

SUNDAY, SEPTEMBER 17<sup>TH</sup>

**Keynote Address**

8:00 – 9:30

Superalloys: The Utility Gas Turbine Perspective

Dr. Brij B. Seth

Manager, Materials Engineering, Siemens Westinghouse Power Corporation

MONDAY, SEPTEMBER 18<sup>TH</sup>

**Session I - Ingot, Powder and Deformation Processing**

8:30 – 8:55

Characterization of Freckles in a High Strength Wrought Nickel Superalloy

P.D. Genereux and C.A. Borg

8:55 – 9:20

Simulation of Intrinsic Inclusion Motion and Dissolution During the Vacuum Arc Remelting of Nickel Based Superalloys

W. Zhang, P.D. Lee, M. McLean and R.J. Siddall

9:20 – 9:45

Predicting Grain Size Evolution of Udimet Alloy 718 During the “Cogging” Process Through the Use of Numerical Analysis

B. F. Antolovich and M.D. Evans

9:45 – 10:10

Control of Grain Size Via Forging Strain Rate Limits for R’88DT

E. Huron, S. Srivatsa and E. Raymond

10:10 – 11:10 Interactive Session I

Segregation and Solid Evolution During the Solidification of Niobium-Containing Superalloys

W. Yang, W. Chen, K.M. Chang, S. Mannan and J. deBarbadillo

Microstructural Evolution of Nickel-Base Superalloy Forgings during Ingot-to-Billet

Conversion: Process Modeling and Validation

C.A. Dandre, C.A. Walsh, R.W. Evans, R.C. Reed and S.M. Roberts

Removal of Ceramic Defects from a Superalloy Powder Using Triboelectric Processing

J.M. Stencel, T.X. Li, J.K. Neathery and L.W. Lherbier

Production Evaluation of 718-ER Alloy

W.D. Cao and R.L. Kennedy

Quench Cracking Characterization of Superalloys Using Fracture Mechanics Approach  
J. Mao, K.M. Chang and D. Furrer

Development and Characterization of a Damage Tolerant Microstructure for a Nickel Base Turbine Disc Alloy  
R.M. Kearsey, A.K. Koul, J.C. Beddoes and C. Cooper

The Microstructure Prediction of Alloy 720LI for Turbine Disk Applications  
T. Matsui, H. Takizawa, H. Kikuchi and S. Wakita

Characteristics and Properties of As-HIP P/M Alloy 720  
J.H. Moll and J.J. Conway

Enhanced Powder Metallurgy (P/M) Processing of Udimet Alloy 720 Turbine Disks – Modeling Studies  
J.J. Fisher, A. Casagrande, S.P. Vaze, F.D. Arnold, S.Y. Lin, G. Salvady and G.A. Miller

Characterization and Thermomechanical Processing of Sprayformed Allvac 720 Alloy  
H.E. Lippard and R.F. Jones

Structure of the Ni-Base Superalloy IN 713C After Continuous Casting  
F. Zupanic, T. Boncina and A. Krizman

The Thermal Analysis of the Mushy Zone and Grain Structure Changes during Directional Solidification of Superalloys  
S.U. An, V. Larionov, V. Monastyrski, E. Monastyrskaya, I. Grafas, J.M. Oh, O.D. Lim, S.H. Kim, J.H. Lee and D.Y. Seo

Freckle Formation in Superalloys  
P. Auburtin, S.L. Cockcroft, A. Mitchell and T. Wang

Modeling of the Microsegregation in CMSX-4 Superalloy and its Homogenisation During Heat Treatment  
M.S.A. Karunaratne, D.C. Cox, P. Carter and R.C. Reed

Enhancement of the High Temperature Tensile Creep Strength of Monocrystalline Nickel-Base Superalloys by Pre-Rafting in Compression  
U. Tetzlaff and H. Mughrabi

11:10 – 11:35

Sub-Solvus Recrystallization Mechanisms in Udimet Alloy 720LI  
B. Lindsley and X. Pierron

11:35 – 12:00

The Mechanical Property Response of Turbine Disks Produced Using Advanced PM Processing Techniques  
A. Banik and K.A. Green

12:00 – 12:25

Properties of RS5 and Other Superalloys Cast Using Thermally Controlled Solidification

M.L. Gambone, S.B. Shendye, P. Andrews, W. Chen, M.N. Gungor, J.J. Valencia and M.L. Tims

12:25 – 12:50

Advanced Superalloys and Tailored Microstructures for Integrally Cast Turbine Wheels

