

The 2nd International Congress on

3DMS

3D Materials Science 2014

PROGRAM AND ABSTRACTS

L'Impérial Palace • Annecy, France • June 29-July 2

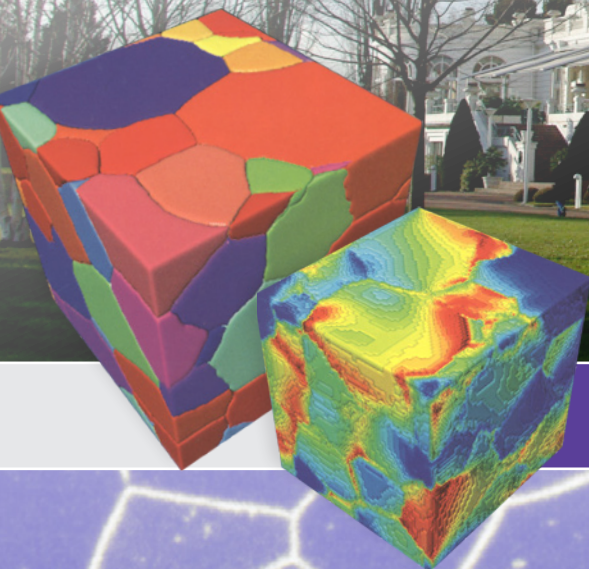
Sponsored by:



and the TMS Advanced Characterization,
Testing and Simulation Committee

Corporate Sponsors:

xradia is now



www.tms.org/3DMS2014

SCHEDULE-AT-A-GLANCE

Sunday, June 29

Registration	5:00 p.m. to 7:30 p.m.	Salle de l'Europe Foyer
Welcome Reception	6:30 p.m. to 7:30 p.m.	Salon Brasserie du Parc

Monday, June 30

Registration	7:00 a.m. to 6:30 p.m.	Salle de l'Europe Foyer
Session: Keynote	8:00 a.m. to 8:45 a.m.	Salle de l'Europe
Exhibition Set-up	10:00 a.m. to 2:00 p.m.	Salle de l'Europe Foyer
Session 1: Diffraction and Related Techniques I	8:45 a.m. to 9:55 a.m.	Salle de l'Europe
Session 2: Acquisition and Handling of 3D Data I	8:45 a.m. to 9:55 a.m.	Salle Verdi
Break	9:55 a.m. to 10:30 a.m.	Salle de l'Europe Foyer
Session 3: Microstructure/Property Relationship in 3D: Characterization and Simulation I	10:30 a.m. to 12:10 p.m.	Salle de l'Europe
Session 4: Microstructure/Property Relationship in 3D: Deformation and Damage I	10:30 a.m. to 12:10 p.m.	Salle Verdi

Lunch	12:10 p.m. to 2:00 p.m.	On Your Own
Session 5: Acquisition and Handling of 3D Data II	2:00 p.m. to 3:10 p.m.	Salle de l'Europe
Session 6: New Experimental Techniques I	2:00 p.m. to 3:10 p.m.	Salle Verdi
Exhibition	3:00 p.m. to 5:00 p.m.	Salle de l'Europe Foyer
Poster Viewing and Reception	3:10 p.m. to 5:00 p.m.	Salle de l'Europe Foyer
Session 7: Microstructure/Property Relationship in 3D: Characterization and Simulation II	5:00 p.m. to 6:30 p.m.	Salle de l'Europe
Session 8: Analysis at the Nanoscale I	5:00 p.m. to 6:30 p.m.	Salle Verdi

Tuesday, July 1

Registration	7:00 a.m. to 6:30 p.m.	Salle de l'Europe Foyer
Session: Keynote	8:00 a.m. to 8:45 a.m.	Salle de l'Europe
Exhibition	8:00 a.m. to 6:30 p.m.	Salle de l'Europe Foyer
Session 9: Diffraction and Related Techniques II	8:45 a.m. to 9:55 a.m.	Salle de l'Europe
Session 10: Microstructure/Property Relationship in 3D: Deformation and Damage II	8:45 a.m. to 9:55 a.m.	Salle Verdi

Break

Session 11: Diffraction and Related Techniques III	9:55 a.m. to 10:30 a.m.	Salle de l'Europe Foyer
Session 12: Microstructure/Property Relationship in 3D: Deformation and Damage III	10:30 a.m. to 12:10 p.m.	Salle de l'Europe
Session 13: Dynamic Processes I	10:30 a.m. to 12:10 p.m.	Salle Verdi

Lunch	12:10 p.m. to 2:00 p.m.	On Your Own
Session 13: Dynamic Processes I	2:00 p.m. to 3:30 p.m.	Salle de l'Europe
Session 14: Microstructure/Property Relationship in 3D: Characterization and Simulation III	2:00 p.m. to 3:50 p.m.	Salle Verdi
Break	3:50 p.m. to 4:10 p.m.	Salle de l'Europe Foyer
Session 15: Dynamic Processes II	4:10 p.m. to 6:30 p.m.	Salle de l'Europe
Session 16: Microstructure/Property Relationship in 3D: Characterization and Simulation IV	4:10 p.m. to 6:30 p.m.	Salle Verdi

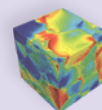
Dinner Cruise

8:00 p.m. to 10:30 p.m. Lake Annecy

Wednesday, July 2

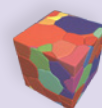
Registration	7:30 a.m. to 5:00 p.m.	Salle de l'Europe Foyer
Exhibition	8:00 a.m. to 3:30 p.m.	Salle de l'Europe Foyer
Session 17: New Experimental Techniques II	8:00 a.m. to 9:30 a.m.	Salle de l'Europe
Session 18: Analysis at the Atomic Scale	8:00 a.m. to 9:10 a.m.	Salle Verdi
Break	9:30 a.m. to 10:00 a.m.	Salle de l'Europe Foyer
Session 19: Analysis at the Nanoscale II	10:00 a.m. to 12:10 p.m.	Salle de l'Europe
Session 20: Microstructure/Property Relationship in 3D: Characterization and Simulation V	10:00 a.m. to 12:10 p.m.	Salle Verdi
Lunch	12:10 p.m. to 2:00 p.m.	On Your Own
Session 21: Acquisition and Handling of 3D Data III	2:00 p.m. to 2:50 p.m.	Salle de l'Europe
Session 22: Diffraction and Related Techniques IV	2:00 p.m. to 3:10 p.m.	Salle Verdi
Break	3:10 p.m. to 3:30 p.m.	Salle de l'Europe Foyer
Exhibition Dismantle	3:30 p.m. to 4:30 p.m.	Salle de l'Europe Foyer
Closing Session and Panel Discussion	3:30 p.m. to 5:00 p.m.	Salle de l'Europe

TABLE OF CONTENTS



WELCOME MESSAGE	3	SPONSORS	5
ORGANIZING COMMITTEE	3	POLICIES	6
ABOUT THE CONGRESS	4	NETWORKING & SOCIAL EVENTS	7
REGISTRATION HOURS	4	ABOUT THE VENUE	7
EXHIBITORS	4	TECHNICAL PROGRAM	8

WELCOME MESSAGE



Welcome to the 2nd International Congress on 3D Materials Science!



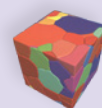
On behalf of The Minerals, Metals & Materials Society (TMS) and the congress organizers, I am pleased to welcome you to this European edition of a congress initiated in 2012 in the U.S. The field of 3D materials science encompasses a broad range of research topics, and we have assembled experts in 3D data collection and analysis, image and data processing, modelling, and simulation to exchange ideas, share new techniques and results, and move the field forward through collaborative efforts. I hope you will take every opportunity during these three days to discover the latest breakthroughs, learn about recent results, engage in the active exchange of ideas, and network with your fellow scientists, engineers, managers, and students.

We look forward to an exciting meeting of dynamic discussions, outstanding speakers, and an interactive poster session, and we thank you for your participation in 3DMS 2014!

