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Member of the ESI Group

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Solidification Course 2016

Announcement

Villars (Switzerland)

May 29 – June 3, 2016

THE LECTURERS

Courses, discussions and exercises will be presented by the following lecturers:

Prof. Christoph Beckermann	Professor, University of Iowa, Iowa City, USA
Dr William J. Boettinger	NIST Fellow Emeritus, National Institute of Standards and Technology (NIST), Gaithersburg, USA Member of the National Academy of Engineering
Prof. Hervé Combeau	Professor, Lorraine University, Institut Jean Lamour, Nancy, France
Prof. Jon Dantzig	Professor Emeritus, University of Illinois, Urbana, USA
Dr Marco Gremaud	Director, Calcom ESI, Lausanne, Switzerland
Prof. Matthew John M. Krane	Professor, Purdue University, USA
Prof. Andreas Ludwig	Professor, Montanuniversitaet Leoben, Austria
Prof. Michel Rappaz	Professor Emeritus, Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland

SCOPE OF THE COURSE

For the twenty-fifth consecutive year, Calcom ESI, in collaboration with the Swiss Federal Institute of Technology of Lausanne (EPFL), is organizing a solidification course with the participation of renowned lecturers from Swiss, French, Austrian and US universities.

This one-week course held in English is designed for engineers and scientists from industry and research centers who wish to improve their knowledge in the field of solidification. Participants should have a degree in materials science, metallurgy, mechanical engineering, physics or chemistry.

Although the theoretical background of solidification is reviewed, the course is oriented towards the application of solidification theories to industrial processes. The macroscopic aspects of the processes (transfer phenomena) are addressed together with the formation of microstructures and defects (microscopic phenomena). Connection between macroscopic and microscopic aspects, such as the prediction of microstructures and defects as a function of process parameters, is also emphasized. Examples of the application of these concepts to industrial processes, such as shape casting, continuous casting and directional solidification, are given.

Exercises, discussions, films and computer demonstrations are organized in order to apply, practice and visualize the content of the lectures. Due to the limited number of participants (maximum 35-40), interactions between the participants and the eight lecturers will allow an optimum transfer of knowledge, during the whole week, as was demonstrated during the previous editions.

Finally, private or group discussions can take place during social hours, evenings and Wednesday afternoon in order to treat more specific problems which the participants may encounter.

The Course is following very closely the content of the Book “Solidification” from J.A. Dantzig and M. Rappaz.

PROGRAMME

Sunday May 29, 2016

From 18:30	Welcome of the participants, registration	
19.15	Dinner	

Monday May 30, 2016

08.30 - 09.45	Introduction / Overview of solidification phenomena	M. Gremaud
09.45 - 10.15	Break	
10.15 - 11.15	Phase diagrams	W. Boettinger
11.15 - 12.15	Discussion/Exercises (Phase diagrams)	M. Rappaz / W. Boettinger
12.30	Lunch	
13.45 - 14.45	Heat and mass transfer	M. Krane
14.45 - 15.45	Discussion/Exercises (Heat & mass tr.)	C. Beckermann / M. Krane
15.45 - 16.15	Break	
16.15 – 17.15	Nucleation and grain refinement in alloys	M. Rappaz
17.15 - 18.00	In-situ visualization of solidification (films)	W. Boettinger
18.30	Social Hour	
19.30	Dinner	

Tuesday May 31, 2016

08.30 - 09.30	Microsegregation	C. Beckermann
09.30 - 10.30	Discussion/Exercises (Microsegregation)	A. Ludwig / C. Beckermann
10.30 - 11.00	Break	
11.00 - 12.00	Dendritic structures	J. Dantzig
12:15	Lunch	
14.00 - 15.00	Eutectic solidification	A. Ludwig
15.00 - 16.15	Discussion/Exercises (Dendrites-Eutectic)	J. Dantzig / A. Ludwig
16.15 - 16.45	Break	
16.45 - 17.45	Mushy zone modeling	H. Combeau
18.30	"Swiss Evening" dinner	

Wednesday June 1, 2016

08.30 - 09.30	Porosity	C. Beckermann
09.30 - 10.30	Discussion/Exercises (Microporosity)	M. Rappaz / C. Beckermann
10.30 - 11.00	Break	
11.00 - 12.00	Modeling of columnar and equiaxed solidification	H. Combeau
12.15	Lunch	
	Free time (free discussions with the professors)	
18.00	Social hour	
19.00	Dinner	

Thursday June 2, 2016

08.30 - 09.30	Macrosegregation	A. Ludwig
09.30 – 10.45	Discussion/Exercises (Macrosegregation)	H. Combeau / A. Ludwig
10.45 - 11.15	Break	
11.15 - 12.15	Solidification path in multi-component systems	W. Boettinger
12.30	Lunch	
14.15 - 15.30	Discussion/Exercises (Multi-comp)	C. Beckermann / W. Boettinger
15.30 - 16.00	Break	
16.00 - 17.00	Thermomechanics	J. Dantzig
17.00 - 17.45	Modeling examples	M. Gremaud / M. Rappaz
18.00	Social hour	
19.00	Dinner	