R.C. Helmink, R.A. Testin, A.R. Price, R. Pachman, G.L. Erickson, K. Harris, J.A. Nesbitt and J.F. Radavich

## **Session II – Processing: Directional Solidification and Single Crystals**

6:30 – 6:55

Improved Quality and Economics of Investment Castings by Liquid Metal Cooling – The Selection of Cooling Media

A. Lohmuller, W. Esser, J. Grossmann, M. Hordler, J. Preuhs and R.F. Singer

6:55 – 7:20

Novel Casting Process for Single Crystal Gas Turbine Components

M. Konter, E. Kats, and N. Hofmann

7:20 – 7:45

Carbon Additions and Grain Defect Formation in High Refractory Nickel-Base Single Crystal Superalloys

S. Tin, T.M. Pollock and W.T. King

7:45 – 8:15 Coffee Break

8:15 – 8:40

New Aspects of Freckle Formation during Single Crystal Solidification of CMSX-4

R. Schadt, I. Wagner, J. Preuhs and P.R. Sahn

8:40 – 9:05

Competitive Grain Growth and Texture Evolution during Directional Solidification of Superalloys

M.G. Ardakani, N. D'Souza, A. Wagner, B.A. Shollock and M. McLean

9:05 – 9:30

Recrystallization in Single Crystals of Nickel Base Superalloys

R. Burgel, P.D. Portella and J. Preuhs

TUESDAY, SEPTEMBER 19<sup>TH</sup>

## **Session III: Blade Alloys**

8:30 – 8:55

Alloying Effects on Surface Stability and Creep Strength of Nickel Based Single Crystal Superalloys Containing 12 mass% Cr

Y. Murata, R. Hashizume, A. Yoshinari, N. Aoki, M. Morinaga and Y. Fukui

8:55 – 9:20

Evaluation of PWA 1483 for Large Single Crystal IGT Blade Applications

D.M. Shah and A. Cetel

9:20 – 9:45

Effect of Ru Addition on Cast Nickel Base Superalloy with Low Content of Cr and High Content of W

Y. Zheng, X. Wang, J. Dong, Y. Han, H. Murakami and H. Harada

9:45 – 10:10

Prediction and Measurement of Microsegregation and Microstructural Evolution in Directionally Solidified Superalloys

B. Bottger, U. Grafe, D. Ma and A. Schnell

10:10 – 11:10 Interactive Session II

Development of a Third Generation DS Superalloy

T. Kobayashi, M. Sato, Y. Koizumi, H. Harada, T. Yamagata, A. Tamura and J. Fujioka

The Development and Long-Time Structural Stability of a Low Segregation Hf-Free Superalloy – DZ125L

Y. Zhu, J.F. Radavich, Z. Zheng, X. Ning, L. Lou, X. Xie and C. Shi

The Growth of Small Cracks in the Single Crystal Superalloy CMSX-4 at 750 and 1000 °C

F. Schubert, T. Rieck and P.J. Ennis

The Influence of Load Ratio, Temperature, Orientation and Hold Time on Fatigue Crack Growth of CMSX-4

S. Muller, J. Rosler, C. Sommer and W. Hartnagel

Modelling the Anisotropic and Biaxial Creep Behaviour of Ni-Base Single Crystal Superalloys CMSX-4 and SRR99 at 1223K

D.W. MacLachlan, L.W. Wright, S.S.K. Gunturi and D.M. Knowles

CBED Measurement of Residual Internal Strains in the Neighbourhood of TCP Phases in Ni-Base Superalloys

F. Pyczak, H. Biermann, H. Mughrabi, A. Volek and R.F. Singer

The Influence of Dislocation Substructure on Creep Rate During Accelerating Creep Stage of Single Crystal Nickel-based Superalloy CMSX-4

N. Miura, Y. Kondo and N. Ohi

Oxidation Improvements of Low Sulfur Processed Superalloys

T.M. Simpson and A.R. Price

Effect of Oxidation on High Temperature Fatigue Crack Initiation and Short Crack Growth in Inconel 718

T. Connolley, M.J. Starink and P.A.S. Reed

The Effects of Processing on Stability of Alloy 718

G. Shen, J. Radavich, X. Xie, and B. Lindsley

Long Term Thermal Stability of Inconel Alloys 718, 706, 909 and Waspaloy at 593 °C and 704 °C  
S. Mannan, S. Patel and J. deBarbadillo

