting rooms, please enter password 86753099.

TRANSPORTATION

A shuttle is available to transport registrants to and from the Seven Springs Mountain Resort and Pittsburgh International Airport. Shuttle tickets with specific times must have been purchased in advance through the symposium registration form.

BADGES

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

GUESTS

Guest tickets only grant access to the social function for which the ticket was purchased. Full-conference registrations must be purchased for access to technical sessions, interactive sessions, and Exhibit Hall. Additional guest tickets may be purchased at the Seven Springs Mountain Resort front desk.

REFUNDS

The deadline for all refunds was August 11, 2016. No refunds will be issued at the conference. Fees and tickets are nonrefundable.

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 TMS Meeting Services at mtgserv@tms.org in advance.

CELL PHONE USE

In consideration of attendees and presenters, we kindly request that you minimize disturbances by setting all cell phones and other devices on “silent” while in meeting rooms.

ANTI-HARASSMENT

In all activities, TMS is committed to providing a professional environment free of harassment, disrespectful behavior, or other unprofessional conduct.

TMS policy prohibits conduct that is disrespectful, unprofessional, or harassing as related to any number of factors including, but not limited to, religion, ethnicity, gender, national origin or ancestry, physical or mental disability, physical appearance, medical condition, partner status, age, sexual orientation, military and veteran status, or any other characteristic protected by relevant federal, state, or local law or ordinance or regulation.

Failure to comply with this policy could lead to censure from the TMS Board of Directors, potential legal action, or other actions.

Anyone who witnesses prohibited conduct or who is the target of prohibited verbal or physical conduct should notify a TMS staff member as soon as possible following the incident. It is the duty of the individual reporting the prohibited conduct to make a timely and accurate complaint so that the issue can be resolved swiftly.

PHOTOGRAPHY AND RECORDING

TMS reserves the right to all audio and video reproduction of presentations at TMS-sponsored meetings. By registering for this meeting, all attendees acknowledge that they may be photographed by TMS personnel while at events and that those photos may be used for promotional purposes, in and on TMS publications and websites, and on social media sites.

Any recording of sessions (audio, video, still photography, etc.) intended for personal use, distribution, publication, or copyright without the express written consent of TMS and the individual authors is strictly prohibited. Attendees violating this policy may be asked to leave the session.

TMS DIVERSITY AND INCLUSION STATEMENT

The Minerals, Metals & Materials Society (TMS) is committed to advancing diversity in the minerals, metals, and materials professions, and to promoting an inclusive professional culture that welcomes and engages all who seek to contribute to the field. TMS recognizes that a diverse minerals, metals, and materials workforce is critical to ensuring that all viewpoints, perspectives, and talents are brought to bear in addressing complex science and engineering challenges. To build and nurture this diverse professional community, TMS welcomes and actively engages the participation of underrepresented groups in all of its initiatives and endeavors.

ANTITRUST COMPLIANCE

TMS complies with the antitrust laws of the United States. Attendees are encouraged to consult with their own corporate counsel for further guidance in complying with U.S. and foreign antitrust laws and regulations.

Opening Plenary Session

Sunday PM
September 11, 2016

Room: Grand Ballroom
Location: Seven Springs Mountain Resort

Session Chairs: Eric Huron, GE Aviation; Mark Hardy, Rolls-Royce plc

8:00 PM Keynote
Innovation Through Collaboration: *Shailesh Patel*[1]; John deBarbadillo[1]; [1]Special Metals Corporation

Session 1: Alloy Development I

Monday AM
September 12, 2016

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chairs: Catherine Rae, University of Cambridge; Tresa Pollock, University of California Santa Barbara

8:30 AM
Alloys-by-Design: Towards Optimization of Compositions of Nickel-Based Superalloys: *Roger Reed*[1]; Alessandro Mottura[2]; David Crudden[1]; [1]University of Oxford; [2]University of Birmingham

8:55 AM
CMSX-4 ® Plus Single Crystal Alloy Development, Characterization and Application Development: *Jacqueline Wahl*[1]; Ken Harris[1]; [1]Cannon-Muskegon

9:20 AM
Development of a Low-Density Rhenium-Free Single Crystal Nickel-Based Superalloy by Application of Numerical Multi-Criteria Optimization Using Thermodynamic Calculations: *Ralf Rettig*[1]; Kamil Matuszewski[1]; Alexander Müller[1]; Harald Helmer[1]; Nils Ritter[1]; Robert Singer[1]; [1]University of Erlangen

9:45 AM
Investigation of Superalloy Composition Space Using High Throughput Thin Film Synthesis and Synchrotron X-Ray Diffraction: *Leigh Connor*[1]; Paul Mignanelli[2]; Samuel Guérin[3]; Jean-Philippe Soulié[3]; Claire Mormiche[3]; Sara Frost[3]; Rachael Greenhalgh[3]; Brian Hayden[3]; Howard Stone[2]; [1]Diamond Light Source; [2]University of Cambridge; [3]Ilika technologies Ltd

Interactive Session A: Alloy Development II

Monday AM
September 12, 2016

Room: Exhibit Hall Annex
Location: Seven Springs Mountain Resort

Session begins at 10:10 AM.

A-1: Development of a Low-Cost Third Generation Single Crystal Superalloy DD9: *Jiarong Li*[1]; Shizhong Liu[1]; Xiaoguang Wang[1]; Zhenxue Shi[1]; Jinqian Zhao[1]; [1]Beijing Institute of Aeronautical Materials

A-2: Grain Boundary Precipitation Strengthening of Phosphorus-Added Nickel-Iron Base Superalloy: *Yusaku Hasebe*[1]; Koichi Takasawa[1]; Takuya Ohkawa[1]; Eiji Maeda[1]; Takashi Hatano[1]; [1]The Japan Steel Works, Ltd.

