

International Conference on Modeling of Casting, Welding and Advanced Solidification Processes 2012

(MCWASP XIII)

**IOP Conference Series: Materials Science and Engineering
Volume 33**

**Schladming, Austria
17 - 22 June 2012**

**ISBN: 978-1-63439-844-2
ISSN: 1779-8; 83**

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.

Copyright© by the Institute of Physics
All rights reserved.

Printed by Curran Associates, Inc. (2015)

For permission requests, please contact the Institute of Physics
at the address below.

Institute of Physics
Dirac House, Temple Back
Bristol BS1 6BE UK

Phone: 44 1 17 929 7481
Fax: 44 1 17 920 0979

techtracking@iop.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

Volume 33

MCWASP XIII: International Conference on Modeling of Casting, Welding and Advanced Solidification Processes
17–22 June 2012, Schladming, Austria

Accepted papers received: 4 April 2012
Published online: 3 July 2012

Preface

011001

[MCWASP XIII: International Conference on Modeling of Casting, Welding and Advanced Solidification Processes](#) Andreas Ludwig

011002

[Peer review statement](#)

Papers

Ingot and Shape Casting

012001

[A Method to set process parameters of local squeeze in HPDC](#) I Ohnaka, J D Zhu, A Sugiyama and F Kinoshita pg. 1

012002

[Simulation of microstructure and mechanical properties of aluminum components during casting and heat treatment](#) M Schneider, W Schaefer, E Sjölander, S Seiffeddine and I L Svensson pg. 9

012003

[The application of integrated computational material engineering \(ICME\) in metal castings simulation](#) J Guo, W Cao and M Samonds pg. 17

012004

[Improving the directional solidification of complex geometries through taper addition](#) C A Monroe, D A Gorsky, R K Huff and R V Grandhi pg. 25

012005

[Modeling and Optimizing Ti-6Al-4V Ingot Production](#) R Shuster, C Reilly, D M Maijer and S L Cockcroft pg. 34

012006

[Through process numerical simulation of a heavy hydro turbine blade casting](#) J W Kang, T J Wang, T Y Huang and B C Liu pg. 42

012007

[Predictions of misruns using three-phase coupled mold-filling and solidification simulations in low pressure turbine \(LPT\) blades](#) S Jana, O Kättlitz, F Hediger, J Jakumeit and J Aguilar pg. 50

012008

[Computer simulation applied to jewellery casting: challenges, results and future possibilities](#) D Tiberto and U E Klotz pg. 58

012009

[The improvement of aluminium casting process control by application of the new CRIMSON process](#) X Dai, M Jolly and B Zeng pg. 68

012010

[Determination of the metal/die interfacial heat transfer coefficient of high pressure die cast B390 alloy](#) Y Cao, Z Guo and S Xiong pg. 76

012011

[Experiment and simulation study on particulate distribution in A356/SiCp suction casting](#) F Sun, H Zhao, Y Zhao, P Dong and F Chen pg. 86

Continuous Casting and Direct Chill Casting

012012

[A numerical benchmark test for continuous casting of steel](#) B Šarler, R Vertnik and K Mramor pg. 94

012013

[Industrial application of a numerical model to simulate lubrication, mould oscillation, solidification and defect formation during continuous casting](#) P E R Lopez, U Sjöström, T Jonsson, P D Lee, K C Mills, M Petäjäjärvi and J Pirinen pg. 104

012014

[Modeling of the flow-solidification interaction in thin slab casting](#) A Vakhrushev, M Wu, A Ludwig, Y Tang, G Hackl and G Nitzl pg. 114

012015

[Simulation of transient fluid flow in mold region during steel continuous casting](#) R Liu, B G Thomas and J Sengupta pg. 122

012016

[A dynamic control water distribution model of steel in continuous casting](#) J-X Fu, W-S Hwang, D-C Tsai, M Tsai and C-H Wang pg. 132

012017

[Modelling of heat transfer and solidification processes in horizontal twin-roll casting of magnesium AZ31](#) A Miehe and U Gross pg. 140

012018

[Three dimensions thermal-mechanical model of the billet in continuous casting petal-like mould](#) J Li, T Wang, L Wu, Z Cao and T Li pg. 148

012019

[Effect of inlet geometry on macrosegregation during the direct chill casting of 7050 alloy billets: experiments and computer modelling](#) L Zhang, D G Eskin, A Miroux, T Subroto and L Katgerman pg. 156