Friday June 3, 2016

08.30 - 09.30	Hot tearing	M. Rappaz
09.30 - 10.30	Discussion/Ex. (Thermomec.&Hot Tear.)	J. Dantzig / M. Rappaz
10.30 - 11.00	Break	
11.00 - 11.45	Synthesis – Linking solidification phenomena	M. Krane
11.45	Concluding remarks	M. Gremaud
11.55	End	
12.00	Lunch	

PRACTICAL INFORMATION

Dates:	from Sunday May 29, 2016 evening to Friday June 3, 2016, mid-day (lunch included).
Location:	Hotel "Eurotel Victoria", Villars, Switzerland (Mountain resort in the Swiss Alps, 100 km from Geneva) www.eurotel-victoria.ch/villars/
Access:	Train or car (2.5 hours by train from Geneva Airport and 4.5 hours by train from Zurich Airport).
Registration:	As soon as possible with the enclosed registration form (to be sent by post or scanned by email to Calcom ESI). *Thanks to send <u>also</u> an email to solidification.course@esi-group.com in order to make sure that we have well received your registration.* Only the first 40 persons will be taken into consideration. All registrations will be confirmed in writing within 2-3 weeks.
Price:	EUR 4'290.- (EUR = Euro currency) This price includes the registration fee, the booklet of the course with the lecture notes, the book "Solidification", the hotel (full board), drinks during the meals, social hours and coffee breaks. The course fee should be paid before April 25, 2016. *A confirmed registration corresponds to a firm commitment. This means that the course fee should paid in any case, unless this registration is cancelled in writing at least 45 days prior to the start of the course.*
Address for payment:	Banque Cantonale Vaudoise (BCV) Case postale 300 CH-1001 Lausanne, Switzerland SWIFT code: BCVLCH2L Clearing number: 767 Calcom ESI account: CO E 5001.77.74 IBAN: CH12 0076 7000 E500 1777 4 To the order of CALCOM ESI

An information package with the practical details will be sent in advance (around end of April 2016) to each registered participant.

REGISTRATION

Solidification Course 2016

Villars (Switzerland) May 29 – June 3, 2016

Mr ☐ Mrs ☐ Ms ☐ First name: _____

Last name: _____

Company: _____

Position in the company: _____

Address: _____

City: _____ Country: _____

Phone: _____ Fax: _____

E-mail: _____

(As the email address is quite often difficult to read on faxed registration forms, thanks to send us an email in parallel to your registration. This will allow to double check it. Send your email to solidification.course@esi-group.com)

Indicate below the requested information:

- Material(s) of primary interest: _____

- Process(es) of primary interest: _____

- Working in industry ☐ Working in National Institute ☐ Working in University ☐

- If working in industry specify: R&D ☐ Production ☐ Quality control ☐

Describe with 3 keywords your main interests/expectations/topics to be addressed in the course:

_____ _____ _____

Limited to the first 40 registrations. All registrations will be confirmed.

Payment Information (no credit card):

☐ Payment by bank transfer
☐ Payment by check (drawn on a Swiss Bank)

Signature of the participant: _____

Authorized**/ signature(s) of the company: _____

**/ I have noticed that this registration is a firm commitment and that the course fee will be paid in any case, unless this registration is cancelled in writing at least 45 days prior to the start of the course.

Return as soon as possible by post to:

CALCOM ESI, Route Cantonale 105, CH-1025 St-Sulpice, Switzerland

(Please send <u>also</u> an email to: solidification.course@esi-group.com to check that we have well received your registration. All registrations will be confirmed.)

Ref.01

Previous courses were attended by participants from the following companies or institutions:

Argentina INTI **Australia** BHP, Comalco, Uni Wollongong **Austria** AMAG, ARC, Böhler, Eisenwerk Sulzau Werfen, Giesserei Institut, Hertwich Eng., Leoben University, LKR, Siemens, Voest-Alpine, TU Graz **Belgium** Allard Europe, Bekaert, Consolidated Precision Products, CRIF, Heraeus Electro-Nite Intl., KU Leuven, Magotteaux, Union Minière **Brazil** Electro Aço Altona, Gerdau, ITP, Villares Metals **Canada** Alcan, Aluminium Tech. Carlton Univ., Centre, University of Windsor, University of Western Ontario **Czech Rep.** Mecas, Vitkovicg Heavy Machinery, Technical Univ. Ostrava **Denmark** Jydsk, Univ. of Denmark **Finland** Outokumpu, VTT **France** Airbus Helicopters, Alcoa Howmet, Asco Metal Creas, Aubert&Duval, Cabinet Braun, CEA, Cemef, Cezus, CLAL, Clecim, Creusot-Loire Industrie, CTIF, Ecole des Mines Albi, Electricité de France, ENSAM, ESI Group, Fives Cryo, Fonderie Nouvelle Jouve, Forcast, Griset, Howmet, Imphy, INPG, INPT, Institut Jean Lamour, IRSN, Le Bélier, Manoir Industries, Manoir St Brieuc, Montupet, Péchiney, Pont-à-Mousson, Renault, Rio Tinto Alcan, Saint-Gobain Cree, Sambre et Meuse, SCC, Sepr, SNECMA, Techpy, Trefimetaux, Turbine Casting, Ugine, Ugitech, Umicore, Unimetal, Univ. de Lorraine, Vallourec, Waeles, Wamar **Germany** Access, Aluminiumfeinguss Soest, Aurubis, Buderus Edelstahl, Daimler Chrysler, DLR, Fraunhofer, GKSS, Helmholtz Zentrum, Hydro, MAN, MKM, MTU, Otto Fuchs, Ritter Al, Salzgitter Mannesmann, Reiner Brach, Siempelkamp, Schmidt & Clemens, SMS Diemag, Thyssen, Tital, TU Dresden, TU Freiberg, VAW, Zollern **Greece** Alcor, Egnatia foundry, Elval **India** Anant, Concast, ESI India, GM, HAL, Jadavpur University, Kalyani Carpenter, Peekay Steel, Simplex Castings **Ireland** DePuy, Dublin Inst. Of Tech., Materials Ireland, Montupet **Israel** NRCN, Urdan **Italy** Area3, Brembo, Centro Ricerche FAR, Fiat, Centro Sviluppo Materiali, Danieli, ECOTRE, EMA, Europa Microfusioni Aerospaziali, Fonderia Atti, Metra, Microfusione Stellite, Politecnico di Torino, Teksid, Univ. of Bologna, Univ. of Brescia, Zanardi Fonderie **Japan** JIPS, Kyushu University, Mitsubishi Heavy Industries, Nippon Steel, Tokyo University **Korea** Hyundai Heavy Ind., Inst. Ind. Tech. **Mexico** Castech, Cinfusa, Ciateq **Netherlands** Bosch, Corus, ESA, Honeywell, Hoogovens, MI2, NIMR, Outokumpu, Shell, Tata Steel, TU Delft, Univ. of Groningen **New Zealand** Supreme Steel Precision **Norway** Elkem, Elkem Solar, Elkem Silicon Materials, Hycast, Hydro, IFE, NTNU, K.A. Rasmussen, Sintef **Poland** AGH, GE Polska, Rzeszow Univ. of Tech., Warsaw University, WSK **Portugal** Funfrap, Instituto Superior Tecnico, Zollern **Russia** Aviadvigatel OJSC, FSUE MMPP SALUT, KUMW, Perm National Research **Saudi Arabia** King Saud University, Sabic **Slovak Rep.** US Steel **Slovenia** Impol D.D., TGC Unitech, Univ. of Nova Gorica **South Africa** Mattek-CSIR, Scaw Metals **Spain** Analisis y Simulación, C4, Centro Metalurgico Azterlan, Cidaut, CTM, Edertek, Fagor Ederlan, Fuchosa, Inasmet, Labein, Mondragon Univ., Precicast, Sidenor, Univ. Vigo **Sweden** ABB, Erasteel Kloster, Gränges Technology, Lulea University, MEFOS, Ovako Steel, Sandwik Rock, SAPA, Swedish Foundry Ass., Swerea Swecast, Volvo Truck, Volvo Powertrain, TPC **Switzerland** Advanced Aerofoil Technologies, Alcan, Algroup, Asulab, Bühler, Cendres et Métaux, Concast, HES SO, Kugler Bimetal, Metalor, Novelis, Nussbaum, Precicast, PSI, PX Holding, Rolex, SMS Concast, Steel Consult, Sulzer, Swatch Group, Swissmetal, Swiss Steel, UMS, Unitechnologies, Varinor, Wolfensberger **Taiwan** Nat. Taiwan Uni. **Thailand** INN, Somboon **Turkey** Assan Kibar Group, CMS, Eyap Artema, FNSS Defense Systems, Gedik Döküm **United Arab Emirates** Dubai Aluminium, Gulf Extrusions, Masdar Institute **United Kingdom** AETC, Aeromet International, Alloy Wheels, Ashland, AWE, British Aerospace, Doncasters, GKN, Namtec, Rolls Royce, Sheffield Forgemasters, Sim-Cast, T&N Technology, Tritech Group, Univ. of Birmingham, Univ. of Cambridge, Univ. of Sheffield, Vulcan, Wall Colmonoy **USA** Alumax, Carnegie Mellon, Carpenter Technology, Caterpillar, Dura-Bar, Consolidated Metco, Ellwood Quality Steels, ESI R&D, Ford Motor Company, General Electric, GM, Howmet, Honeywell Aerospace, Los Alamos Natl. Lab., Naval Surface Center, NIST, Novelis, PCC Structural, Stuller, United Technologies, Virginia Tech, Wagstaff, West Coast Foundry, Wright Patterson AFB, Wyman Gordan

CALCOM ESI, Member of the ESI Group
Route Cantonale 105
CH-1025 St-Sulpice, Switzerland

Phone: +41-21-925 9300
solidification.course@esi-group.com
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