A-3: Development of New SX Superalloys – Fast Experimental Feedback Versus Thermodynamic Modeling: *Rainer Völkl*[1]; Ernst Fleischmann[1]; R. Rettig[2]; Ernst Affeldt[1]; Uwe Glatzel[1]; [1]University Bayreuth; [2]Friedrich-Alexander-University Erlangen

A-4: Experimental Study of the Binary Ni-Ru-System Using Diffusion Couples Manufactured by Encapsulating Cast: *Robert Popp*[1]; Rainer Völkl[1]; Thomas Göhler[2]; Uwe Glatzel[1]; [1]University of Bayreuth; [2]MTU Aero Engines AG

A-5: The Role of Local Chemical Composition for TCP Phase Precipitation in Ni-Base and Co-Base Superalloys: *Thomas Hammerschmidt*[1]; Jörg Koßmann[1]; Christopher Zenk[2]; Steffen Neumeier[2]; Mathias Göken[2]; Inmaculada Lopez-Galilea[3]; Lais Mujica Roncery[3]; Stephan Huth[3]; Aleksander Kostka[3]; Werner Theisen[3]; Ralf Drautz[1]; [1]ICAMS, Ruhr-Universität Bochum; [2]Materials Science and Engineering, Institute I, Friedrich-Alexander Universität Erlangen-Nürnberg; [3]Lehrstuhl Werkstofftechnik, Ruhr-Universität Bochum

A-6: Precipitation Kinetic Modeling of the New η-Phase Ni_6AlNb in Ni-Base Superalloys: *Markus Rath*[1]; Erwin Povoden-Karadeniz[1]; Ernst Kozeschnik[1]; [1]Vienna University of Technology

A-7: Development of Ni-Cr-Fe-W-Al Superalloy for Advanced Ultra-Supercritical Fossil Power Plants: *Hao Xianchao*[1]; M.Q. Ou[2]; T. Liang[2]; C. Xiong[2]; Y.C. Ma[2]; K. Liu[2]; [1]Institute of Metal Research, Chinese Academy of Sciences; [2]Institute of Metals Research, Chinese Academy of Sciences

A-8: Development of Low or Zero-Rhenium High-Performance Ni-Base Single-Crystal Superalloys for Jet Engine and Power Generation Applications: *Kyoko Kawagishi*[1]; Tadaharu Yokokawa[1]; Toshiharu Kobayashi[1]; Yutaka Koizumi[1]; Masao Sakamoto[1]; Michinari Yuyama[1]; Hiroshi Harada[1]; Ikuo Okada[2]; Masaki Taneike[2]; Hidetaka Oguma[2]; [1]National Institute for Materials Science; [2]Mitsubishi Heavy Industries, Ltd.

A-9: Design of Next Generation Ni-Base Single Crystal Superalloys Containing Ir: Towards 1150 °C Temperature Capability: *Tadaharu Yokokawa*[1]; Hiroshi Harada[2]; Yuhi Mori[3]; Kyoko Kawagishi[1]; Yutaka Koizumi[1]; Toshiharu Kobayashi[1]; Michinari Yuyama[1]; Shinsuke Suzuki[3]; [1]National Institute for Materials Science; [2]NIMS; [3]Waseda University

A-10: Sulfur and Minor Element Effects on the Oxidation of Bilayer γ'+β Bond Coats for Thermal Barrier Coatings on René N5: David Jorgensen[1]; Akane Suzuki[2]; Don Lipkin[2]; *Tresa Pollock*[1]; [1]UC Santa Barbara; [2]GE Global Research

A-11: High Temperature Creep of γ'-Containing CoNi-Based Superalloys: *Michael Titus*[1]; Luke Rettberg[1]; Tresa Pollock[1]; [1]University of California, Santa Barbara

A-12: Effects of Si Addition on the High Temperature Strength and Oxidation Behavior of γ'-Bearing Co-Based Superalloys: *An-Chou Yeh*[1]; I-Ting Ho[1]; Sheng-Chi Wang[1]; Chia-Fu Cheng[1]; [1]National Tsing Hua University

A-13: The Effect of Alloying Elements on the High Temperature Oxidation of Solid-Solution Strengthened Ni-Base Superalloys: *Dae Won Yun*[1]; Y. S. Yoo[1]; H. W. Jeong[1]; S. M. Seo[1]; [1]Korea Institute of Materials Science

A-14: Effect of Bond Coat and Substrate Chemistry on the Interfacial Degradation of Thermal Barrier Coatings: *Liberty Wu*[1]; Rudder Wu[1]; Toshio Osada[1]; Kuan-I Lee[2]; Mingwen Bai[2]; Ping Xiao[2]; [1]National Institute for Materials Science; [2]The University of Manchester

A-15: Effect of Re and Ta on Hot Corrosion Resistance of Nickel-Base Single Crystal Superalloys: Jianxiu Chang[1]; Dong Wang[1]; Gong Zhang[1]; Langhong Lou[1]; *Jian Zhang*[1]; [1]Institute of Metal Research, Chinese Academy of Sciences

Session 2: Alloy Development III

Monday AM
September 12, 2016

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chairs: Mark Hardy, Rolls-Royce plc; Roger Reed, University of Oxford

11:20 AM
Advanced Supersolvus Nickel Powder Disk Alloy DOE: Chemistry, Properties, Phase Formations and Thermal Stability: *Andrew Powell*[1]; Ken Bain[1]; Andrew Wessman[1]; Daniel Wei[1]; Timothy Hanlon[2]; David Mourer[1]; [1]GE Aviation; [2]GE Global Research

11:45 AM
γ' Phase Instabilities in High Refractory Content γ-γ' Ni-Base Superalloys: *Stoichko Antonov*[1]; Dieter Isheim[2]; David Seidman[2]; Eugene Sun[3]; Randolph Helmink[3]; Sammy Tin[1]; [1]Illinois Institute of Technology; [2]Northwestern University Center for Atom Probe Tomography (NUCAPT); [3]Rolls-Royce Corporation

12:10 PM
Development of Nickel-Cobalt Base P/M Superalloys for Disk Applications: *Yuefeng Gu*[1]; T Osada[1]; T Yokokawa[1]; H Harada[1]; J Fujioka[1]; [1]National Institute for Materials Science, Japan

12:35 PM
Superalloys for Advanced Energy Applications: INCONEL Alloy 740H - A Case Study on International Government-Industry-University Collaboration: *John deBarbadillo*[1]; Brian Baker[1]; Xishan Xie[2]; [1]Special Metals Corporation; [2]University of Science and Technology Beijing

Session 3: Blade Alloy Manufacture

Monday PM
September 12, 2016
Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chairs: Brian Griffin, Alcoa Howmet; Jacqueline Wahl, Cannon-Muskegon

6:30 PM
Application and Validation of a Directional Solidification Model and Dendrite Morphology Criterion for Complex, Single-Crystal Castings: Jonathan Miller[1]; *Kevin Chaput*[1]; David Lee[1]; Michael Uchic[1]; [1]Materials and Manufacturing Directorate, Air Force Research Laboratory