Effects of Microstructure and Loading Parameters on Fatigue Crack Propagation Rates in AF2-1DA-6

J. Mason, J. Lemsky, T. Stuhldreher and D. Furrer

The Common Strengthening Effect of Phosphorus, Sulfur and Silicon in Lower Contents and a Problem of a Net Superalloy

W.R. Sun, S.R. Guo, J.T. Guo, B.Y. Tong, Y.S. Yang, X.F. Sun, H.R. Guan and Z.Q. Hu

Simulation of Microstructure of Nickel Base Alloy 706 in Production of Power Generation Turbine Discs

J. Huez and J.F. Uginet

#### **Session IV: Disk Alloys**

11:10 – 11:35

Optimisation of the Mechanical Properties of a New PM Superalloy for Disk Applications  
D. Locq, M. Marty and P. Caron

11:35 – 12:00

$\gamma'$  Formation in a Nickel-Base Disk Superalloy

T.P. Gabb, D.G. Backman, D.Y. Wei, D.P. Mourer, D. Furrer, A. Garg and D.L. Ellis

12:00 – 12:25

Microstructure and Mechanical Property Development in Superalloy U720LI  
D.U. Furrer and H.J. Fecht

12:25 – 12:50

Sub-Solidus HIP Process for P/M Superalloy Conventional Billet Conversion  
X. Pierron, A. Banik, G.E. Maurer, J. Lemsky, D.U. Furrer and S. Jain

WEDNESDAY, SEPTEMBER 20<sup>TH</sup>

#### **Session V: Mechanical Behavior**

8:30 – 8:55

Influence of Long Term Exposure in Air on Microstructure, Surface Stability and Mechanical Properties of Udimet 720LI

D. Helm and O. Roder

8:55 – 9:20

Effects of Grain and Precipitate Size Variation on Creep-Fatigue Behaviour of Udimet 720LI in Both Air and Vacuum

N.J. Hide, M.B. Henderson and P.A.S. Reed

9:20 – 9:45

Effect of Local Cellular Transformation on Fatigue Small Crack Growth in CMSX-4 and CMSX-2 at High Temperature

M. Okazaki, T. Hiura and T. Suzuki

9:45 – 10:10

Multiaxial Creep Deformation of Single Crystal Superalloys: Modelling and Validation

H.C. Basoalto, R.N. Ghosh, M.G. Ardakani, B. A. Shollock and M. McLean

10:10 – 11:10 Interactive Session III

Microstructural Changes in MA 760 during High Temperature Low Cycle Fatigue

A. Hynna and V.T. Kuokkala

High Temperature Low-Cycle Fatigue Behavior of Haynes 230 Superalloy

L.J. Chen, Y.H. He, P.K. Liaw, J.W. Blust, P.F. Browning, R.R. Seeley and D.L. Klarstrom

High Cycle Fatigue of ULTIMET Alloy

L. Jiang, C.R. Brooks, P.K. Liaw and D.L. Klarstrom

The Effect of Strain Rate and Temperature on the LCF Behavior of the ODS Nickel-Base Superalloy PM 1000

M. Heilmaier, M. Nganbe, F.E.H. Muller and L. Schultz

Effect of Thermomechanical Processing on Fatigue Crack Propagation in Inconel Alloy 783

L.Z. Ma, K.M. Chang, S.K. Mannan and S.J. Patel

The Ductility of Haynes 242 Alloy as a Function of Temperature, Strain Rate and Environment

S.D. Antolovich, D.L. Klarstrom and J.F. Radavich

Novel Techniques for Investigating the High Temperature Degradation of Protective Coatings on Nickel Base Superalloys

A.A. Alibhai, D.P. Garriga-Majo, B.A. Shollock and D.S. McPhail

Sintering of the Top Coat in Thermal Spray TBC Systems Under Service Conditions

J.A. Thompson, W. Ji, T. Klocker and T.W. Clyne

Overaluminising of NiCoCrAlY Coatings by Arc PVD on Ni-Base Superalloys

L. Swadzba, A. Maciejny and B. Mendala

Improving Properties of Single Crystal to Polycrystalline Cast Alloy Welds Through Heat Treatment

A.E. Kolman

Improving Repair Quality of Turbine Nozzles Using SA650 Braze Alloy

W.A. Demo, S. Ferrigno, D. Budinger and E. Huron

The Influence of B, P and C on Heat Affected Zone Micro-Fissuring in INCONEL type Superalloy