012020

[Simulation study on continuous casting process of Al/Al bimetal round billet under multi-electromagnetic](#) L Wu, T Wang, Y Fu, J Li, Z Cao and T Li pg. 164

012021

[A multiscale slice model for continuous casting of steel](#) B Šarler, R Vertnik, A Z Lorbiecka, I Vušanović and B Senčič pg. 174

012022

[Comprehensive CFD simulation of the ladle cycle toward lining service life optimization](#) M Al-Harbi, A Al-Nefai, S Al-Jarallah, A Al-Dossary and Y Jagan pg. 182

Directional Solidification and Zone Melting

012023

[Modeling and Numerical Optimization of Withdrawal Rate in Directional Solidification Process](#) V Monastyrskiy pg. 191

012024

[Thermal simulation of thermoelectric material by zone-melting technique](#) Y-R Chen, W-S Hwang, H-L Hsieh, T-K Huang, J-D Hwang and M-H Hung pg. 199

Modeling of Welding

012025

[3D finite element simulation of TIG weld pool](#) X Kong, O Asserin, S Gounand, P Gilles, J M Bergheau and M Medale pg. 209

012026

[A combined enthalpy / front tracking method for modelling melting and solidification in laser welding](#) G Duggan, W U Mirihanage, M Tong and D J Browne pg. 217

012027

[Effects of electrode bevel angle on argon arc properties and weld shape](#) W C Dong, S P Lu, D Z Li and Y Y Li pg. 226

012028

[Design of a braze alloy for fast epitaxial brazing of superalloys](#) S Piegert, B Laux and J Rösier pg. 234

012029

[An integrated framework for multi-scale multi-physics numerical modelling of interface evolution in welding](#) M Tong, J Liu, Y Xie, H B Dong, R L Davidchack, J Dantzig, D Ceresoli, N Marzari, A Cocks, C Zhao, I Richardson, A Kidess, C Kleijn, L Hoglund, S W Wen, R Barnett and D J Browne pg. 246

Centrifugal Casting

012030

[Modelling of horizontal centrifugal casting of work roll](#) Z Xu, N Song, R V Tol, Y Luan and D Li pg. 258

012031

[Numerical simulation of centrifugal casting of pipes](#) E Kaschnitz pg. 266

012032

[Shallow water model for horizontal centrifugal casting](#) J Boháček, A Kharicha, A Ludwig and M Wu pg. 272

Experimental Investigation and In-Situ Observations

012033

[In-situ observation of transient columnar dendrite growth in the presence of thermo-solutal convection](#) W U Mirihanage, L Arnberg and R H Mathiesen pg. 281

012034

[X-ray tomographic microscopy analysis of the dendrite orientation transition in Al-Zn](#) J Friedli, J L Fife, P Di Napoli and M Rappaz pg. 287

012035

[In situ X-ray monitoring of convection effects on segregation freckle formation](#) N Shevchenko, S Eckert, S Boden and G Gerbeth pg. 296

012036

[Massive transformation from \$\delta\$ phase to \$\gamma\$ phase in Fe-C alloys and strain induced in solidifying shell](#) H Yasuda, T Nagira, M Yoshiya, A Sugiyama, N Nakatsuka, M Kiire, M Uesugi, K Uesugi, K Umetani and K Kajiwara pg. 304

012037

[In situ, time-resolved tomography for validating models of deformation in semi-solid alloys](#) K M Kareh, P D Lee and C M Gourlay pg. 312

012038

[Quantifying damage accumulation during the hot deformation of free-cutting steels using ultra-fast synchrotron tomography](#) C Puncreobutr, P D Lee, M Kaye, D Balint, D Farrugia, T Connolley and J Lin pg. 320

012039

[Real time imaging on dendrite morphology evolution during alloy solidification under electric field](#) J Zhu, T Wang, Z Chen, J Xu, H Xie, T Xiao and T Li pg. 328

012040

[Observation of the initiation and propagation of solidification cracks by means of in situ synchrotron X-ray radiography](#) J W Aveson, G Reinhart, B Billia, H Nguyen-Thi, N Mangelinck-Noël, T A Lafford, C A Vie, J Baruchel and H J Stone pg. 336

012041

[In-Situ Observation of Horizontal Centrifugal Casting using a High-Speed Camera](#) H Esaka, K Kawai, H Kaneko and K Shinozuka pg. 344