Warmest regards on behalf of the 3DMS 2014 Organizing Committee,

Jean-Yves Buffiere, INSA-Lyon

ORGANIZING COMMITTEE



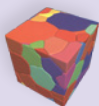
Organizing Committee:

- Jean-Yves Buffiere, INSA-Lyon, France
- Dominique Bernard, Institute of Condensed Matter Chemistry of Bordeaux, France
- Tresa Pollock, University of California Santa Barbara, USA
- Henning Friis Poulsen, Technical University of Denmark, Denmark
- Anthony Rollett, Carnegie Mellon University, USA
- Michael Uchic, U.S. Air Force Research Lab, USA

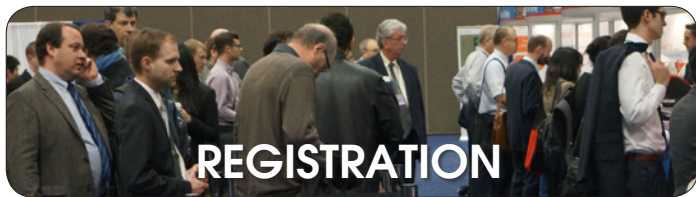
International Advisory Committee:

- Cnudde Veerle, Ghent University, Belgium
- Luc Salvo, INP Grenoble, France
- Greg Rohrer, Carnegie Mellon University, USA

- Robert Suter, Carnegie Mellon University, USA
- Dorte Juul Jensen, DTU Riso Campus, Denmark
- Javier Llorca, IMDEA, Spain
- Ricardo Lebensohn, Los Alamos National Laboratory, USA
- Hiroyuki Toda, Kyushu University, Japan
- Qing Liu, Chongqing University, China
- Milo Kral, University of Canterbury, New Zealand
- Simon Ringer, The University of Sydney, Australia
- Dierk Rabbe, Max-Planck-Institute, Germany
- Steve Hall, Lund University, Sweden
- Hamish Fraser, Ohio State University, USA
- Ulrich Lienert, Deutsches Elektronen-Synchrotron, Germany
- Eric Maire, INSA, France



ABOUT THE CONGRESS



Your full congress registration includes one copy of the proceedings disk. Your badge ensures admission to each of these events:

- Technical and Poster Sessions
- Exhibition
- Sunday Welcome Reception
- Monday Poster Reception
- Tuesday Dinner Cruise

REGISTRATION HOURS

The registration desk will be located in the Salle de l'Europe Foyer.

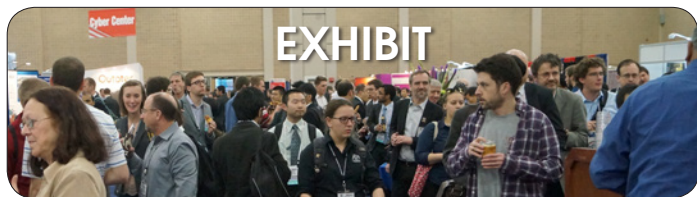
Sunday	5:00 p.m. to 7:30 p.m.
Monday	7:00 a.m. to 6:30 p.m.
Tuesday	7:00 a.m. to 6:30 p.m.
Wednesday	7:30 a.m. to 5:00 p.m.

TECHNICAL SESSIONS

All oral presentations will be held in Salle de l'Europe or Salle Verdi of L'Impérial Palace. All poster presentations will be held in the Salle de l'Europe Foyer. See the Technical Program section on pages 8-15 for room locations.

PROCEEDINGS

Full congress registrants receive one copy of the proceedings as part of the registration fee. Additional copies may be purchased for \$89.95 at www.wiley.com (TMS members receive a 35% discount). Approximately six weeks after the meeting, individual papers will be available through the Wiley Online Library: <http://onlinelibrary.wiley.com>.



EXHIBITION HOURS

The exhibition will be located in the Salle de l'Europe Foyer.

Monday	3:00 p.m. to 5:00 p.m.
Tuesday	8:00 a.m. to 6:30 p.m.
Wednesday	8:00 a.m. to 3:30 p.m.
Monday set-up	10:00 a.m. to 2:00 p.m.
Wednesday dismantle	After 3:30 p.m. break

EXHIBITORS

TMS would like to thank the Exhibitors and Sponsors on the following pages for their gracious support of the event.



CAMECA

CAMECA® is a world leader of high performance SIMS, EPMA & Atom Probe instrumentation for product development, quality monitoring, and materials research. Our instruments measure elemental and isotopic composition down to atomic resolution and equip the most prestigious government and university labs as well as leading high-tech industrial companies, supporting breakthrough research in novel materials and nanotechnologies. CAMECA is part of the AMETEK Materials Analysis Division, and is headquartered near Paris, France with locations in Brazil, China, India, Germany, Japan, Korea, Russia, Taiwan, and USA.



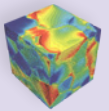
Maney Publishing

Maney Publishing focuses on the publication and international dissemination of high quality, peer-reviewed scientific research. We deliver a personalized service to authors, societies, readers and libraries. Maney publish a collection of highly regarded, peer-reviewed journals covering niche and general topics in materials research, mineral resources, physical metallurgy, surface engineering, geotechnical engineering, water science and technology and transportation. Ranging from fundamental research to materials for electronics, energy and biomedicine, to fabrication, processing and characterisation, properties and performance. Specializing in print and electronic journal publishing, Maney is committed to technical and editorial innovation combined with traditional values of quality and collaboration.



Simpleware

Simpleware provides world-leading software solutions for converting 3D image data (MRI, CT...) into computational models used for Finite Element Analysis (FEA), Computational Fluid Dynamics (CFD), CAD and 3D printing. The software includes an extensive range of image visualisation, analysis and processing options for generating simulation-ready models for a wide range of applications. Simpleware software is used for image processing and model generation tasks across the Life



and Material Sciences, with applications to orthopaedics, digital rock physics, composites and many more fields. Compared to other software, Simpleware provides the most efficient route from scan data to simulation-ready 3D models.

SYNERGIE⁴

GOLD SPONSOR

 **xradia** is now



Carl Zeiss X-ray Microscopy, Inc.

ZEISS expanded its Microscopy business, the only manufacturer of light, electron and X-ray microscopes, by acquiring US-based Xradia. X-ray microscopy (XRM) provides non-destructive, three-dimensional imaging of diverse samples in premier research laboratories worldwide. We offer unique solutions for research and industry in materials and life sciences, natural resources, electronics, and other industrial sectors. ZEISS XRM solutions deliver resolution down to 50 nm, superior contrast and groundbreaking 4D/in situ imaging for a wide variety of samples and applications.

BRONZE SPONSORS



FEI Visualization Sciences Group

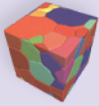
FEI Visualization Sciences Group is exhibiting at 3DMS 2014 to present the latest version of Avizo. Avizo is the advanced 3D visualization and analysis software application for exploring materials science data from tomography, microscopy, MRI, and more techniques. From straight forward visualization and measurement to advanced image processing, quantification and skeletonization, Avizo provides a comprehensive, multimodality digital lab for advanced 2D and 3D visualization, materials characterization, 3D model generation, simulation, and calculation of physical properties. Avizo delivers the whole feature set allowing scientists to explore, understand and present their data.

Learn more at AVIZO3D.COM.



UES

RoboMet.3D® is a fully automated, serial sectioning system that generates two-dimensional data for three-dimensional reconstruction. With sectioning rates up to 100 times faster than manual sectioning, Robo-Met.3D collects data in a matter of hours, not months. Robo-Met.3D enables more time for data analysis and characterization and ensures repeatable and accurate data is collected in an efficient and cost-effective manner. UES, Inc. is an innovative science and technology company that provides its industry and government customers with superior research and development expertise. We create products and services from our technology breakthroughs and successfully commercialize them.



POLICIES

BADGES

All attendees must wear registration badges at all times during the congress to ensure admission to events included in the paid registration fee such as technical sessions, exhibition and receptions.

REFUNDS

The deadline for all refunds was June 6, 2014. No refunds will be issued at the congress. Fees and tickets are nonrefundable.

PHOTOGRAPHY NOTICE

By registering for this congress, all attendees acknowledge that they may be photographed by meeting personnel while at events and that those photos may be used for promotional purposes.



AUDIO/VIDEO RECORDING POLICY

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.

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.