S. Benhaddad, N.L. Richards, U. Prasad, H. Guo and M.C. Chaturvedi

The Application of CALPHAD Calculations to Ni-Based Superalloys

N. Saunders, M. Fahrmann and C.J. Small

Formation of a Pt<sub>2</sub>Mo Type Phase in Long-Term Aged INCONEL Alloy 686

M.G. Fahrmann and J.R. Crum

Development of New Nitrided Nickel-Base Alloys for High Temperature Applications

C.D. Penna

MC-NG: A 4<sup>th</sup> Generation Single Crystal Superalloy for Future Aeronautical Turbine Blades and Vanes

D. Argence, C. Vernault, Y. Desvallees and D. Fournier

11:10 – 11:35

Investigations on the Origin and Effect of Anomalous Rafting

H. Biermann, U. Tetzlaff, H. Mughrabi, B. von Grossman, S. Mechsner and T. Ungar

11:35 – 12:00

Stress Rupture Behavior of Waspaloy and IN738LC at 600 °C in Low Oxygen Gaseous Environments Containing Sulfur

D.C. Seib

12:00 – 12:25

Isothermal and Thermomechanical Fatigue of Superalloy C263

Y.H. Zhang and D.M. Knowles

12:25 – 12:50

Structure/Property Interactions in a Long Range Order Strengthened Superalloy

M.F. Rothman, D.L. Klarstrom, M. Dollar and J.F. Radavich

## **Session VI – Coatings, Welding and Repair**

6:30 – 6:55

Processing Effects on the Failure of EBPVD TBCs on MCrAlY and Platinum Aluminide Bond Coats

N.M. Yanar, M.J. Stiger, G.H. Meier and F.S. Pettit

6:55 – 7:20

Compositional Effects on Aluminide Oxidation Performance: Objectives for Improved Bond Coats

B.A. Pint, J.A. Haynes, K.L. More, I.G. Wright and C. Leyens

7:20 – 7:45

Modelling and Neutron Diffraction Measurement of Stresses in Sprayed TBCs

J.A. Thompson, J. Matejicek and T.W. Clyne

7:45 – 8:15 Coffee Break

8:15 – 8:40

Interdiffusion Behavior in NiCoCrAlYRe-Coated IN-738 at 940 °C and 1050 °C

K.A. Ellison, J.A. Daleo and D.H. Boone

8:40 – 9:05

Effect of Coating on the TMF Lives of Single Crystal and Columnar Grained CM186 Blade Alloy

S.D. Peteves, F. De Haan, J. Timm, J. Bressers, P.M. Hughes, S.J. Moss, P. Johnson and M. Henderson

9:05 – 9:30

Process Modelling of the Electron Beam Welding of Aeroengine Components

R.C. Reed, H.J. Stone, D. Dye and S.M. Roberts

THURSDAY, SEPTEMBER 21<sup>ST</sup>

### **Session VII – Alloy Development**

8:30 – 8:55

Development of a New Single Crystal Superalloy for Industrial Gas Turbines

T. Hino, T. Kobayashi, Y. Koizumi, H. Harada and T. Yamagata

8:55 – 9:20

High  $\gamma'$  Solvus New Generation Nickel-Based Superalloys for Single Crystal Turbine Blade Applications

P. Caron

9:20 – 9:45

Distribution of Platinum Group Metals in Ni-Base Single Crystal Superalloys

H. Murakami, T. Honma, Y. Koizumi and H. Harada

9:45 – 10:10

Development of A Low Angle Grain Boundary Resistant Single Crystal Superalloy YH61

H. Tamaki, A. Yoshinari, A. Okayama and S. Nakamura



10:10 – 10:30 Coffee Break

10:30 – 10:55

Topologically Close Packed Phases in an Experimental Rhenium-Containing Single Crystal Superalloy

C.M.F. Rae, M.S.A. Karunaratne, C.J. Small, R.W. Broomfield, C.N. Jones and R.C. Reed

10:55 – 11:20

A Low-Cost Second Generation Single Crystal Superalloy DD6

J.R. Li, Z.G. Zhong, D.Z. Tang, S.Z. Liu, P. Wei, P.Y. Wei, Z.T. Wu, D. Huang and M. Han

11:20 – 11:45

The Development of Improved Performance PM Udimet 720 Turbine Disks

S.K. Jain, B.A. Ewing and C.A. Yin

11:45 – 12:10

Microstructural Stability and Crack Growth Behaviour of a Polycrystalline Nickel-Base Superalloy

D.W. Hunt, D.K. Skelton and D.M. Knowles