012042

[Simultaneous observation of melt flow and motion of equiaxed crystals during solidification using a dual phase Particle Image Velocimetry technique](#) A Kharicha, M Stefan-Kharicha, A Ludwig and M Wu pg. 352

012043

[Observation of peritectic reaction in Ag-Sn alloys](#) Y Hattori, H Esaka and K Shinozuka pg. 360

012044

[Correlation between microstructure and yield strength of a high-strength cold rolled enameling steel](#) M Jiang, F J Zheng, X F Huang, T Dai, B W Krakauer and M F Zhu pg. 368

Electromagnetic Coupling

012045

[Using thermoelectric magnetohydrodynamics to control microstructural evolution](#) A Kao and K Pericleous pg. 376

012046

[Simulation of a directional solidification of a binary Al-7wt%Si and a ternary alloy Al-7wt%Si-1wt%Fe under the action of a rotating magnetic field](#) O Budenkova, F Baltaretu, J Kovács, A Roósz, A Rónaföldi, A -M Bianchi and Y Fautrelle pg. 384

012047

[Adjustment and verification of macroscopic melt flow during solidification by means of various AC magnetic fields](#) S Eckert, D Rábiger, T Vogt, S Franke, J Czarske and G Gerbeth pg. 393

012048

[Radial solidification of Al-Si alloys in the presence of a rotating magnetic field](#) V Travnikov, P A Nikrityuk, K Eckert, D Rábiger, S Odenbach and S Eckert pg. 401

Thermomechanics

012049

[Measurement and simulation of deformation and stresses in steel casting](#) D Galles, C A Monroe and C Beckermann pg. 410

012050

[Transient and residual stresses in large castings, taking time effects into account](#) J Thorborg, J Klinkhammer and M Heitzer pg. 418

012051

[Casting and stress-strain simulations of a cast ductile iron component using microstructure based mechanical behavior](#) J Olofsson and I L Svensson pg. 426

012052

[A partitioned resolution for concurrent fluid flow and stress analysis during solidification: application to ingot casting](#) M Bellet, O Boughanmi and G Fidel pg. 434

012053

[Macroscopic modelling of semisolid deformation for considering segregation bands induced by shear deformation](#) S Morita, H Yasuda, T Nagira, C M Gourlay, M Yoshiya and A Sugiyama pg. 440

012054

[Numerical tensile test on a mushy zone sample](#) J-F Zaragoci, L Silva, M Bellet and C-A Gandin pg. 448

012055

[Simulation of distortion and residual stress in high pressure die casting – modelling and experiments](#) P Hofer, E Kaschnitz and P Schumacher pg. 456

012056

[Modelling of shrinkage cavity defects during the wheel and belt casting process](#) S Dablement, D Mortensen, H Fjaer, M Lee, J Grandfield, G Savage and V Nguyen pg. 464

012057

[Simulating the deformation of dies in the foundry](#) A Chabod, Y Longa, J M Dracon, K Chailier, P Hairy and A Da Silva pg. 474

012058

[Thermo-mechanical modeling of dendrite deformation in continuous casting of steel](#) J Domitner, J -M Drezet, M Wu and A Ludwig pg. 481

012059

[Residual Thermal Stresses Simulation for Multi-crystalline Silicon Casting](#) J-W Huang, W-S Hwang, C-H Hwang and Y-W Chang pg. 489

Thermodynamics and Solidification Paths

012060

[Neutron diffraction analysis and solidification modeling of Impulse-Atomized Al-36 wt%Ni](#) A Ilbagi, D Tourret, H Henein and C -A Gandin pg. 497

012061

[Prediction of solidification path and carbide precipitation in Fe-C-V-Cr-Mo-W high speed steels](#) H Zhang, C-A Gandin, J He and K Nakajima pg. 507

012062

[Resampling technique applied to statistics of microsegregation characterization](#) J Lacaze, J Eiken and A Hazotte pg. 515

012063

[A multiphase segregation model for multicomponent alloys with a peritectic transformation](#) H Zhang, C-A Gandin, K Nakajima and J He pg. 523

012064

[Linking up of HT-LSCM and DSC measurements to characterize phase diagrams of steels](#) P Presoly, R Pierer and C Bernhard pg. 531

012065

[Using orthogonal experimental design to optimize alloy composition](#) X M Li and J J Yu pg. 540