6:55 PM
Innovations in Casting Techniques for Single Crystal Turbine Blades of Superalloys: Dexin Ma[1]; *Fu Wang*[1]; Qiang Wu[2]; Samuel Bogner[1]; Andreas Bührig-Polaczek[1]; [1]Foundry Institute, RWTH Aachen; [2]ALD Vacuum Technologies GmbH

7:20 PM
The Distribution and Retention of Yttrium and Lanthanum in Cast Single Crystal Superalloys: *Steve Leyland*[1]; Ian Edmonds[2]; Steven Irwin[2]; Colin Jones[2]; Ayan Bhowmik[3]; David Ford[4]; Catherine Rae[1]; [1]Cambridge University; [2]Rolls-Royce plc; [3]Imperial College, London; [4]European Investment Casters' Federation,

Interactive Session B: Alloy & Component Manufacture I

Monday PM
September 12, 2016
Room: Exhibit Hall Annex
Location: Seven Springs Mountain Resort

Session begins at 7:45 PM.

B-1: Multiscale Modeling of Heat Treatment Processing for Single-Crystal Ni-Base Superalloys: *Chen Shen*[1]; Akane Suzuki[1]; Douglas Konitzer[2]; [1]GE Global Research; [2]GE Aviation

B-2: Microstructure Instability of Ni-Base Single Crystal Superalloys During Solution Heat Treatment: *Neil D'Souza*[1]; Dean Welton[1]; Joe Kelleher[2]; G. D. West[3]; Z.H. Dong[4]; Gyn Brewster[1]; Hongbiao Dong[5]; [1]Roll-Royce Plc; [2]ISIS Facility, Science, Technology and Facilities Council; [3]Warwick Manufacturing Group, University of Warwick; [4]Department of Engineering, University of Leicester; [5]University of Leicester

B-3: Development of Thermal Barrier Coating System Using EQ Coating for Advanced Single Crystal Superalloys: *Kazuhide Matsumoto*[1]; Kyoko Kawagishi[1]; Hiroshi Harada[1]; [1]National Institute for Materials Science

B-4: Effect of Rejuvenation Heat Treatment and Aging on the Microstructural Evolution in Rene N5 Single Crystal Ni Base Superalloy Blades: Joydeep Pal[1]; *Dheepa Srinivasan*[1]; Eric Cheng[2]; [1]GE India Technology Centre; [2]GE Aviation

B-5: The Formation Mechanism, Influencing Factors and Processing Control of Stray Grains in Nickel-Based Single Crystal Superalloys: Yafeng Li[1]; *Lin Liu*[1]; Taiwen Huang[1]; Dejian Sun[1]; Jun Zhang[1]; Hengzhi Fu[1]; [1]Northwestern Polytechnical University

B-6: Resonant Ultrasound Spectroscopy for Defect Detection in Single Crystal Superalloy Castings: *Brent Goodlet*[1]; Luke Rettberg[1]; Tresa Pollock[1]; [1]University of California, Santa Barbara

B-7: Investigation of Oxide Bifilms in Investment Cast Superalloy IN100: Max Kaplan[1]; Rachel Guarriello[1]; *Gerhard Fuchs*[1]; [1]Univ of Florida

B-8: A New Analysis of the Microstructure of Ni-Based Single-Crystal Superalloys: Relevant Topological Parameters for Efficient Microstructural Modeling: Matthieu Degeiter[1]; *Mikael Perrut*[1]; Benoît Appolaire[2]; Yann Le Bouar[2]; Alphonse Finel[2]; [1]Onera; [2]CNRS / Onera

B-9: Single-Crystal Superalloy Joining: *Akane Suzuki*[1]; Jeffrey Schoonover[1]; Chen Shen[1]; David Wark[1]; [1]GE Global Research

B-10: Selective Electron Beam Melting of the Single Crystalline Nickel-Base Superalloy CMSX-4: From Columnar Grains to a Single Crystal: *Markus Ramsperger*[1]; Carolin Körner[1]; [1]Universität Erlangen-Nürnberg

B-11: Defect Formation and Its Mitigation in Selective Laser Melting of High γ' Ni-Based Superalloys: *Xiqian Wang*[1]; Noriko Read[1]; Luke Carter[1]; Mark Ward[1]; Moataz Attallah[1]; [1]University of Birmingham

B-12: Developing Processing Parameters for Nickel-Base Superalloys for the Electron Beam Melting Additive Manufacturing Process: *Francisco Medina*[1]; Michael Kirka[2]; Ulf Ackelid[1]; Ryan Dehoff[2]; [1]Arcam; [2]Oak Ridge National Laboratory

B-13: Parameter Optimization for Electron Beam Melting of IN718 Based on Melt Pool Characterization: *Xiao Ding*[1]; Yuichiro Koizumi[2]; Akihiko Chiba[2]; [1]Tohoku University ; [2]Tohoku University

B-14: Effect of Heat Treatments on the Microstructure and Texture of CM247LC Processed by Selective Laser Melting: Rocio Munoz Moreno[1]; Divya V. D.[1]; Oliver M. D. M. Messé[1]; Trevor Illston[2]; Scarlett Baker[3]; *Howard J. Stone*[1]; [1]University of Cambridge; [2]Materials Solutions ; [3]Materials Solutions

Session 4: Blade Alloy Behavior

Monday PM
September 12, 2016
Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chairs: Venkat Seetharaman, Pratt & Whitney; Jian Zhang, Institute of Metal Research, Chinese Academy of Sciences

8:45 PM
Thermal Cycling Creep Resistance of Ni-Based Single Crystal Superalloys: *Jonathan Cormier*[1]; [1]ISAE-ENSMA / Institut Pprime - UPR CNRS 3346

9:10 PM
Influence of Crystal Orientation on Cyclic Sliding Friction and Fretting Fatigue Behavior of Single Crystal Ni-Base Superalloys: *Balavenkatesh Rengaraj*[1]; Sotaro Baba[2]; Masakazu Okazaki[2]; [1]Department of Mechanical Engnieering, Nagaoka University of Technology ; [2]Department of Mechanical Engnieering, Nagaoka University of Technology

