

2nd European Symposium on Superalloys and their Applications (EUROSUPERALLOYS 2014)

MATEC Web of Conferences Volume 14 (2014)

**Giens, France
12-16 May 2014**

Editors:

Jean-Yves Guedou

Jeanne Chone

ISBN: 978-1-63439-323-2

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

This work is licensed under a Creative Commons Attribution license:
<http://creativecommons.org/licenses/by/2.0/>

You are free to:

Share – copy and redistribute the material in any medium or format.

Adapt – remix, transform, and build upon the material for any purpose, even commercial.

The licensor cannot revoke these freedoms as long as you follow the license terms.

Under the following terms:

You must give appropriate credit, provide a link to the license, and indicate if changes were made.

You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. The copyright is retained by the corresponding authors.

Printed by Curran Associates, Inc. (2014)

For additional information, please contact EDP Sciences – Web of Conferences
at the address below.

EDP Sciences – Web of Conferences
17, Avenue du Hoggar
Parc d'Activité de Courtabœuf
BP 112
F-91944 Les Ulis Cedex A
France

Phone: +33 (0) 1 69 18 75 75

Fax: +33 (0) 1 69 28 84 91

contact@webofconferences.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2634
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

WHAT IS THE ROLE OF RHENIUM IN SINGLE CRYSTAL SUPERALLOYS?	1
<i>Mottura Alessandro, Reed Roger C.</i>	
COMPOSITIONAL EFFECT ON TCP PHASE FORMATION IN RU-CONTAINING NI-BASED SINGLE CRYSTAL SUPERALLOYS	7
<i>Shi Qianying, Huo Jiajie, Cao Lamei, Li Jie, Ding Xianfei, Zheng Yunrong, Feng Qiang</i>	
DEVELOPMENT OF A NEW 718-TYPE NI-CO SUPERALLOY FAMILY FOR HIGH TEMPERATURE APPLICATIONS AT 750°C	13
<i>Fedorova Tatiana, Rösler Joachim, Klöwer Jutta, Gehrmann Bodo</i>	
MECHANICAL PROPERTIES AND DEVELOPMENT OF SUPERSOLVUS HEAT TREATED NEW NICKEL BASE SUPERALLOY AD730™	19
<i>Devaux A., Berglin L., Thebaud L., Delattre R., Crozet C., Nodin O.</i>	
VACUUM INDUCTION MELTING AND VACUUM ARC REMELTING OF CO-AL-W-X GAMMA-PRIME SUPERALLOYS	25
<i>McDevitt Erin T.</i>	
FACTORS AFFECTING THE CORROSION FATIGUE LIFE IN NICKEL BASED SUPERALLOYS FOR DISC APPLICATIONS	31
<i>Rosier Hollie, Perkins Karen, Girling Andrew, Leggett Jonathan, Gibson Grant</i>	