012066

[Investigation of solidification in undercooled Al-rich Al-Ni alloy systems](#) G J Ehlen and D M Herlach pg. 549

Prediction of Defects

012067

[Simplified pressure model for quantitative shrinkage porosity prediction in steel castings](#) A V Catalina and C A Monroe pg. 559

012068

[Semi-quantitative predictions of hot tearing and cold cracking in aluminum DC casting using numerical process simulator](#) T Subroto, A Miroux, D Mortensen, M M'Hamdi, D G Eskin and L Katgerman pg. 567

012069

[Integrated design of castings: effect of porosity on mechanical performance](#) R A Hardin and C Beckermann pg. 575

012070

[A 3D coupled hydro-mechanical granular model for the prediction of hot tearing formation](#) M Sistaninia, A B Phillion, J -M Drezet and M Rappaz pg. 583

012071

[Numerical study of dendrite coherency during equiaxed solidification by the Discrete Element Method](#) L Yuan, C O'Sullivan and C M Gourlay pg. 591

012072

[Modelling of different entrainment mechanisms and their influences on the mechanical reliability of Al-Si castings](#) Y Yue and N R Green pg. 599

012073

[Modelling of liquid metal flow and oxide film defects in filling of aluminium alloy castings](#) X Dai, M Jolly, X Yang and J Campbell pg. 607

012074

[Four-phase fully-coupled mold-filling and solidification simulation for gas porosity prediction in aluminum sand casting](#) J Jakumeit, S Jana, T Waclawczyk, A Mehdizadeh, A Sadiki and J Jouani pg. 617

Meso/Macroscale Modeling of Structure and Segregation

012075

[Simulation of the as-cast structure of Al-4.0wt.%Cu ingots with a 5-phase mixed columnar-equiaxed solidification model](#) M Wu, M Ahmadein, A Kharicha, A Ludwig, J H Li and P Schumacher pg. 627

012076

[Integrated modeling and heat treatment simulation of austempered ductile iron](#) E Hepp, V Hurevich and W Schäfer pg. 635

012077

[Direct simulation of a directional solidification experiment observed *in situ* and real-time using X-ray imaging](#) G Reinhart, Ch-A Gandin, N Mangelinck-Noël, H Nguyen-Thi, B Billia and J Baruchel pg. 645

012078

[Modeling of microstructure evolution of magnesium alloy during the high pressure die casting process](#) M Wu and S Xiong pg. 653

012079

[Multiscale modeling of the solidification microstructure evolution in the presence of ultrasonic stirring](#) L Nastac pg. 661

012080

[Numerical simulation on austenitization of cast steel during heating process](#) B Su, Z Q Han, B C Liu, Y R Zhao, B Z Shen and L Z Zhang pg. 669

012081

[Modeling of different zones of as-cast structure of high carbon steel ingots](#) Z Chen, S Arnsfeld and D Senk pg. 677

012082

[3-D analysis of grain selection process](#) T Arao, H Esaka and K Shinozuka pg. 685

012083

[Cellular automaton modelling of ductile iron microstructure in the thin wall casting](#) A A Burbelko, D Gurgul, W Kapturkiewicz and M Górny pg. 694

012084

[A Stochastic mesoscopic model for predicting the globular grain structure and solute redistribution in cast alloys at low superheat](#) L Nastac and N E Kaddah pg. 703

012085

[Prediction of Solidification and Microstructure of Inconel Alloy Using Numerical Simulation](#) J Roučka, V Kosour, M Kováč, V Krutiš and K Hrbacek pg. 711

Formation of Macrosegregation

012086

[Analysis of a numerical benchmark for columnar solidification of binary alloys](#) H Combeau, M Bellet, Y Fautrelle, D Gobin, E Arquis, O Budenkova, B Dussoubs, Y Du Terrail, A Kumar, C -A Gandin, B Goyeau, S Mosbah, T Quatravaux, M Rady and M Založnik pg. 719

012087

[3D CAFE simulation of a macrosegregation benchmark experiment](#) T Carozzani, H Digonnet, M Bellet and C -A Gandin pg. 731

012088

[Three-dimensional study of macro- and mesosegregation formation in a rectangular cavity cooled from one vertical side](#) V F De Felice, K O Tveito, M Založnik, H Combeau and M M'Hamdi pg. 740

012089

[Numerical study of the impact of inoculant and grain transport on macrosegregation and microstructure formation during solidification of an Al-22%Cu alloy](#) K O Tveito, M Bedel, M Založnik, H Combeau, M M'Hamdi, A Kumar and P Dutta pg. 748