9:35 PM
Sustained Peak Low-Cycle Fatigue in Single Crystals With Equilibrium γ/γ'Coatings: *Marissa Lafata*[1]; Luke Rettberg[1]; Christopher Mercer[2]; Tresa Pollock[1]; [1]University of California, Santa Barbara; [2]National Institute for Materials Science

Session 5: Disk Alloy Manufacture

Tuesday AM
September 13, 2016

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chairs: Beth Lewis, Wyman Gordon Company; Anthony Banik, ATI Specialty Materials

8:30 AM

Heteroepitaxial Recrystallization Observed in René 65™ and Udimet 720 ™: A New Recrystallization Mechanism Possibly Occurring in All Low Lattice Mismatch γ-γ' Superalloys: *Marie-Agathe Charpagne*[1]; Thomas Billot[2]; Jean-Michel Franchet[3]; Nathalie Bozzolo[4]; [1]CEMEF Mines Paristech, Snecma-Safran group; [2]Snecma-Safran Group; [3]Safran SA, SafranTech; [4]CEMEF-MINES ParisTech, PSL

8:55 AM

Systematic Evaluation of Microstructural and Thermo-Mechanical Effects on the As-Forged Condition of Alloy ATI 718Plus®: Ana Casanova[1]; Katja Loehnert[2]; Daniela Huenert[2]; Mark Hardy[3]; *Catherine Rae*[1]; [1]University of Cambridge; [2]Rolls-Royce Deutschland Ltd & Co KG; [3]Rolls-Royce plc

9:20 AM

Effect of Ingot Size on Microstructure and Properties of the New Advanced AD730 ™ Superalloy: Coraline Crozet[1]; *Alexandre Devaux*[1]; Romain Forestier[1]; Sylvain Charmond[1]; Marco Hueller[2]; Dietmar Helm[2]; Werner Buchmann[2]; [1]Aubert&Duval; [2]MTU Aero Engines

9:45 AM

Inhomogeneous Grain Coarsening Behavior in Supersolvus Heat Treated Nickel-Based Superalloy RR1000: *Iain Parr*[1]; Thomas Jackson[1]; Mark Hardy[1]; Daniel Child[1]; Christos Argyrakis[1]; Kevin Severs[2]; Vikas Saraf[2]; Jordan Stumpf[2]; [1]Rolls-Royce plc; [2]ATI Forged Products, Cudahy

Interactive Session C: Alloy & Component Manufacture II

Tuesday AM
September 13, 2016

Room: Exhibit Hall Annex
Location: Seven Springs Mountain Resort

Session begins at 10:10 AM.

C-1: The Influence of the Starting Grain Size During High-Temperature Grain Boundary Engineering of Ni-Base Superalloy RR1000: *Martin Detrois*[1]; John Rotella[1]; Robert Goetz[2]; Randolph Helmink[2]; Sammy Tin[1]; [1]Illinois Institute of Technology; [2]Rolls-Royce Corporation

C-2: Evaluation of AD730™ for High Temperature Fastener Applications: Alexandre Devaux[1]; *Wei Li*[2]; Coraline Crozet[1]; Jean-Marc Lardon[1]; [1]Aubert & Duval; [2]Rolls-Royce

C-3: Conventionally Forged RR1000 Billet for Forged Turbine Components: *Kevin Bockenstedt*[1]; Christopher O'Brien[1]; Ramesh Minisandram[1]; George Smith[1]; David Bryant[2]; [1]ATI Specialty Metals; [2]Rolls-Royce

C-4: Full Field Modeling of the Zener Pinning Phenomenon in a Level Set Framework - Discussion of Classical Limiting Mean Grain Size Equation: Benjamin Scholtes[1]; *Dmitrii Ilin*[1]; Amico Settefrati[2]; Nathalie Bozzolo[1]; Andrea Agnoli[3]; Marc Bernacki[1]; [1]MINES ParisTech; [2]Transvalor; [3]Snecma

C-5: Deformation Mechanisms and Microstructural Evolution of γ+γ' Duplex Aggregates Generated During Thermomechanical Processing of Nickel-Base Superalloys: *Beijiang Zhang*[1]; Guangpu Zhao[1]; Wenyun Zhang[1]; Guohua Xu[1]; Heyong Qin[1]; [1]China Iron & Steel Research Institute Group

C-6: Integrated Process Modeling for the Mechanical Properties Optimization of Direct Aged Alloy 718 Engine Disks: Bernd Oberwinkler[1]; Andreas Fischersworring-Bunk[2]; Marco Hüller[2]; *Martin Stockinger*[1]; [1]Böhler Schmiedetechnik GmbH & Co KG; [2]MTU Aero Engines AG

C-7 CANCELLED: Influence of Carbide Distribution on Ductility of Haynes 282 Forgings: *Ceena Joseph*[1]; Magnus Hornqvist[1]; Rebecka Bromesson[1]; Christer Persson[1]; [1]Chalmers University of Technology

C-8: An Approach to Microstructure Modeling in Nickel-Based Superalloys: *Aleksey Reshetov*[1]; Olga Bylya[1]; Nicola Stefani[2]; Malgorzata Rosochowska[1]; Paul Blackwell[1]; [1]Advanced Forming Research Centre, University of Strathclyde; [2]University of Strathclyde

C-9: Mechanical Properties of Cast & Wrought Hybrid Disks: Hesser Taboada Michel[1]; Layla Sasaki Reda[1]; Georgia Effgen Santos[1]; *Jonathan Cormier*[2]; Christian Dumont[3]; Patrick Villechaise[2]; Philippe Bocher[4]; Damien Texier[4]; Eric Georges[3]; Florent Bridier[4]; Florence Hamon[2]; Alexandre Devaux[3]; [1]Aubert & Duval and Institut Pprime; [2]ENSMA / Institut Pprime - UPR CNRS 3346; [3]Aubert & Duval; [4]Ecole de Technologie Supérieure

C-10 CANCELLED: Friction Stir Processing of Cast Alloy 718: Bharat Jasthi[1]; Edward Chen[2]; Brahmanandam Kaligotla[1]; Todd Curtis1; Michael West[1]; Christian Widener[1]; [1]South Dakota School of Mines and Technology; [2]Transition45 Technologies, Inc.