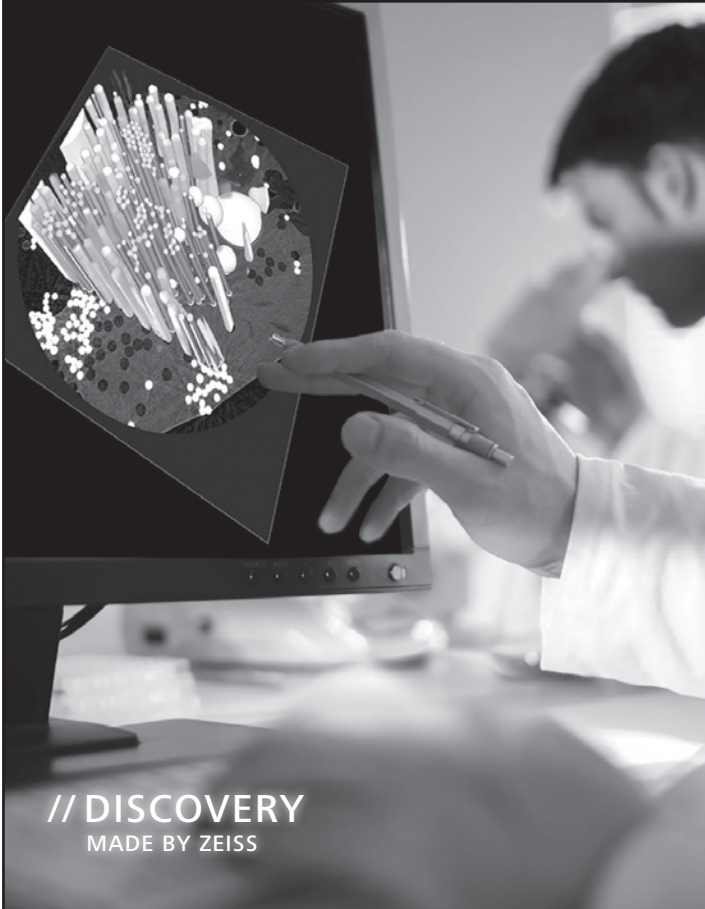
CELL PHONE USE

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.

RECYCLING

At the end of the meeting, discard badges and programs in the bins located in the Registration area.

Be materials-minded.  *Join TMS in reducing, reusing and recycling.*



The moment exploration becomes discovery.

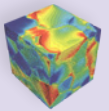
This is the moment we work for.

Study the microstructural evolution of your unique materials. Quantify the impact of stress under variable conditions and over time with non-destructive 3D X-ray microscopy. ZEISS: the only provider of light, X-ray, electron and helium ion microscopes. Facilitating your multi-lengthscale discovery process.

www.zeiss.com/xray



We make it visible.



WELCOME RECEPTION

The Welcome Reception will be held on Sunday, June 29 from 6:30 p.m. to 7:30 p.m. in Salon Brasserie du Parc.

POSTER VIEWING AND RECEPTION

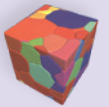
Poster viewing and a reception are planned for Monday, June 30 from 3:10 p.m. to 5:00 p.m. following the technical sessions in Salle de l'Europe Foyer. Don't miss this great networking opportunity!

DINNER CRUISE

The dinner cruise on Lake Annecy will be held on Tuesday, July 1 from 8:00 p.m. to 10:30 p.m. After the boat completes its tour of the lake, it will return to the town center. The boat remains in the quay so the guests can enjoy an evening of dancing (until 12:30 a.m.). Cruise participants should plan to meet in front of the hotel at 7:15 p.m. to walk to the town center (20 minute walk).



ABOUT THE VENUE

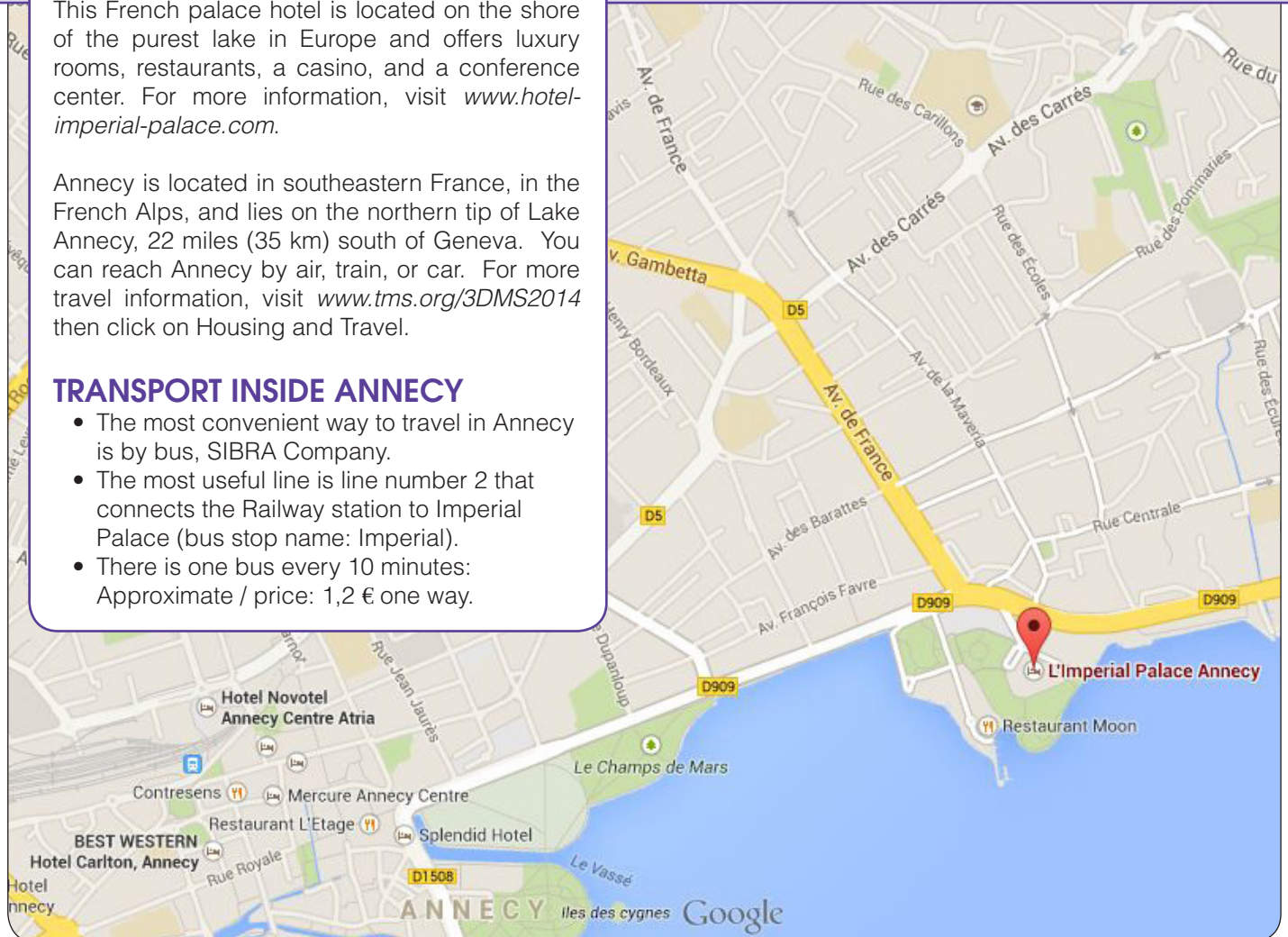


Near Geneva, L'Impérial Palace-Annecy is a charming hotel in the heart of the French Alps. This French palace hotel is located on the shore of the purest lake in Europe and offers luxury rooms, restaurants, a casino, and a conference center. For more information, visit www.hotel-imperial-palace.com.

Annecy is located in southeastern France, in the French Alps, and lies on the northern tip of Lake Annecy, 22 miles (35 km) south of Geneva. You can reach Annecy by air, train, or car. For more travel information, visit www.tms.org/3DMS2014 then click on Housing and Travel.

TRANSPORT INSIDE ANNECY

- The most convenient way to travel in Annecy is by bus, SIBRA Company.
- The most useful line is line number 2 that connects the Railway station to Imperial Palace (bus stop name: Imperial).
- There is one bus every 10 minutes:
Approximate / price: 1,2 € one way.