MECHANISMS OF DWELL FATIGUE CRACK GROWTH IN AN ADVANCED NICKEL DISC ALLOY RR1000	37
<i>Yu S. Y., Li H. Y., Hardy M. C., McDonald S. A., Bowen P.</i>	
EFFECT OF MICROSTRUCTURE REFINEMENT ON LOW CYCLE FATIGUE BEHAVIOR OF ALLOY 718	43
<i>Mukhtarov Shamil, Utyashev Farid</i>	
TOWARD A BETTER UNDERSTANDING OF STRAIN INCOMPATIBILITIES AT GRAIN BOUNDARIES IN THE ANALYSIS OF FATIGUE CRACK INITIATION AT LOW TEMPERATURE IN THE UDIMET™ 720 LI SUPERALLOY	48
<i>Larrouy Baptiste, Villechaise Patrick, Cormier Jonathan, Berteaux Olivier</i>	
THE EFFECT OF MINIMUM DWELL CYCLES ON THE ENVIRONMENTAL AND FATIGUE RESPONSE OF RR1000	54
<i>O'Hanlon J. H., Hardy M. C., Child D. J., Foss B., Withers P. J., Bache M. R.</i>	
OXIDE-ASSISTED CRACK GROWTH IN HOLD-TIME LOW-CYCLE-FATIGUE OF SINGLE-CRYSTAL SUPERALLOYS	60
<i>Suzuki Akane, Gao Yan, Lipkin Don, Singhal Anjali, Krug Matthew, Konitzer Douglas, Almer Jonathan, Pollock Tresa, Bewlay Bernard</i>	
MICROSTRUCTURAL DAMAGE EVOLUTION IN TWO NI BASED SUPERALLOYS SUBJECTED TO DIFFERENT MECHANICAL LOADING CONDITIONS THROUGH QUANTITATIVE EBSD MEASUREMENTS USING CROSS-COURT SOFTWARE	65
<i>Vacchieri E., Costa A., Parodi S., Holdsworth S. R.</i>	
DEVELOPMENT AND APPLICATION OF A NEW FRECKLE CRITERION FOR TECHNICAL REMELTING PROCESSES	71
<i>Böttger B., Schmitz G. J., Wahlers F.-J., Klöwer J., Tewes J., Gehrmann B.</i>	
ORIGINS OF MISORIENTATION DEFECTS IN SINGLE CRYSTAL CASTINGS: A TIME RESOLVED IN SITU SYNCHROTRON X-RAY RADIOGRAPHY STUDY	77
<i>Aveson J. W., Reinhart G., Nguyen-Thi H., Mangelinck-Noël N., D\Souza N., Stone H. J.</i>	
PROBING THE STRAIN DISTRIBUTION WITHIN A SINGLE CRYSTAL SUPERALLOY DURING HIGH TEMPERATURE TESTING	82
<i>Alain Jacques, Biskri Mohamed, Schenk Thomas, Cornu Jean Philippe Chateau, Bastie Pierre</i>	
THERMOMECHANICAL FATIGUE IN SINGLE CRYSTAL SUPERALLOYS	88
<i>Moverare Johan J., Reed Roger C.</i>	
APPLICATION OF LASER ULTRASONICS TO MONITOR MICROSTRUCTURE EVOLUTION IN INCONEL 718 SUPERALLOY	94
<i>Garcin Thomas, Schmitt Jean-Hubert, Militzer Matthias</i>	
SOLUTIONS FOR THE "DIFFICULT-TO-DEFORM" WROUGHT SUPERALLOYS	100
<i>Bi Zhongnan, Lv Xudong, Zhang Ji</i>	
A STUDY ON THE EFFECT OF COMPOSITION, AND THE MECHANISMS OF RECRYSTALLISATION IN SINGLE CRYSTAL NI-BASED SUPERALLOYS	106
<i>Mathur Harshal N., Jones Neil (C. N.), Rae Catherine M. F.</i>	