Session 6: Disk Alloy Behavior I

Tuesday AM
September 13, 2016

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chairs: Eric Huron, GE Aviation; Rajiv Soman, Evans Analytical Group

11:20 AM

Separating the Influence of Environment from Stress Relaxation Effects on Dwell Fatigue Crack Growth in a Nickel-Base Disk Alloy: *Jack Telesman*[1]; Tim Gabb[1]; Louis Ghosn[1]; [1]NASA GRC

11:45 AM

Microstructural Aspects of Fatigue Crack Initiation and Short Crack Growth in René 88DT: Zafir Alam[1]; David Eastman[1]; George Weber[1]; Somnath Ghosh[1]; *Kevin Hemker*[1]; [1]Johns Hopkins University

12:10 PM

Statistical Assessment of Fatigue-Initiating Microstructural Features in a Polycrystalline Disk Alloy: *William Lenthe*[1]; Jean-Charles Stinville[1]; McLean Echlin[1]; Tresa Pollock[1]; [1]University of California Santa Barbara

12:35 PM

Determination of Orientation and Alloying Effects on Creep Response and Deformation Mechanisms in Single Crystals of Ni-Base Disk Superalloys: *Timothy Smith*[1]; L.V. Duchao[1]; Tim Hanlon[1]; Andrew Wessman[1]; Yunzhi Wang[1]; Michael Mills[1]; [1]The Ohio State University

Session 7: Alloy & Component Manufacture III

Wednesday AM
September 14, 2016

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chairs: Jean-Yves Guedou, SAFRAN Aircraft Engines

8:30 AM

High Temperature Properties of a Single Crystal Superalloy PWA1484 Directly Recycled After Turbine Blade Use: *Satoshi Utada*[1]; Yuichiro Joh[1]; Makoto Osawa[2]; Tadaharu Yokokawa[2]; Toshiharu Kobayashi[2]; Kyoko Kawagishi[2]; Shinsuke Suzuki[1]; Hiroshi Harada[2]; [1]Waseda University; [2]National Institute for Materials Science

8:55 AM

Manufacture of Large Ni-Base Ingots and Forgings: *Nikolaus Blaes*[1]; Bernhard Donth[1]; Andreas Diwo[1]; Dieter Bokelmann[1]; [1]Saarschmiede GmbH Freiformschmiede

9:20 AM
Influence of Hot Working Conditions on Grain Growth Behavior of Alloy 718: *Chuya Aoki*[1]; Tomonori Ueno[1]; Takehiro Ohno[1]; [1]Hitachi Metals

9:45 AM
Microstructure-Sensitive Model for Predicting Surface Residual Stress Relaxation and Redistribution in a P/M Nickel-Base Superalloy: *Micheal Burba*[1]; Dennis Buchanan[2]; Michael Caton[1]; Reji John[1]; Robert Brockman[2]; [1]Air Force Research Laboratory; [2]University of Dayton Research Institute

Interactive Session D: Alloy & Component Behavior I

Wednesday AM
September 14, 2016

Room: Exhibit Hall Annex
Location: Seven Springs Mountain Resort

Session begins at 10:10 AM.

D-1: Fatigue Crack Growth Rate Assessment of Superalloys by the EBSD Method: *Daisuke Kobayashi*[1]; Tsutomu Takeuchi[1]; Masahiro Achiwa[1]; [1]CHUBU Electric Power Co., Inc.

D-2: Stage I Fatigue Crack Propagation in a Single Crystal and a Directional Solidified Ni-Base Superalloy: *Motoki Sakaguchi*[1]; Ryota Komamura[1]; Yuta Hosaka[1]; Hirotsugu Inoue[1]; [1]Tokyo Institute of Technology

D-3: Anisothermal High-Temperature Cyclic Behavior of a Ni-Base Single Crystal Superalloy: *Jean-Briac le Graverend*[1]; Jonathan Cormier[2]; Franck Gallerneau[3]; Serge Kruch[3]; Jose Mendez[2]; [1]Texas A&M University; [2]Institut P'/ ISAE-ENSMA; [3]ONERA

D-4: Discussing the Effect of Gamma Prime Coarsening on High Temperature Low Stress Creep Deformation With Respect to the Role of Refractory Elements: *T. Goehler*[1]; C. Schwalbe[2]; J. Svoboda[3]; E. Affeldt[1]; R.F. Singer[4]; [1]MTU Aero Engines AG; [2]Cambridge University; [3]Academy of Sciences of the Czech Republic; [4]University of Erlangen

D-5: On the Development of ICME Tools for Creep and Aging of CMSX-8: *Ernesto Estrada Rodas*[1]; Sanam Gorgannejad[1]; Richard Neu[1]; Zachary Dyer[2]; Phillip Draa[2]; Sachin Shinde[2]; [1]Georgia Institute of Technology; [2]Siemens Energy

D-6: Creep Deformation of a Sixth Generation Ni-Base Single Crystal Superalloy at 800 °C and 735 MPa: *Yong Yuan*[1]; Kyoko Kawagishi; Yuichiro Koizumi[1]; T. Kobayashi[1]; T. Yokokawa[1]; Hiroshi Harada[1]; [1]National Institute for Materials Science

D-7: Effect of Hf and B on Transverse and Longitudinal Creep of a Re-Containing Nickel-Base Bicrystal Superalloy: *Yunsong Zhao*[1]; Jian Zhang[2]; Yushi Luo[2]; Gang Sha[3]; Dingzhong Tang[2]; Qiang Feng[1]; [1]University of Science and Technology Beijing (USTB); [2]Beijing Institute of Aeronautical Materials; [3]Nanjing University of Science and Technology

D-8: Mechanical Properties and Microstructure Design in Repairing Mar-M 509 Alloy Turbine Components: *Zengmei Koenigsmann*[1]; Ravi Shankar[2]; Richard Fenton[2]; [1]chromalloy; [2]Chromalloy Gas Turbine LLC

D-9: Evaluation of Temperature and Stress in a First Stage High Pressure Turbine Blade of a Directionally Solidified Superalloy DZ125 After Service in Aeroengines: *Yadong Chen*[1]; Yunrong Zheng[1]; Chengbo Xiao[2]; Qiang Feng[1]; [1]University of Science and Technology Beijing; [2]Beijing Institute of Aeronautical Materials

D-10: On the Temperature Dependence of Creep Behavior of Ni-Base Single Crystal Superalloys: *Philip Wollgramm*[1]; Xiaoxiang Wu[1]; Gunther Eggeler[1]; [1]Ruhr-Universität Bochum