012090

[Modelling of macrosegregation in steel ingots: benchmark validation and industrial application](#) W LI, B SHEN, H SHEN and B LIU pg. 756

012091

[Modelling macrosegregation in a 2.45 ton steel ingot](#) J Li, M Wu, A Ludwig and A Kharicha pg. 764

012092

[Numerical simulation of delayed pouring technique for a 360t heavy steel ingot](#) J Li, D R Liu, X H Kang and D Z Li pg. 772

012093

[Modeling of macrosegregation and solidification microstructure for Al-Si alloy under unidirectional solidification by a coupled cellular automaton – finite volume model](#) H Zhang, K Nakajima, E Wang and J He pg. 780

012094

[Numerical study of effect of sulphur element on mesosegregation by thermosolutal convection in Iron-Carbon-Sulphur system](#) D R Liu, X H Kang and D Z Li pg. 790

Structure Formation at Microscale

012095

[Multi-scale needle-network model of complex dendritic microstructure formation](#) D Tourret and A Karma pg. 798

012096

[Quantitative phase-field model for dendritic growth with two-sided diffusion](#) S Y Pan and M F Zhu pg. 806

012097

[Capillary-mediated dendritic branching](#) M E Glicksman pg. 814

012098

[Competitive grain growth in directional solidification investigated by phase field simulation](#) J Li, Z Wang, Y Yang and J Wang pg. 822

012099

[A new approach to multi-phase field for the solidification of alloys](#) P C Bollada, P K Jimack and A M Mullis pg. 830

012100

[A modified cellular automaton method for polydimensional modelling of dendritic growth and microsegregation in multicomponent alloys](#) S C Michelic, J M Thuswaldner and C Bernhard pg. 838

012101

[Phase field simulation of multi-dendrite growth in a coupled thermal-solute-convective environment](#) Z Guo, J Mi and P S Grant pg. 846

012102

[Influence of natural convection on microstructure evolution during the initial solidification transient: comparison of phase-field modeling with in situ synchrotron X-ray monitoring data](#) Y Chen, H Nguyen-Thi, D Z Li, A-A Bogno, B Billia and N M Xiao pg. 854

012103

[Modelling of dendritic growth and bubble formation](#) W Wu, M F Zhu, D K Sun, T Dai, Q Y Han and D Raabe pg. 864

012104

[3D Phase-Field Simulation of Micropore Formation during Solidification: Morphological Analysis](#) H Meidani, A Jacot and M Rappaz pg. 872

012105

[Numerical solution of the phase-field equation with minimized discretization error](#) J Eiken pg. 880

012106

[Growth of a free dendrite in pure substances under modulated flow conditions](#) H Neumann-Heyme, K Eckert, A Voigt and S Odenbach pg. 888

012107

[Phase-field modelling of microstructure formation during the solidification of continuously cast low carbon and HSLA steels](#) B Böttger, M Apel, B Santillana and D G Eskin pg. 896

012108

[Fractal characteristics of dendrite in aluminum alloys](#) K Ohsasa, T Katsumi, R Sugawara and Y Natsume pg. 904

012109

[Phase-field modelling of rapid solidification in alloy systems: Spontaneous grain refinement effects](#) A M Mullis pg. 913

012110

[Phase field simulation of precipitation in a Mg-Al alloy using two techniques of approximation](#) G M Han, Z Q Han, A A Luo, A K Sachdev and B C Liu pg. 921

012111

[Phase-field modeling of the dendrite orientation transition in Al-Zn alloys](#) J Friedli, P Di Napoli, M Rappaz and J A Dantzig pg. 929

012112

[Modeling and simulation of dendrite growth in solidification of Al-Si-Mg ternary alloys](#) Y Shi, Y Zhang, Q Xu, B Liu, H Cui and G Mi pg. 939

Numerical Methods

012113

[Molecular dynamics calculation of thermodynamic properties of iron solidification](#) J Liu and H B Dong pg. 947

012114

[Application of particle method to the casting process simulation](#) N Hirata, Y M Zulaida and K Anzai pg. 957

012115

[Exploration of the double-diffusive convection during dendritic solidification with a combined volume-averaging and cellular-automaton model](#) A Kharicha, M Stefan-Kharicha, M Wu and A Ludwig pg. 965