KeynoteMonday AM
June 30, 2014Room: Salle de l'Europe
Location: Imperial Palace Congress Center**8:00 AM Keynote****Correlative 3D Imaging Across Time and Length Scales:** *Philip Withers*¹;
Timothy Burnett¹; ¹University of Manchester**8:30 AM Question and Answer Period****Session 1: Diffraction and Related Techniques I**Monday AM
June 30, 2014Room: Salle de l'Europe
Location: Imperial Palace Congress Center**8:45 AM Invited****3D Mapping of Polycrystalline Materials by X-ray Diffraction Imaging Techniques:** *Wolfgang Ludwig*¹; Andrew King²; Peter Reischig²; Laura Nervo²; Nicola Vigano²; Nicolas Gueninchault³; Henry Proudhon³; Yoann Guilhem²; ¹Université de Lyon; ²ESRF; ³Mines Paristech**9:15 AM****Status Report on HEDM at the APS: Measurements and Analysis in 3D:** *Robert Suter*¹; ¹Carnegie Mellon University**9:35 AM****Identification of the Onset of the Common Tensile Twinning Mode in Titanium Alloys using Neutron Diffraction and X-ray Diffraction Contrast Tomography Techniques:** *Laura Nervo*¹; Andrew King²; Arnas Fitzner³; Joao Quinta da Fonseca³; Michael Preuss³; Wolfgang Ludwig⁴; ¹ESRF & University of Manchester; ²Synchrotron SOLEIL; ³University of Manchester; ⁴INSA LYON**9:55 AM Break****Session 2: Acquisition and Handling of 3D Data I**Monday AM
June 30, 2014Room: Salle Verdi
Location: Imperial Palace Congress Center**8:45 AM Invited****Equilibrium Gap Regularized Radio-Based Digital Volume Correlation:** *Stephane Roux*¹; T. Taillandier-Thomas¹; A. Bouterf¹; H. Leclerc¹; F. Hild¹; ¹CNRS/ENS-Cachan**9:15 AM****Combined Estimation of Affine Movement and Reconstruction in Tomography:** *Vincent Nieuwenhove*¹; Geert Van Eyndhoven¹; Jan Sijbers¹; ¹University of Antwerp**9:35 AM****Analysis of Crack Propagation in Freeze Cast Ceramics Based Composite Materials Characterised by Micro X-ray Computed Tomography:** *Steven Van Boxel*¹; Eleonora D'Elia²; Claudio Ferraro²; Salvatore Grasso³; Mike Reece³; Peter Lee¹; Philip Withers¹; Eduardo Saiz²; ¹University of Manchester; ²Imperial College London; ³Queen Mary University of London**9:55 AM Break****Session 3: Microstructure/Property Relationship in 3D: Characterization and Simulation I**Monday AM
June 30, 2014Room: Salle de l'Europe
Location: Imperial Palace Congress Center**10:30 AM****Challenges for Focused Ion Beam Analysis of Three Dimensional Microstructures in WC-Co Hardmetals:** *Ken Mingard*¹; Helen Jones¹; Bartlomiej Winiarski¹; Mark Gee¹; Ali Gholinia²; ¹National Physical Laboratory; ²University of Manchester**10:50 AM****3D Structure of Abrasion Damage to WC/Co Hardmetals:** *Mark Gee*¹; Helen Jones¹; Andrew Gant¹; John Nunn¹; Ken Mingard¹; ¹National Physical Laboratory**11:10 AM****Characterization by 3D SEM/FIB Tomography of Cracks and Damage in Hardmetals:** *Emilio Jimenez Pique*¹; Jose Maria Tarrago¹; Miquel Turon-Viñas¹; Gemma Fargas¹; Ihsan Al-Dawery²; Ludwig Schneider²; Luis Llanes¹; ¹Universitat Politècnica de Catalunya; ²Sandvik Hard Materials**11:30 AM****Geometric and Mechanical Modeling of Fiber-Reinforced Composites:** Heiko Andrä¹; Martin Gurka²; Matthias Kabel¹; Sebastian Nissle²; Claudia Redenbach³; Katja Schladitz¹; *Oliver Wirjadi*¹; ¹Fraunhofer ITWM; ²Institut für Verbundwerkstoffe IVW; ³TU Kaiserslautern**11:50 AM****3D Image Segmentation and Cylinder Recognition for Composite Materials:** *Amaury Walbron*¹; Denis Rochais¹; Sylvain Chupin¹; Maïtine Bergounioux²; Romain Abraham²; ¹CEA Le Ripault; ²MAPMO/CNRS**12:10 PM Lunch (On Your Own)****Session 4: Microstructure/Property Relationship in 3D: Deformation and Damage I**Monday AM
June 30, 2014Room: Salle Verdi
Location: Imperial Palace Congress Center**10:30 AM****Investigating the Plastic Zone at the Tip of a Crack: A 3D Diffraction and Imaging Study using Synchrotron X-rays:** Peter Hruby¹; Sudhanshu Singh¹; Jason Williams¹; Xianghui Xiao²; Ruqing Xu²; Peter Kenesei²; Francesco Decarlo²; John Almer²; *Nikhilesh Chawla*¹; ¹Arizona State University; ²Argonne National Laboratory**10:50 AM****3D Quantification of Trans- and Inter-lamellar Fatigue Crack in Ti Alloy:** *Laurent Babout*¹; Lukasz Jopek¹; Marcin Janaszewski¹; Michael Preuss²; ¹Lodz University of Technology; ²University of Manchester**11:10 AM****Damage in Amorphous Crystalline Composite:** *Antoine Ferre*¹; Eric Maire¹; Sylvain Dancette¹; ¹INSA Lyon**11:30 AM****3D Study of Second Phase Particle Break-up in AlSi₁₂ Cast Alloy:** *Tireira Ahy*¹; Requena Guillermo²; Borbely Andras¹; Helmut Klöcker¹; ¹ENS MINES SAINT ETIENNE; ²Vienna University of Technology**11:50 AM****3D Features of Hydrogen Accumulation Induced by Deformation:** *Lei Zhang*¹; Chunli Dai¹; Shaogang Wang¹; Jun Tan¹; ¹Institute of Metal Research**12:10 PM Lunch (On Your Own)**

Session 5: Acquisition and Handling of 3D Data II

Monday PM
June 30, 2014

Room: Salle de l'Europe
Location: Imperial Palace Congress Center

2:00 PM Invited

Creating a Common Environment for Storing, Sharing and Working With Digital Microstructure Data: Thoughts and Lessons Learned: *Michael Groeber*¹; Michael Uchic¹; Michael Jackson²; ¹AFRL; ²BlueQuartz Software

2:30 PM

A Multiresolution Approach to the Discrete Algebraic Reconstruction Technique (DART): *Andrei Dabrovolski*¹; Joost Batenburg²; Jan Sijbers¹; ¹University of Antwerp; ²Centrum Wiskunde & Informatica (CWI)

2:50 PM

A Beamline Refurbishment Dedicated to Multi-scale Microtomography: Multi-purpose Setups Accessible for Academic and Industrial Studies: *Elodie Boller*¹; Alexander Rack¹; Michel Rénier¹; Anne Bonnin¹; Vincent Fernandez¹; Paul Tafforeau¹; ¹ESRF

Session 6: New Experimental Techniques I

Monday PM
June 30, 2014

Room: Salle Verdi
Location: Imperial Palace Congress Center

2:00 PM Invited

Comparative Analysis of Strontium Titanate Datasets by 3D Femtosecond Laser and Synchrotron Diffraction Contrast Tomography: *McLean Echlin*¹; Michael Titus¹; Will Lenthe¹; Andreas Trenkle²; Melanie Syha²; Peter Gumbsch²; Tresa Pollock¹; ¹UC Santa Barbara; ²KIT

2:30 PM

Dynamic High-temperature Monitoring of Microwave Energy Absorption and Heating of Materials with Ultrafast In-situ Synchrotron X-ray Tomographic Microscopy and Powder Diffraction Techniques: *Sebastien Vaucher*¹; Rajmund Mokso²; Kotaro Ishizaki¹; Manuela Stir³; Radu Nicula¹; ¹Empa - Swiss Federal Laboratories for Materials Science and Technology; ²Swiss Light Source, Paul Scherrer Institute; ³University of Berne

2:50 PM

Tracking of Individual Grains of Geomaterials During Phase Transitions Using In situ 3D-X-ray Diffraction up to 25 GPa and 1000 K: *Angelika Rosa*¹; Sebastien Merkel¹; Sujoy Ghosh²; Nadege Hilairet¹; Jean-Phillipe Perrillat³; Mohamed Mezouar⁴; Gavin Vaughan⁴; ¹Université Lille1; ²ETH Zürich; ³Université Claude Bernard Lyon; ⁴ESRF

Poster Session

Monday PM
June 30, 2014

Room: Foyer
Location: Imperial Palace Congress Center

P1: 3-D Microstructural and Micromechanical Characterization of Nanoporous Gold/Epoxy Composites: *Kaixiong Hu*¹; Markus Ziehmer¹; Ke Wang²; Daniel Kupka¹; Erica Lilleodden¹; ¹Institute of Materials Research, Materials Mechanics, Helmholtz-Zentrum Geesthacht; ²Institute of Materials Physics and Technology, Technische Universität Hamburg-Harburg

P2: 3D Analysis of a Fatigue Crack in Cast Iron using Digital Volume Correlation of X-ray Tomographic Images: *Joel Lachambre*¹; Jean-Yves Buffiere¹; Julien Rethore¹; ¹INSA LYON / Lab. MATEIS

P3: 3D Characterization of Cast Ni Superalloys using an Automated Multimodal Serial Sectioning System: *Michael Uchic*¹; Michael Groeber¹;