D-11: Microstructure Changes and Oxidation Resistance of Aluminized Ni-Based Single Crystal Superalloys: *Hideyuki Murakami*[1]; Kazuki Kasai; [1]National Institute for Materials Science

D-12: Factors Affecting TBC Furnace Cycle Lifetime: Temperature, Environment, Structure and Composition: *Bruce Pint*[1]; James Haynes[1]; Michael Lance[1]; Henry Aldridge[1]; Vaishak Viswanathan[2]; Gopal Dwivedi[2]; Sanjay Sampath[2]; [1]Oak Ridge National Laboratory; [2]Stony Brook University

D-13: Oxidation Coating Life Extension in Gas Turbine Blades During Repair: *Dheepa Srinivasan*[1]; Narayana Dayananda[1]; Neha Kondekar[2]; Mounika Gandi[3]; Hariharan Sundaram[1]; [1]GE India Technology Centre; [2]Georgia Institute of Technology; [3]Indian Institute of Science

Session 8: Blade Alloy Behavior II

Wednesday AM
September 14, 2016

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chairs: Sammy Tin, Illinois Institute of Technology; Qiang Feng, University of Science and Technology Beijing

11:20 AM
High Temperature Creep Damage Mechanisms in a Directionally Solidified Alloy: Impact of Crystallography and Environment: *Lorena Suave*[1]; Jonathan Cormier[2]; Patrick Villechaise[2]; Denis Bertheau[2]; Guillaume Benoit[2]; Florent Mauget[2]; Georges Cailletaud[3]; Lionel Marcin[1]; [1]Safran; [2]Institut Pprime; [3]Centre des Matériaux - Mines Paristech

11:45 AM
Characterization of Tilt and Twist Low Angle Grain Boundaries and Their Effects on Intermediate-Temperature Creep Deformation Behaviour: Yao Wang[1]; Dong Wang[1]; Gong Zhang[1]; Langhong Lou[1]; *Jian Zhang*[1]; [1]Institute of Metal Research, Chinese Academy of Sciences

12:10 PM
Crack Initiation and Propagation During Thermal-Mechanical Fatigue of IN792: Effects of Dwell Time: *Paraskevas Kontis*[1]; David Collins[1]; Sten Johansson[2]; Angus Wilkinson[1]; Johan Moverare[2]; Roger Reed[1]; [1]University of Oxford; [2]Linköping University

12:35 PM
Creep and Oxidation Behaviour of Coated and Uncoated Thin Walled Single Crystal Samples of the Alloy PWA1484: *Fabian Krieg*[1]; Mike Mosbacher[1]; Markus Fried[2]; Ernst Affeldt[2]; Uwe Glatzel[1]; [1]University Bayreuth; [2]MTU Aero Engines AG

Session 9: Disk Alloy Behavior II

Wednesday PM
September 14, 2016

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chairs: Michael Mills, The Ohio State University; Akihiro Sato, IHI INC.

6:30 PM
ATI718Plus® – New Nickel Based Disk Alloy and Its Capability: *Daniela Huenert*[1]; Martin Proebstle[2]; Ana Casanova[3]; Regina Schluetter[3]; Robert Krakow[3]; Markus Buescher[4]; P. Randelzhofer[5]; Alexander Evans[1]; Katja Loehnert[1]; Thomas Witulski[4]; Steffen Neumeier[2]; Catherine Rae[3]; [1]Rolls-Royce Deutschland; [2]University Erlangen-Nürnberg; [3]University of Cambridge; [4]Otto Fuchs KG; [5]University Erlangen-Nurnberg, Germany

6:55 PM
Thermal Stability of Cast and Wrought Alloy Rene 65: *Andrew Wessman*[1]; Aude Laurence[2]; Jonathan Cormier[2]; Patrick Villechaise[2]; Thomas Billot[3]; Jean-Michel Franchet[4]; [1]GE Aviation; [2]Insititut Pprime; [3]Snecma-Safran Group; [4]Safran SA

7:20 PM
Novel Techniques to Assess Environmentally-Assisted Cracking in a Nickel-based Superalloy: *Andre Nemeth*[1]; David Crudden[1]; David Collins[1]; David Armstrong[1]; Roger Reed[1]; [1]University of Oxford

Interactive Session E: Alloy & Component Behavior II

Wednesday PM
September 14, 2016

Room: Exhibit Hall Annex
Location: Seven Springs Mountain Resort

Session begins at 7:45 PM.

E-1: Benchmarking Crystal Plasticity Models With Microtensile Evaluation and 3D Characterization of René 88DT: *David Eastman*[1]; Zafir Alam[1]; George Weber[1]; Paul Shade[2]; Mike Uchic[2]; Will Lenthe[3]; Tresa Pollock[3]; Kevin Hemker[1]; [1]Johns Hopkins University; [2]AFRL; [3]UCSB

E-2: Characterization and Modeling of Deformation Mechanisms in Ni-Base Superalloy 718: *Donald McAllister*[1]; Ducho Lv[1]; Hallee Deutchman[2]; Benjamin Peterson[2]; Yunzhi Wang[1]; Michael Mills[1]; [1]The Ohio State University; [2]Honeywell Aerospace

E-3: Dislocations Nucleation and Interaction With Grain Boundaries in a Polycrystalline Nickel Base Superalloy: *Olivier Messe*[1]; Cathie Rae[1]; [1]University of Cambridge

E-4 Effect of Large Plastic Strains and Strain Gradients on Residual Stress Relaxation in Shot Peened IN100: *Dennis Buchanan*[1]; Reji John[2]; [1]UDRI; [2]US Air Force

E-5: Relationship Between the Microstructure, Low Cycle Fatigue and Creep Properties of a Cast and Wrought Ni-Co Base Superalloy TMW-4M3 Disk: *Shinichi Kobayashi*[1]; Tomonori Ueno[1]; Takehiro Ohno[1]; Hiroshi Harada[2]; [1]Hitachi Metals, Ltd.; [2]National Institute for Materials Science

E-6: Probability of Occurrence of Life-Limiting Fatigue Mechanism in P/M Nickel-Based Superalloys: *Sushant Jha*[1]; William Porter[2]; Michael Caton[3]; R. John[4]; Dennis Buchanan[2]; Andrew Rosenberger[3]; James Larsen[3]; [1]US Air Force Research Laboratory/Universal Technology Corporation; [2]University of Dayton Research Institute; [3]US Air Force Research Laboratory; [4]US Air Force Research Laboratory, AFRL/RXCM