CHARACTERIZATION OF ABNORMAL GRAIN COARSENING IN ALLOY 718	112
<i>Watson Richard, Preuss Michael, Fonseca João Quinta Da, Witulski Thomas, Terlinde Gregor, Büscher Markus</i>	
TAILORING THE GRAIN STRUCTURE OF IN718 DURING SELECTIVE ELECTRON BEAM MELTING	117
<i>Körner Carolin, Helmer Harald, Bauereiß Andreas, Singer Robert F.</i>	
EFFECT OF THERMAL EXPOSURE ON MICROSTRUCTURE AND NANO-HARDNESS OF BROACHED INCONEL 718	123
<i>Chen Zhe, Peng Ru Lin, Avdovic Pajazit, Zhou Jinming, Moverare Johan, Karlsson Fredrik, Johansson Sten</i>	
THE EFFECT OF RU ON PRECIPITATION OF TOPOLOGICALLY CLOSE PACKED PHASES IN RE – CONTAINING NI BASE SUPERALLOYS: QUANTITATIVE FIB-SEM INVESTIGATION AND 3D IMAGE MODELING	129
<i>Matuszewski Kamil, Rettig Ralf, Singer Robert F.</i>	
ON THE DIFFUSION MECHANISMS OF FINE-SCALE γ' IN AN ADVANCED NI-BASED SUPERALLOY	135
<i>Chen Y., Francis E. M., Preuss M., Haigh S. J.</i>	
EVOLUTION OF SECONDARY PHASES IN ALLOY ATI 718PLUS[®] DURING PROCESSING	140
<i>Casanova Ana, Martin-Piris Nuria, Hardy Mark, Rae Catherine</i>	
γ' PRECIPITATION KINETICS IN THE POWDER METALLURGY SUPERALLOY N19 AND INFLUENCE OF THE PRECIPITATION LATENT HEAT	146
<i>Perrut Mikael, Locq Didier</i>	
THRESHOLDS OF TIME DEPENDENT INTERGRANULAR CRACK GROWTH IN A NICKEL DISC ALLOY ALLOY 720LI	152
<i>Li Hangyue, Fisk Joe, Lim Lik-Beng, Williams Steve, Bowen Paul</i>	
THERMOMECHANICAL BEHAVIOR OF DIFFERENT NI-BASE SUPERALLOYS DURING CYCLIC LOADING AT ELEVATED TEMPERATURES	158
<i>Huber Daniel, Hacksteiner Matthias, Poletti Cecilia, Warchomicka Fernando, Stockinger Martin</i>	
RESIDUAL STRESSES IN INCONEL 718 ENGINE DISKS	164
<i>Dahan Yoann, Nouveau Sebastien, Georges Eric, Flageolet Benjamin</i>	
LARGE SCALE 3-D PHASE-FIELD SIMULATION OF COARSENING IN NI-BASE SUPERALLOYS	170
<i>Kumar Rajendran Mohan, Shchyglo Oleg, Steinbach Ingo</i>	
HIGH RESOLUTION ORIENTATION MAPPING OF SECONDARY PHASES IN ATI 718PLUS[®] ALLOY	175
<i>Krakow Robert, Hardy Mark C., Rae Catherine M. F., Midgley Paul A.</i>	
NUMERICAL SIMULATION OF AM1 MICROSTRUCTURE	180
<i>Rougier Luc, Jacot Alain, Gandin Charles-André, Napoli Paolo Di, Ponsen Damien, Jaquet Virginie</i>	
EXAMINATION OF CHEMICAL ELEMENTS PARTITIONING BETWEEN THE γ AND γ' PHASES IN CMSX-4 SUPERALLOY USING EDS MICROANALYSIS AND ELECTRON TOMOGRAPHY	186
<i>Kruk Adam, Dubiel Beata, Czyska-Filemonowicz Aleksandra</i>	
MODELLING TERNARY EFFECTS ON ANTIPHASE BOUNDARY ENERGY OF Ni_3Al	191
<i>Vamsi K. V., Karthikeyan S.</i>	
MISORIENTATION EFFECT OF GRAIN BOUNDARY ON THE FORMATION OF DISCONTINUOUS PRECIPITATION IN SECOND AND THIRD GENERATION SINGLE CRYSTAL SUPERALLOYS	197
<i>Yu Zhengrong, Ding Xianfei, Zheng Yunrong, Cao Lamei, Feng Qiang</i>	
MULTIPASS FORGING OF INCONEL 718 IN THE DELTA-SUPERSOLVUS DOMAIN: ASSESSING AND MODELING MICROSTRUCTURE EVOLUTION	203
<i>Zouari Meriem, Loge Roland E., Beltran Oscar, Rousselle Sébastien, Bozzolo Nathalie</i>	
PREDICTION OF RECRYSTALLISATION IN SINGLE CRYSTAL NICKEL-BASED SUPERALLOYS DURING INVESTMENT CASTING	209
<i>Panwisawas Chinnapat, Mathur Harshal N., Broomfield Robert W., Putman Duncan, Rae Catherine M. F., Reed Roger C.</i>	
TURBINE BLADES PRODUCTION TECHNIQUE EQUIPMENT BUILT WITH A GLANCE OF HIGH-GRADIENT DIRECTIONAL CRYSTALLIZATION PROCESS NATURE	215
<i>Echin Alexander, Bondarenko Yury</i>	
OPTIMIZATION OF THE HOMOGENIZATION AND HOT ISOSTATIC PRESSING HEAT TREATMENTS OF A FOURTH GENERATION SINGLE CRYSTAL SUPERALLOY	220
<i>Caron Pierre, Ramusat Catherine</i>	
WELDABILITY OF HAYNES 282 SUPERALLOY AFTER LONG-TERM THERMAL EXPOSURE	226
<i>Caron Jeremy, Pike Lee</i>	