J. Scott²; Jonathan Miller¹; ¹Air Force Research Laboratory; ²UES, Inc.

P4: 3D Characterization of Rapid Solidification Microstructures in Al-4.5wt%Cu Droplets: *Abdoul-Aziz Bogno*¹; Guillaume Reinhart²; Xing Xiaoxiong¹; Hani Henein¹; Henri Nguyen-Thi²; Elodie Boller³; Denis Sheptyakhov⁴; ¹University of Alberta; ²Aix- Marseille Univ & 3 CNRS, IM2NP UMR 7334; ³European Synchrotron Radiation Facility; ⁴Laboratory for Neutron Scattering, Paul Scherrer Institut

P5: 3D Crack in 316L Stainless Steel Revealed by X-ray Tomography: *Shao-Gang Wang*¹; Liang Xiong¹; Su-Cheng Wang¹; Lei Zhang¹; ¹Institute of Metal Research, Chinese Academy of Sciences

P6: 3D EBSD Analysis with a Dual Beam Focused Ion Beam: *Ali Gholinia*¹; ¹University of Manchester

P7: 3D Evaluation of Inhomogeneous Plastic Deformation of Grains in Aluminum Alloy: *Masakazu Kobayashi*¹; Yuki Kawamura¹; ¹Toyoashi University of Technology

P8: 3D MC Simulation of Grain Growth Kinetics and the Zener Limit in Two-phase Polycrystals: *Phaneesh Kalale*¹; Gautam²; Anirudh Bhat³; K.T. Kashyap³; ¹M. S Ramaiah Institute of Technology; ²Consultant; ³PESIT

P9: 3D Microstructure-based Modeling for Hole-expansion Formability of Dual-phase and Ferrite-bainite Steels: *Jinjin Ha*¹; Jinwoo Lee¹; Ji Hoon Kim²; Frédéric Barlat¹; Myoung-Gyu Lee¹; ¹Graduate Institute of Ferrous Technology (GIFT), Pohang University of Science and Technology (POSTECH); ²Korea Institute of Materials Science

P10: 3D Microstructure of Sub Microns Reinforced Metal Matrix Composites: Post Mortem and In situ Tomography Analysis: *Rémi Daudin*¹; Sofiane Terzi¹; Pierre Lhuissier¹; Michelle Alvarez²; Luc Salvo¹; Elodie Boller¹; ¹SIMAP

P11: 3D Modeling and Analysis of the Microstructure and Strength of Paper Products: *Majid Targhagh*¹; Yash Sharma²; Pouyan Jahangiri²; *Andre Phillion*¹; D. Mark Martinez³; ¹Okanagan School of Engineering, The University of British Columbia, Kelowna, Canada.; ²Department of Mechanical Engineering, The University of British Columbia, Vancouver, Canada.; ³Department of Chemical and Biological Engineering, The University of British Columbia, Vancouver, Canada.

P12: 3D Multiscale Characterization of Silica Aerogels Composites: *Anouk Perret*¹; Geneviève Foray²; Lucian Roiban²; Karine Masenelli-Varlot²; Eric Maire²; Jérôme Adrien²; Bernard Yrieix³; ¹MATEIS/EDF; ²MATEIS INSA de Lyon; ³EDF R&D

P13: 3D SEM-Based Investigation of Fracture Toughness Properties of Modified 9Cr-1Mo Steel: *Xiang Chen*¹; *Randy Nanstad*¹; Mikhail Sokolov¹; ¹Oak Ridge National Laboratory

P14: A New Design for In-situ Tomographic Tensile Stage: *Nicolas Guenin*¹; Arthur Desprès²; Yannick Pannier³; Nicolas Lenoir⁴; Henry Proudhon¹; ¹Mines Paristech; ²INSA Lyon; ³ENSMA; ⁴ENPC

P15: A Novel Approach to Multiscale Homogenisation: *Philippe Young*¹; David Raymond²; *David Harman*²; ¹University of Exeter; ²Simpleware Ltd.

P16: A Novel Superelastic Porous Material Made of a Single Entangled NiTi Wire: *Benjamin Gadot*¹; Laurent Orgeas²; David Rodney³; Sabine Rolland Durocoat²; Didier Bouvard¹; ¹SIMAP-GPM2; ²CNRS/3SR Lab; ³Université Claude Bernard Lyon, Institut Lumière Matière

P17: Adaptive Ring Artefact Suppression Method for Tomography Applications: *Diwaker Jha*¹; Henning Sørensen¹; Sören Dobbenschütz¹; Susan Stipp¹; ¹Copenhagen University

P18: 3D Stochastic Modeling of Microstructure Evolution during the Solidification of Dendritic Alloys: *Laurentiu Nastac*¹; Daojie Zhang¹; ¹The University of Alabama

P19: Analyzing Microstructure and Damage in Construction Materials with 3D Micro CT: *Dietmar Meinel*¹; Andreas Staude¹; Karsten Ehrig¹; ¹BAM

P20: Capability of Submicron X-ray Diffraction Beamline at Taiwan Photon Source for 2D and 3D Materials Research: *Ching-Shun Ku*¹; Chi-Yi Huang¹; Ling Lee²; Yen-Ting Liu³; Shang-Jui Chiu¹; Cheng-Chi Chen¹; Hsin-Yi Lee¹; ¹National Synchrotron Radiation Research Center; ²Tunghai University; ³National Chiao Tung University

P21: Microstructural Data for Model Development and Validation: *Veronica Livrescu*¹; Curt Bronkhorst¹; John Bingert¹; ¹Los Alamos National Laboratory

P22: Characterising 3D Force Transfer in Granular Material: *Stephen Hall*¹; Jonathan Wright²; ¹Lund University; ²ESRF

P23: Characterization of Gamma Prime Precipitate Morphology: *McLean Echlin*¹; *William Lenthe*¹; Tresa Pollock¹; Robert Rhein¹; ¹University of California Santa Barbara

P24: Characterization of Mg-Ca Alloys using X-ray Tomography: *Paul Salero*¹; ¹Laboratoire MATEIS

P25: Comparison of Plastic Deformation in 3D between Experiments and Simulation: *Anthony Rollett*¹; Ricardo Lebensohn²; Reeju Pokharel²; Jonathan Lind¹; Samikshya Subedi¹; Frankie Li³; Ulrich Lienert⁴; Robert Suter¹; ¹Carnegie Mellon University; ²Los Alamos National Laboratory; ³Lawrence Livermore Natl. Lab.; ⁴DESY

P26: Determination of Quantified Relationships Between 2D and 3D Microstructural Metrics in $\alpha+\beta$ Titanium Alloys: *John Sosa*¹; Daniel Huber¹; Brian Welk¹; Peter Collins²; Hamish Fraser¹; ¹The Ohio State University; ²University of North Texas

P27: Development and Application of Tools and Techniques for Three-dimensional Materials Characterization Using MIPAR™, a Novel Analytical 3D Software Package: *John Sosa*¹; Daniel Huber¹; Hamish Fraser¹; ¹The Ohio State University

P28: Efficient Reconstruction of Subsurface Grain Structure from Selective Differential Aperture X-ray Microscopy: *Philip Eisenlohr*¹; Pratheek Shanthraj²; Wenjun Liu³; Bret Dunlap¹; Chen Zhang¹; Thomas Bieler¹; ¹Michigan State University; ²Max-Planck-Institut für Eisenforschung; ³Argonne National Laboratory

P29: Evolution of Different Generations of Gamma Prime Precipitates in Nickel Base Superalloys – A Three-dimensional Perspective: Tanaporn Rojhirunsakool¹; Subhashish Meher¹; Gopal Viswanathan²; Antariksh Singh¹; Junyeon Hwang¹; Rajagopalan Srinivasan²; Soumya Nag¹; Jaimie Tiley²; Hamish Fraser²; *Rajarshi Banerjee*¹; ¹University of North Texas; ²The Ohio State University; ³Air Force Research Laboratory

P30: Finite Element Simulation and Experimental Analysis on Fatigue Behavior of SiC_n/Al Co-Continuous Composites: *Yu Liang*¹; Kun-Peng Yang²; Yan-Li Jiang²; Nan-nao Ge³; Ming Fang⁴; ¹Key Laboratory of New Processing Technology for Nonferrous Metals & Materials, Ministry of Education, College of Materials Science and Engineering; ²Key Laboratory of New Processing Technology for Nonferrous Metals & Materials, Ministry of Education, Guilin University of Technology; ³Zhejiang Tianle New Material Technologic Co. Ltd; ⁴Zhejiang Tianle New Material Technologic Co. Ltd.