E-7: A Unified LCF Model for Conventionally Heat Treated Inconel 718: *Michael Marotta*[1]; David Dudzinski[1]; [1]Derivation Research Lab

E-8: Relationships Between Microstructural Parameters and Time-Dependent Mechanical Properties of a New Nickel Based Superalloy AD730™: *Louis Thebaud*[1]; Patrick Villechaise[2]; Jonathan Cormier[2]; Florence Hamon[2]; Coraline Crozet[3]; Alexandre Devaux[3]; Jean-Michel Franchet[4]; Anne-Laure Rouffie[4]; Antoine Organista[5]; [1]Aubert & Duval / Institut Pprime; [2]Institut Pprime; [3]Aubert & Duval; [4]Safran SA - Safran Tech; [5]Safran Turbomeca

E-9: Influence of Residual Stresses on the Fatigue Life of a Shot-Peened Nickel-Based Single Crystal Superalloy: From Measurements to Modeling: Amélie Morançais[1]; *Mathieu Fèvre*[2]; Manuel François[3]; Nicolas Guel[3]; Serge Kruch[2]; Pascale Kanouté[2]; Arnaud Longuet[1]; [1]SAFRAN Snecma Villaroche; [2]Onera; [3]Université de Technologie de Troyes

E-10: Effect of Non-Metallic Ceramic Inclusions on Strain Localization During Low Cycle Fatigue of a Polycrystalline Superalloy: *J.C. Stinville*[1]; V.M. Miller[1]; T.M. Pollock[1]; [1]University of California Santa Barbara

E-11: Effects of Oxidation on Fatigue Crack Initiation and Propagation in an Advanced Disk Alloy: *Rong Jiang*[1]; Nong Gao[1]; Michael Ward[2]; Zabeada Aslam[2]; John Walker[1]; Philippa Reed[1]; [1]University of Southampton; [2]University of Leeds

E-12: Physics-Based Modeling Tools for Predicting Type II Hot Corrosion in Ni-Based Superalloys: *Kwai Chan*[1]; Michael Enright[1]; Jonathan Moody[1]; Simeon Fitch[2]; [1]Southwest Research Institute; [2]Elder Research Inc

E-13: Characterization of Grain Boundaries and Associated Minor Phases in Disk Alloy ME3 Exposed at 815 °C: *Chantal Sudbrack*[1]; Laura Evans[1]; Anita Garg[1]; Daniel Perea[2]; Daniel Schreiber[2]; [1]NASA Glenn Research Center; [2]Pacific Northwest National Laboratory

Session 10: Environmental Behavior

Wednesday PM
September 14, 2016

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chairs: Bruce Pint, Oak Ridge National Laboratory; Jonathan Cormier, ENSMA / Institut Pprime - UPR CNRS 3346

8:45 PM
Slip Localization and Hydrogen Embrittlement of Alloy 718: *Zhenbo Zhang*[1]; Gideon Obasi[1]; Roberto Morana[1]; Michael Preuss[1]; [1]University of Manchester

9:10 PM
Effects of Sea Salt on the Oxidation of CMSX-4® at 1100 °C: *Hon Pang*[1]; Feng Li[1]; Siavash Pahlavanyali[2]; Ian Edmonds[3]; Gyn Brewster[3]; Catherine Rae[1]; [1]University of Cambridge; [2]Edif ERA; [3]Rolls-Royce plc.

9:35 PM
Damage Evolution During Compressive Hold Sustained Peak Low Cycle Fatigue of a Ni-Based Single-Crystal Superalloy: *Swapnil Patil*[1]; Shenyan Huang[2]; Mallikarjun Karadge[2]; Doug Konitzer[2]; Akane Suzuki[2]; [1]General Electric India Technology Center Pvt Ltd; [2]General Electric

Session 11: Co_3AlW & High Entropy Alloys

Thursday AM
September 15, 2016

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chairs: David Dye, Imperial College; Akane Suzuki, GE Global Research

8:30 AM
The Role of the Base Element in γ' Strengthened Cobalt/Nickel-Base Superalloys: *Christopher Zenk*[1]; Steffen Neumeier[1]; Markus Kolb[1]; Nicklas Volz[1]; Suzana Fries[2]; Oleksandr Dolotko[3]; Ivan Povstugar[4]; Dierk Raabe[4]; Mathias Göken[1]; [1]Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU); [2]Ruhr-Universität Bochum (RUB); [3]Technische Universität München (TUM); [4]Max-Planck-Institut für Eisenforschung GmbH (MPIE)

8:55 AM
Alloying Effects on Microstructural Stability and γ' Phase Nano-Hardness in Co-Al-W-Ta-Ti-Base Superalloys: *Haijing Zhou*[1]; Wendao Li[1]; Fei Xue[1]; Lin Zhang[1]; Xuanhui Qu[1]; Qiang Feng[1]; [1]University of Science & Technology Beijing,USTB

9:20 AM
Oxide Scale Formation in Novel γ-γ' Cobalt-Based Alloys: *Colin Stewart*[1]; Robert Rhein[1]; Akane Suzuki[2]; Tresa Pollock[1]; Carlos Levi[1]; [1]University of California Santa Barbara; [2]GE Global Research

9:45 AM
High Temperature Properties of Advanced Directionally-Solidified High Entropy Superalloys: *Te-Kang Tsao*[1]; An-Chou Yeh[1]; Jien-Wei Yeh[1]; Mau-Sheng Chiou[2]; Chen-Ming Kuo[2]; Hideyuki Murakami[3]; Koji Kakehi[4]; [1]National Tsing Hua University; [2]I-Shou University; [3]National Institute for Materials Science; [4]Tokyo Metropolitan University

10:10 AM BREAK

Session 12: Additive Layer Manufacture

Thursday AM
September 15, 2016

Room: Exhibit Hall
Location: Seven Springs Mountain Resort

Session Chairs: Eric Huron, GE Aviation; David Novotnak, Carpenter Powder Products

10:40 AM
Inconel 625 by Direct Metal Laser Sintering: Effects of the Process Parameters and Heat Treatments on Microstructure and Hardness: *Giulio Marchese*[1]; Massimo Lorusso[2]; Flaviana Calignano[2]; Elisa Ambrosio[2]; Diego Manfredi[2]; Matteo Pavese[1]; Sara Biamino[1]; Daniele Ugues[1]; Paolo Fino[1]; [1]Politecnico di Torino; [2]Istituto Italiano di Tecnologia