EFFECT OF SOLIDIFICATION PARAMETERS ON THE SECONDARY DENDRITE ARM SPACING IN MAR M-247 SUPERALLOY DETERMINED BY A NOVEL APPROACH.....	232
<i>Milenkovic S., Rahimian M., Sabirov I., Maestro L.</i>	
DISSOLUTION KINETICS AND MORPHOLOGICAL CHANGES OF γ' IN AD730™ SUPERALLOY.....	237
<i>Masoumi F., Jahazi M., Cormier J., Shahriari D.</i>	
WELDABILITY OF THE SUPERALLOYS HAYNES 188 AND HASTELLOY X BY ND:YAG.....	243
<i>Graneix Jérémie, Beguin Jean-Denis, Pardheillan François, Alexis Joël, Masri Talal</i>	
REMOVAL OF CASTING DEFECTS FROM CMSX-4® AND CMSX-10® ALLOYS BY ELECTROPOLISHING IN A NOVEL ELECTROLYTE; DEEP EUTECTIC SOLVENT.....	249
<i>Dsouza Neil, Appleton Matthew, Ballantyne Andrew, Cook Amy, Harris Robert, Ryder Karl S.</i>	
EFFECT OF CARBON ON WETTABILITY AND INTERFACE REACTION BETWEEN MELT SUPERALLOY AND CERAMIC MATERIAL.....	256
<i>Chen Xiaoyan, Zhou Yizhou, Jin Tao, Sun Xiaofeng</i>	
THE ROLE OF PARTICLE RIPENING ON THE CREEP ACCELERATION OF NIMONIC 263 SUPERALLOY.....	261
<i>Angella Giuliano, Donnini Riccardo, Ripamonti Dario, Maldini Maurizio</i>	
RELATING FUNDAMENTAL CREEP MECHANISMS IN WASPALOY TO THE WILSHIRE EQUATIONS.....	267
<i>Deen C., Whittaker M. T., Harrison W., Rae C. M. F., Williams S. J.</i>	
CREEP BEHAVIOR OF A NOVEL CO-AL-W-BASE SINGLE CRYSTAL ALLOY CONTAINING TA AND TI AT 982°C.....	273
<i>Xue Fei, Zhou Haijing, Chen Xuhua, Shi Qianying, Chang Hai, Wang Meiling, Ding Xianfei, Feng Qiang</i>	
FATIGUE CRACK INITIATION IN NICKEL-BASED SUPERALLOYS STUDIED BY MICROSTRUCTURE-BASED FE MODELING AND SCANNING ELECTRON MICROSCOPY.....	279
<i>Fried M., Krechel C., Affeldt E. E., Eckert B., Kimmig S., Retze U., Höppel H. W., Göken M.</i>	
DYNAMIC STRAIN AGING IN HAYNES 282 SUPERALLOY.....	286
<i>Hörnqvist Magnus, Joseph Ceena, Persson Christer, Weidow Jonathan, Lai Haiping</i>	
FATIGUE CRACK GROWTH FROM HANDLING SURFACE ANOMALIES IN A NICKEL BASED SUPERALLOY AT HIGH TEMPERATURE.....	292
<i>Gourdin Stéphane, Doremus Luc, Nadot Yves, Hénaff Gilbert, Pierret Stéphane</i>	
SIMULATION OF OXIDATION-NITRIDATION-INDUCED MICROSTRUCTURAL DEGRADATION IN A CRACKED NI-BASED SUPERALLOY AT HIGH TEMPERATURE.....	298
<i>Yuan Kang, Peng Ru Lin, Li Xin-Hai, Johansson Sten, Wang Yan-Dong</i>	
STRAIN RATE AND TEMPERATURE EFFECTS ON CRACK INITIATION OF DIRECT AGED 718 ALLOY.....	304
<i>Perrais Maxime, Burteau Anthony, Seror Alexandre, Poquillon Dominique, Andrieu Eric</i>	
CYCLIC PLASTICITY AND LIFETIME OF THE NICKEL-BASED ALLOY C-263: EXPERIMENTS, MODELS AND COMPONENT SIMULATION.....	308
<i>Maier G., Hübsch O., Riedel H., Somsen C., Klöwer J., Mohrmann R.</i>	
DEVELOPMENT OF ADVANCED P/M NI-BASE SUPERALLOYS FOR TURBINE DISKS.....	314
<i>Garibov Genrikh S., Grits Nina M., Vostrikov Alexey V., Fedorenko Yelizaveta A., Volkov Alexander M.</i>	
NEW SINGLE CRYSTAL SUPERALLOYS – OVERVIEW AND UPDATE.....	318
<i>Wahl Jacqueline, Harris Ken</i>	
ON THE EFFECT OF BORON ON THE MECHANICAL PROPERTIES OF A NEW POLYCRYSTALLINE SUPERALLOY.....	324
<i>Kontis Paraskevas, Mohd Yusof Hanis A., Moore Katie L., Grovenor Chris R. M., Reed Roger C.</i>	
HAYNES 244 ALLOY – A NEW 760°C CAPABLE LOW THERMAL EXPANSION ALLOY.....	330
<i>Fahrman Michael G., Srivastava S. Krishna, Pike Lee M.</i>	
FIRST PRINCIPLES STUDY OF STRUCTURAL STABILITY AND SITE PREFERENCE IN CO₃ (W,X).....	335
<i>Joshi Sri Raghunath, Vamsi K. V., Karthikeyan S.</i>	
INVESTIGATION OF TERNARY SUBSYSTEMS OF SUPERALLOYS BY THIN-FILM COMBINATORIAL SYNTHESIS AND HIGH-THROUGHPUT ANALYSIS.....	341
<i>König Dennis, Pfetzing-Micklich Janine, Frenzel Jan, Ludwig Alfred</i>	
LIFING THE THERMO-MECHANICAL FATIGUE (TMF) BEHAVIOUR OF THE POLYCRYSTALLINE NICKEL-BASED SUPERALLOY RR1000.....	345
<i>Jones Jonathan, Whittaker Mark, Lancaster Robert, Williams Stephen</i>	
CREEP-FATIGUE INTERACTIONS IN EQUIAXED AND SINGLE CRYSTAL NI-BASE SUPERALLOYS.....	351
<i>Vacchieri E., Costa A., Riva A., Poggio E., Holdsworth S. R.</i>	