P31: Fitting Subdivision Surfaces on Three Dimensional EBSD Maps: *Edgar de Araujo*¹; Hadi Pirgazi¹; Leo Kestens²; ¹Ghent University; ²Ghent University and Delft University of Technology

P32: Geometric Modeling of Closed-Cell Rigid Polymer Foam Structures for Prediction of Mechanical Properties: *Irene Vecchio*¹; Ralf Schlimper²; Katja Schladitz¹; Claudia Redenbach³; ¹Fraunhofer ITWM; ²Fraunhofer IWM; ³Technische Universität Kaiserslautern

P33: Grain Mapping at the High Energy Beamline HEMS: *Torben Fischer*¹; Lars Lottermoser¹; Norbert Schell¹; Martin Müller¹; Andreas Schreyer¹; ¹Helmholtz-Zentrum Geesthacht

P34: High-energy Microtomography using Synchrotron Radiation at DESY for Materials Science Application: *Felix Beckmann*¹; ¹Helmholtz-Zentrum Geesthacht

P35: High-resolution, In situ, Modular, Lab-scale X-ray Computed Tomography (XCT) System for 4D Materials Science: *Nikhilesh Chawla*¹; *James Mertens*; Jason Williams¹; ¹Arizona State University

P36: High Resolution MicroCT Imaging and 3D Image Analysis of Paper

Products: *Yash Sharma*¹; Andre Phillion²; D. Mark Martinez³; ¹Department of Mechanical Engineering, The University of British Columbia, Vancouver, Canada; ²Okanagan School of Engineering, The University of British Columbia, Kelowna, Canada; ³Department of Chemical and Biological Engineering, The University of British Columbia, Vancouver, Canada

P37: Identification and Characterization of Subgrain Features in 3D EBSD Data: *Andrew Loeb*¹; Brian Soe¹; Cullen McMahon¹; Michael Ferry²; Lori Bassman¹; ¹Harvey Mudd College; ²University of New South Wales

P38: Improvement of Mechanical Properties with Reversed Austenite and Copper-rich Phases in an Alloyed Steel with Intercritical Treatment: *Qingdong Liu*¹; Wenqing Liu²; Jianfeng Gu¹; ¹Shanghai Jiaotong University; ²Shanghai University

P39: In-situ 3D Imaging of Structure and Failure of Materials using Synchrotron Radiation Tomography: *K M Mostafijur Rahman*¹; Jerzy Szipunari¹; George Belev²; Mohammad Reza Toroghinejad³; ¹Department of Mechanical Engineering, University of Saskatchewan; ²Canadian Light Source; ³Department of Materials Engineering, Isfahan University of Technology

P40: Influence of Casting Defects on the Fatigue Behaviour of an AlSi₇Mg_{0.6}Ti_{0.6} Aerospace Alloy: Itziar Serrano-Munoz¹; Jean-Yves Buffière¹; Catherine Verdu¹; ¹Laboratoire Mateis

P41: Influence of Particles and Microstructure on Short Fatigue Crack Initiation and Propagation in AA2050-T8 and AA7050-T7451: *Erembert Nizery*¹; Jean-Yves Buffiere¹; H. Proudhon²; P. Cloetens³; A. Daniélou⁴; S. Forest²; ¹INSA Lyon; ²Mines ParisTech; ³ESRF; ⁴Constellium CRV

P42: Influence of the Lost Foam Casting Microstructure on Low Cycle Fatigue Damage of A319 Aluminum Alloy: Nora Dahdah¹; Nathalie Limodin¹; Ahmed El Bartali¹; Jean-Francois Witz²; Rian Seguir¹; *Long Wang*¹; Eric Charkaluk¹; Jean-Yves Buffiere²; ¹Laboratoire de Mécanique de Lille (LML), UMR CNRS; ²Laboratoire Matériaux, Ingénierie et Sciences (MATEIS), UMR CNRS

P43: Investigation of Pre-existing Pores in Creep Loaded 9Cr Steel: *Surya Deo Yadav*¹; Joerdis Rose²; Bernhard Sartory²; Roland Brunner²; Bernhard Sonderegger³; Christof Sommitsch¹; Cecilia Poletti¹; ¹Graz University of Technology; ²Materials Center Leoben Forschung GmbH (MCL); ³University of Cape Town

P44: Large Scale 3D Multi-phase-field Simulation of Microstructure Evolution using TSUBAME2.5 GPU-supercomputer: *Akinori Yamanaka*¹; Masashi Okamoto¹; Takashi Shimokawabe²; Takayuki Aoki²; ¹Tokyo University of Agriculture and Technology; ²Tokyo Institute of Technology

P45: Large Volume Serial Sectioning Tomography by Broad Ion Beam Polishing and Automated EBSD-SEM Data Artefact Correction: *Bartlomiej Winiarski*¹; Ali Gholinia¹; Ken Mingard²; Helen Jones²; Mark Gee²; George Thompson¹; Philip Withers¹; ¹University of Manchester; ²National Physical Laboratory

P46: Methods for Reconstructing and Quantifying 3D Woven Structures: *Amanda Levinson*¹; David Rowenhorst²; Richard Fonda²; ¹National Research Council Fellow, Naval Research Laboratory; ²Naval Research Laboratory

P47: Microstructure and Mechanical Optimization in Sea Urchin Shells: *Dirk Mütter*¹; Henning Sørensen¹; Jette Oddershede²; Susan Stipp¹; ¹University of Copenhagen; ²Danish Technical University

P48: Morphological and Performance Measures of Poly(urethane) Foams using X-ray CT and Mechanical Testing: *Brian Patterson*¹; Kevin Henderson¹; Manuel Chavez¹; Stephanie Tornga¹; Nikolaus Cordes¹; Robert Gilbertson¹; Zachary Smith¹; ¹Los Alamos National Laboratory

P49: Multi-Dimensional 3-D Characterization: Bridging the Gap Between Experiments and Modeling: *Neal Magdefrau*¹; Julie Wittenzellner¹; Matthew Lynch¹; Rajesh Kumar¹; Wayne Schmidt¹; Jodi Vecchiarelli¹; ¹United Technologies Research Center

P50: Multiscale Analysis of Cellular Materials by X-ray Tomography and Finite Element Modelling: *Clemence Petit*¹; Eric Maire¹; Sylvain Meille¹; Jérôme Adrien¹; ¹MATEIS Laboratory INSA de Lyon - Université de Lyon

P51: Non-destructive Study of Microstructure Evolution in Polycrystalline Cu using Synchrotron Radiation and Full-field

Simulation: *Reeju Pokharel*¹; Jonathan Lind²; Shiu Fai Li²; Peter Kenesei³; Ricardo Lebensohn¹; Robert Suter⁴; Anthony Rollett⁴; ¹Los Alamos National Laboratory; ²Lawrence Livermore National Laboratory; ³Argonne National Laboratory; ⁴Carnegie Mellon University

P52: Nonstandard Materials Electrical Discharge Machining (by Example of Electrolytic Chrome): *Anna Okunkova*¹; Pavel Peretyagin¹; Yuri Vladimirov¹; Marina Volosova¹; Ramon Torrecillas²; ¹Moscow State University of Technology "STANKIN"; ²Centro de Investigación en Nanomateriales y Nanotecnología CSIC

P53: Procedure for 3D Microstructure Reconstruction of a Heterogeneous Metal Matrix Composite Material: *Donna Guillen*¹; Heng Ban²; Zilong Hua²; ¹Idaho National Laboratory; ²Utah State University

P54: Quantifying and Representing Non-Primary Phases in Metallic Microstructure: *Joseph Tucker*¹; Adam Pilchak²; Michael Groeber²; ¹UES, Inc.; ²U.S. Air Force Research Lab

P55: Reconstruction of Grain Boundary Surfaces from Large-Scale Three-Dimensional Data by Manual Serial Sectioning Technique: *Hadi Pirgazi*¹; Edgar Gomes¹; Leo Kestens²; ¹Ghent University; ²Ghent University and Delft University of Technology

P56: Reconstruction of the 3D Representative Volume Element from the Generalized 2-point Correlation Function: *Abhijit Brahma*¹; Yauheni Staraselski¹; Raja Mishra²; Kaan Inal¹; ¹University of Waterloo; ²General Motors Research and Development Center

P57: Single-distance Phase Retrieval for DP Structures in Steels: *Hiroyuki Toda*¹; Fukuto Tomizato¹; Ryo Harasaki¹; Kentaro Uesugi²; Akihisa Takeuchi²; Yoshio Suzuki²; Masakazu Kobayashi¹; ¹Toyoohashi University of Technology; ²Japan Synchrotron Radiation Research Institute

P58: Site Specific 3D Pathway Analysis of Functional Energy Materials: *Peter Jørgensen*¹; Tobias Stegk¹; Karin Hansen¹; ¹DTU