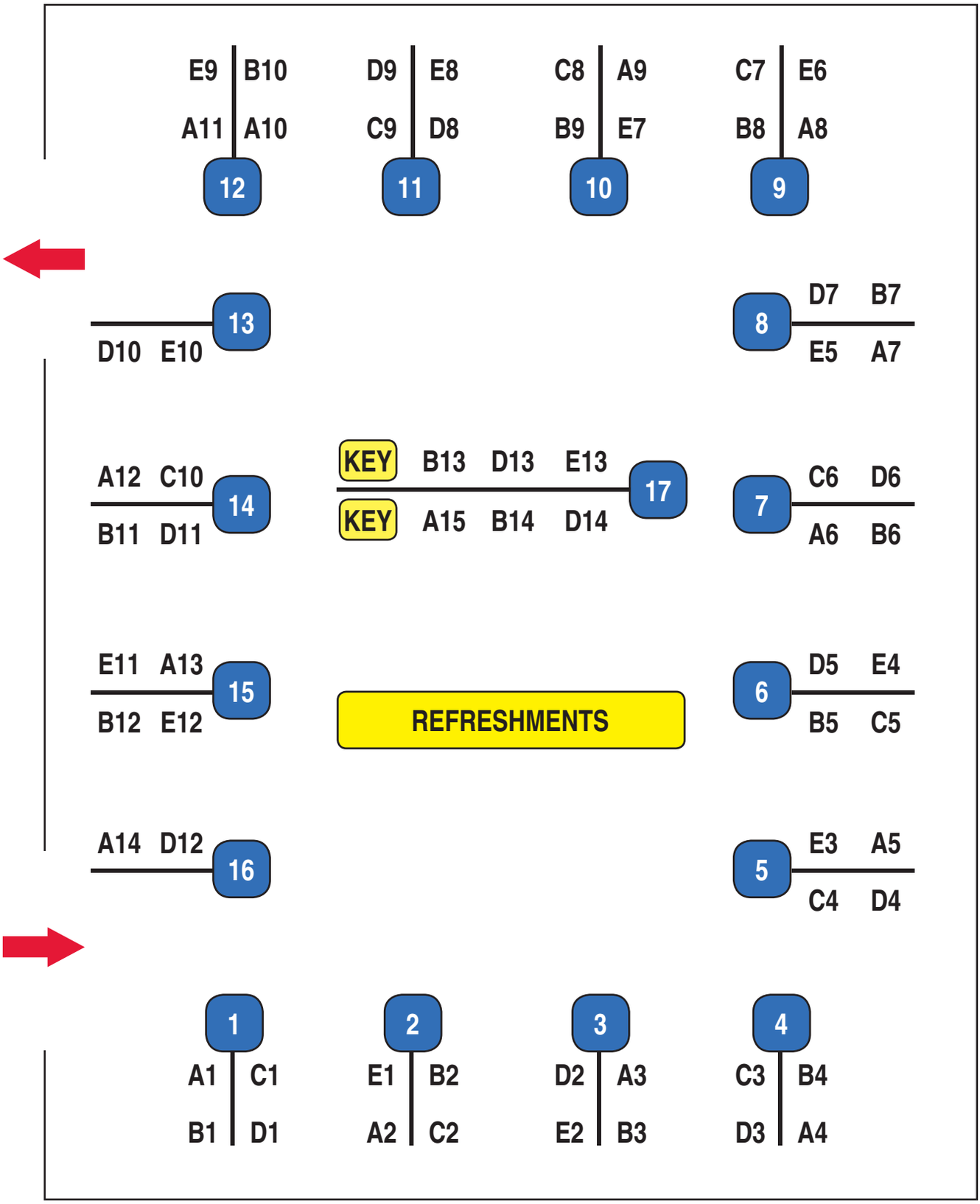
11:05 AM
A Multi-Scale Multi-Physics Approach to Modelling of Additive Manufacturing in Nickel-Based Superalloys: *Chinnapat Panwisawas*[1]; Yogesh Sovani[1]; Magnus Anderson[1]; Richard Turner[1]; Nunzio Palumbo[2]; Benjamin Saunders[2]; Isabelle Choquet[3]; Jeffery Brooks[1]; Hector Basoalto[1]; [1]University of Birmingham; [2]Rolls-Royce plc; [3]University West

11:30 AM
Integrated Process Optimization of Alloy 718Plus for Additive Manufacturing: *Jiadong Gong*[1]; Hallee Deutchman[2]; Alonso Peralta[2]; David Snyder[1]; Michael Enright[3]; John McFarland[3]; James Neumann[2]; Jason Sebastian[1]; Greg Olson[1]; [1]QuesTek Innovations, LLC; [2]Honeywell Aerospace; [3]Southwest Research Institute

11:55 AM
A Study on the Effects of Substrate Crystallographic Orientation on Microstructural Characteristics of René N5 Processed Through Scanning Laser Epitaxy: *Amrita Basak*[1]; Suman Das[1]; [1]Georgia Institute of Technology

INDEX

INTERACTIVE SESSION FLOORPLAN



THANK YOU TO OUR SPONSORS

MONDAY AFTERNOON AND WEDNESDAY MORNING COFFEE BREAKS AND TUESDAY NIGHT BANQUET COCKTAILS:

CARPENTER®

MONDAY MORNING COFFEE BREAK:

ATI

TUESDAY NIGHT BANQUET WINE:

AUBERT&DUVAL

WEDNESDAY BBQ REFRESHMENTS:

CANNON-MUSKEGON CORPORATION

WEDNESDAY AFTERNOON COFFEE BREAK:

EAG LABORATORIES

MONDAY NIGHT MEET AND GREET SESSION REFRESHMENTS:

PRATT & WHITNEY DEPENDABLE ENGINES

TUESDAY MORNING COFFEE BREAK:

IHI

PRINTING AND PUBLICATION SUPPORT:

IMR

SUNDAY KEYNOTE RECEPTION:

WYMAN GORDON A PCC Company

SPECIAL METALS A PCC Company

STUDENT SUPPORT PROVIDED BY:

ALCOA

ATI

CARPENTER®

GE

TABLETOP EXHIBITORS:

Thermo-Calc Software

EAG LABORATORIES