DEVELOPMENT AND USE OF A NEW BURNER RIG FACILITY TO MIMIC SERVICE LOADING CONDITIONS OF NI-BASED SINGLE CRYSTAL SUPERALLOYS	357
<i>Mauget Florent, Marchand Damien, Benoit Guillaume, Morisset Médéric, Bertheau Denis, Cormier Jonathan, Mendez José, Hervier Zéline, Ostoja-Kuczynski Elisabeth, Moriconi Clara</i>	
CREEP DEFORMATION BEHAVIOUR OF RHENIUM FREE NI-BASED SINGLE CRYSTAL SUPERALLOYS LSC-15.....	363
<i>Tsuno Nobuyasu, Takahashi Satoshi</i>	
IMPACT OF MICROSTRUCTURAL EVOLUTIONS DURING THERMAL AGING OF ALLOY 625 ON ITS MONOTONIC MECHANICAL PROPERTIES	367
<i>Suave Lorena Mataveli, Bertheau Denis, Cormier Jonathan, Villechaise Patrick, Soula Aurélie, Hervier Zéline, Laigo Johanne</i>	
INFLUENCE OF THE QUENCHING RATE AND STEP-WISE COOLING TEMPERATURES ON MICROSTRUCTURAL AND TENSILE PROPERTIES OF PER72 ® NI-BASED SUPERALLOY.....	373
<i>Le Baillif Paul, Lamesle Pascal, Delagnes Denis, Velay Vincent, Dumont Christian, Rézai-Aria Farhad</i>	
STUDYING THE INFLUENCE OF SUBSTITUTIONAL ELEMENTS ON MECHANICAL BEHAVIOR OF ALLOY 718.....	379
<i>Max Bertrand, Juan Jose San, Nó Maria L., Cloué Jean-Marc, Viguier Bernard, Andrieu Eric</i>	
Author Index	