P59: The Intervariant Crystallographic Planes Distribution in a Lath Martensite: *Hossein Beladi*¹; Gregory Rohrer²; Anthony Rollett²; Vahid Tari³; Peter Hodgson¹; ¹Deakin University; ²Carnegie Mellon University; ³Mississippi State University

P60: The Materials Science Beamline ID11 at the ESRF: Gavin Vaughan¹; *Jonathan Wright*¹; Wolfgang Ludwig¹; Henning Poulsen²; Andrea Bernasconi¹; Nicholas Harker¹; Henri Gleyzolle¹; ¹ESRF; ²Technical University of Denmark

P61: The Quantification of Rafting in Ni-based Superalloys Using Moment Invariants: *Lily Nguyen*¹; Rongpei Shi²; Dong Wang²; Marc De Graef¹; ¹Carnegie Mellon University; ²Ohio State University

P62: Three-dimensional Deformation Morphology under Nano-indentation: *Sanjit Bhowmick*¹; Syed Asif¹; ¹Hysitron

P63: Three Dimensional Morphology and Spatial Distribution of Non-metallic Inclusions in Steel Slabs: *Seiki Takebayashi*¹; Kenichi Yamamoto¹; Masafumi Miyazaki¹; Mayuko Ishino¹; Yoshiyuki Ueshima¹; ¹Nippon Steel & Sumitomo Metal Corporation

P64: Tomography and Imaging at the Psiché Beamline, Soleil: *Andrew King*²; Nicolas Guignot¹; Pierrick Zerbino¹; Aurélien Delmotte¹; Jean-Paul Itié¹; ¹Synchrotron SOLEIL

P65: Using Moment Invariants to Quantify a Strain Glass Transition: *Lily Nguyen*¹; Dong Wang²; Yunzhi Wang²; Marc De Graef¹; ¹Carnegie Mellon University; ²Ohio State University

P66: X-ray Computed Tomography Characterisation of Titanium Powders for Additive Manufacturing: *Fabien Leonard*¹; Samuel Tammas-Williams¹; Fatos Derguti²; Iain Todd²; Philip Withers¹; ¹The University of Manchester; ²University of Sheffield

P67: X-ray Microscopy for In Situ Characterization of 3D Microstructure Evolution in the Laboratory: *Leah Lavery*¹; Arno Merkle¹; Jeff Gelb¹; ¹Carl Zeiss X-ray Microscopy, Inc.

P68: X-ray Microtomography of the Heat Damage in Carbon Fibre Reinforced Composites: *Peifeng Li*¹; ¹Nanyang Technological University

P69: X-ray Tomography Study of Gallo-Roman Archeologic Artefacts:

*Christophe Le Boulrot*¹; Jérôme Adrien¹; Eric Maire¹; ¹MATEIS - INSA de Lyon

P70: X Ray Tomographic Characterisation of Damage in a Cast Al Alloy During Thermomechanical Fatigue Tests: *Sébastien Dézécot*¹; Vincent Maurel²; Alain Köster²; Fabien Szymtka³; Jean-Yves Buffière¹; ¹INSA de Lyon; ²Centre des Matériaux; ³PSA Peugeot Citroën

P71: "Dissector-select" Technique for Efficient Grain Volume Distribution Determination by Serial Sectioning: *Burton Patterson*¹; Tyler Kaub¹; Robert DeHoff²; Veena Tikare²; George Strickland, II¹; ¹University of Florida; ²Sandia National Laboratories

Session 7: Microstructure/Property Relationship in 3D: Characterization and Simulation II

Monday PM
June 30, 2014

Room: Salle de l'Europe
Location: Imperial Palace Congress Center

5:00 PM Invited

Quantifying Polycrystalline Grain Boundary Networks for 3D Property Simulation: *Alexis Lewis*¹; Amanda Levinson²; David Rowenhorst¹; ¹Naval Research Laboratory; ²National Research Council

5:30 PM

Acquisition of 3D Data for Prediction of the Cyclic Properties of Ni-Base Alloys: Will Lenthe¹; Jean-Charles Stinville¹; McLean Echlin¹; *Tresa Pollock*¹; ¹UC Santa Barbara

5:50 PM

Hierarchical Investigation of 3D Microstructure at Three Different Length Scales – Towards Quantitative Understanding of Microstructure Formation for the Example of Lightweight Al-Si Alloys with Complex Morphology: *Frank Mücklich*¹; Jenifer Barrirero¹; Michael Engstler¹; ¹Saarland University

6:10 PM

Micromechanical Characterization of Dielectric Inclusions Used to Produce Anisotropic Ferroelectric Composites: *Julien Lesseur*¹; Jean-François Camenen²; Jérôme Majimel¹; Catherine Elissalde¹; Ivan Iordanoff²; Claude Estournès³; Dominique Bernard¹; ¹ICMCB CNRS, UPR9048; ²I2M CNRS, UMR5295; ³CIRIMAT CNRS, PNF2 MHT

Session 8: Analysis at the Nanoscale I

Monday PM
June 30, 2014

Room: Salle Verdi
Location: Imperial Palace Congress Center

5:00 PM Invited

3D Analysis of Crack-tip Dislocations Using High Voltage Electron Microscopy: *Kenji Higashida*¹; Masaki Tanaka¹; ¹Kyushu University

5:30 PM

Three-dimensional Tomographic Reconstruction of Precipitates in High Entropy Alloys (HEAs) to Determine the Quantitative Influence of Varied Data Acquisition Parameters: Daniel Huber¹; Brian Welk¹; Jacob Jensen¹; John Sosa¹; Robert Williams¹; *Hamish Fraser*¹; ¹The Ohio State University

5:50 PM

Atomic Scale and 3D Characterization of the Heterogeneously Formed S (A₂CuMg) Precipitates at Dislocations in Al-Cu-Mg Alloy: *Zongqiang Feng*¹; Yanqing Yang¹; Yanxia Chen¹; ¹Northwestern Polytechnical University

6:10 PM

3D Orientation Imaging with Transmission Electron Microscopy: *Soren Schmidt*¹; Peter Larsen¹; Xiaoxu Huang¹; ¹Technical University of Denmark

Keynote

Tuesday AM
July 1, 2014

Room: Salle de l'Europe
Location: Imperial Palace Congress Center

8:00 AM Keynote

Measurements of 4D Microstructural Evolution: J. Gibbs¹; K. Mohan²; E. Gulsoy¹; A. Shahaini¹; C. Bouman²; M. DeGraef³; *Peter Voorhees*¹; ¹Northwestern University; ²Purdue University; ³Carnegie Mellon University

8:30 AM Question and Answer Period**Session 9: Diffraction and Related Techniques II**

Tuesday AM
July 1, 2014

Room: Salle de l'Europe
Location: Imperial Palace Congress Center

8:45 AM Invited

Image Alignment and Distortion Removal in EBSD Serial Sectioning: *David Rowenhorst*¹; Amanda Levinson¹; Alexis Lewis¹; ¹The U.S. Naval Research Laboratory

9:15 AM

Simultaneous Spatial and Orientational Tracking of Ostwald Ripening in Semisolid Al-5 wt% Cu at High Volume Fractions of the Coarsening Phase: Jules Dake¹; James Shatto¹; Thomas Werz¹; Jette Oddershede²; Henning Sørensen³; Søren Schmidt²; *Carl Krill*¹; ¹Ulm University; ²Technical University of Denmark; ³University of Copenhagen

9:35 AM

Three-dimensional Microstructural Measurements of Sintered UO₂ Fuel Pellets: *Reeju Pokharel*¹; Donald Brown¹; Darrin Byler¹; Shiu Fai Li²; Robert Suter³; Peter Kenesei⁴; Levente Balogh⁵; ¹Los Alamos National Laboratory; ²Lawrence Livermore National Laboratory; ³Carnegie Mellon University; ⁴Argonne National Laboratory; ⁵Queen's University

9:55 AM Break**Session 10: Microstructure/Property Relationship in 3D: Deformation and Damage II**

Tuesday AM
July 1, 2014

Room: Salle Verdi
Location: Imperial Palace Congress Center

8:45 AM Invited

High Speed and High Resolution In-situ Tensile Tests in Synchrotron Tomography Applied to Ductile Damage: *Eric Maire*¹; Aude Simar²; Heiki Suhonen³; Jerome Adrien¹; Rajmund Mokso⁴; Elodie Boller⁵; ¹Mateis Université Lyon INSA; ²UC Louvain; ³ESRF ID22; ⁴SLS Tomcat; ⁵ESRF ID19

9:15 AM

Three-dimensional Porosity-induced Fatigue Cracking Behavior in Hybrid Laser Welded 7075-T6 Al Joints via High-resolution Synchrotron X-ray Microtomography: Sheng-Chuan Wu¹; JY Buffiere²; *Cheng Yu*¹; Wei-Hua Zhang¹; ¹State Key Laboratory of Traction Power, Southwest Jiaotong University; ²Université de Lyon INSA LYON

9:35 AM

Three Dimensional Damage Characterisation of Composites Loaded in Tension: A Laboratory X-ray Computed Tomography Investigation: *Jasmin Stein*¹; Robert Bradley¹; Constantinos Soutis¹; Philip Withers¹; ¹The University of Manchester

9:55 AM Break**Session 11: Diffraction and Related Techniques III**

Tuesday AM
July 1, 2014

Room: Salle de l'Europe
Location: Imperial Palace Congress Center

10:30 AM

Evolution of Grain Boundary Energy Distribution: *S.F. Li*¹; J. Lind¹; V. V. Bulatov¹; B. W. Reed¹; C. M. Hefferan²; R. M. Suter³; M. Kumar¹; ¹Lawrence Livermore National Lab; ²R. J. Lee Group; ³Carnegie Mellon University

10:50 AM

Deformation-Induced Intragranular Orientation Spread in Ferrite Investigated by 3DXRD and Forward Modeling: *Jette Oddershede*¹; Grethe Winther²; Jon Wright³; ¹DTU Physics; ²DTU Mechanical Engineering; ³ESRF

11:10 AM

Diffraction-Amalgamated Grain-Boundary Tracking (DAGT) Technique: *Hiroyuki Toda*¹; Takanobu kamiko¹; Kentaro Uesugi²; Akihisa Takeuchi²; Yoshio Suzuki²; Masakazu Kobayashi¹; ¹Toyohashi University of Technology; ²Japan Synchrotron Radiation Research Institute

11:30 AM

3D-XRD Investigation of the High Pressure α - ω Transformation in Polycrystalline Titanium: *Sebastien Merkel*¹; Amélie Malpot¹; Angelika Rosa¹; Hanns-Peter Liermann²; ¹Université Lille 1; ²DESY - PETRA III

11:50 AM

Studying Microstructural Evolution of Strain in Austenitic Stainless Steel Under Load using Diffraction Contrast Tomography: *Stefan Schmiederer*¹; Andrew King²; Joao Quinta Da Fonseca³; ¹ESRF; ²SOLEIL; ³University of Manchester

12:10 PM Lunch (On Your Own)**Session 12: Microstructure/Property Relationship in 3D: Deformation and Damage III**

Tuesday AM
July 1, 2014

Room: Salle Verdi
Location: Imperial Palace Congress Center

10:30 AM

3D Tomographic Characterization of Woven Ceramic Textile Composites under In situ Loading at Ultrahigh Temperatures: *Hrishikesh Bale*¹; Siyuan Xin¹; Ryan Wilkerson¹; Brian Cox²; David Marshall²; Robert Ritchie¹; ¹University of California, Berkeley; ²Teledyne Scientific Co LLC

10:50 AM

Mechanical Properties of Crumpled Aluminium Foils: *Sandrine Cottrino*¹; Eric Maire¹; Damien Fabregue¹; Pierre Viviers¹; ¹INSA of Lyon-Laboratory MATEIS CNRS UMR5510

11:10 AM

Influence of the Casting Microstructure Upon the Tensile Behaviour in A319 Al-Si Alloy Investigated by X-ray Tomography and Digital Volume Correlation: *Long Wang*¹; Nathalie Limodin¹; Ahmed El Bartali¹; Julien Rethore²; Jean-François WITZ¹; Rian SEGHIR¹; Eric Charkaluk¹; Jean-Yves Buffiere³; ¹Laboratoire de Mécanique de Lille (LML), CNRS, UMR 8107; ²Laboratoire de Mécanique des Contacts et des Structures (LaMCoS), CNRS, UMR 5259; ³Laboratoire Matériaux, Ingénierie et Sciences (MATEIS), CNRS, UMR 5510

11:30 AM

Application of Diffraction-Amalgamated Grain Boundary Tracking (DAGT) to Fatigue Crack Propagation Behavior in High Strength Aluminum Alloy: *Hui Li*¹; Hiroyuki Toda²; Kentaro Uesugi³; Akihisa Takeuchi³; Yoshio Suzuki³; Masakazu Kobayashi¹; ¹Toyohashi University of Technology; ²Kyushu University; ³Japan Synchrotron Radiation Research Institute

11:50 AM

Spatial Correlation of 3D Datasets Across Multiple Scales: Combining Electron and X-ray Tomography Volumes for Analysis of Creep Cavitation in 316 H Stainless Steel. *Tim Burnett*¹; ¹Manchester University/FEI

12:10 PM Lunch (On Your Own)

Session 13: Dynamic Processes I
Tuesday PM
July 1, 2014Room: Salle de l'Europe
Location: Imperial Palace Congress Center

2:00 PM Invited

In-situ Micro- and Nanoscale X-ray Tomography with High Temporal Resolution for Quantitative Analysis of the Microstructure Dynamics: *Rajmund Mokso*¹; Julie Fife¹; Federica Marone¹; Youssef Souhail²; Michele Griffo³; Sarah Irvine¹; Marco Stampanoni¹; ¹Paul Scherrer Institut; ²IFP Energies Nouvelles; ³EMPA Dübendorf

2:30 PM

In situ High Temperature Deformation: Interest of 4D Characterization at Higher Strain Rate: *Pierre Lhuissier*¹; Mario Scheel²; Robin Gibaud¹; Louis Marciliac¹; Rémi Daudin¹; Elodie Boller²; Luc Salvo¹; Jean-Jacques Blandin¹; ¹SIMaP/GPM2-CNRS-Grenoble University; ²ID15 & ID19 Beamlines - ESRF

2:50 PM

In-situ Study of the Evolution of the 3D-morphology of Moving Interphases between Individual Grains of Ferrite and Austenite: *Sven Offerman*¹; Alexander Kostenko¹; Andrew King²; Wolfgang Ludwig³; Lucas Van Vliet¹; Richard Huizenga¹; ¹Delft University of Technology; ²Synchrotron SOLEIL; ³ESRF

3:10 PM

Abnormal Grain Growth by Complexion Transitions Requires Propagation Mechanisms: *William Frazier*¹; Anthony Rollett¹; Gregory Rohrer¹; ¹Carnegie Mellon University

3:30 PM Break

Session 14: Microstructure/Property Relationship in 3D: Characterization and Simulation III
Tuesday PM
July 1, 2014Room: Salle Verdi
Location: Imperial Palace Congress Center

2:00 PM Invited

Fast Fourier Transform-based Micromechanical Modeling with Direct Input from 3-D Images of Polycrystalline Microstructures: *Ricardo Lebensohn*¹; ¹Los Alamos National Laboratory

2:30 PM

Modeling of Thermoelastic Stresses in Thermal Barrier Coatings: Sean Donegan¹; *Anthony Rollett*¹; ¹Carnegie Mellon University

2:50 PM

Polycrystalline FE Modeling of Deformation and Fatigue Cracking Using Experimental 3D Microstructures: *Henry Proudhon*¹; Jia Li¹; Yoann Guilhem²; Peter Reischig³; Arjen Roos⁴; Samuel Forest¹; Loic Signor⁵; Wolfgang Ludwig³; ¹MINES ParisTech; ²ENS Cachan; ³ESRF; ⁴ONERA; ⁵ENSMA

3:10 PM

Characterizing Populations, Predicting Presence, and Examining Mechanical Response using Three-Dimensional Reconstructions of Porosity in Laser Welds: *Jonathan Madison*¹; Corbett Battaile¹; Jeff Rodelas¹; Tyler Payton¹; Larry Aagesen²; Victor Chan²; Katsuyo Thornton²; ¹Sandia National Laboratories; ²University of Michigan

3:30 PM

Three Dimensional Image-based Modelling of Barnacle Debonding: *Andrew Geltmacher*¹; Alexis Lewis¹; William Pogue¹; Richard Everett¹; ¹Naval Research Laboratory

3:50 PM Break

Session 15: Dynamic Processes II
Tuesday PM
July 1, 2014Room: Salle de l'Europe
Location: Imperial Palace Congress Center

4:10 PM

Characterizing Annealing Twin Formation during Grain Growth in Nickel: *Brian Lin*¹; Chris Hefferan²; Robert Suter¹; Gregory Rohrer¹; Anthony Rollett¹; ¹Carnegie Mellon University; ²R.J. Lee Group

4:30 PM

3D Serial Sectioning Studies on Growth during Recrystallization: *Yubin Zhang*¹; Guohua Fan²; Julian Driver³; Dorte Juul Jensen¹; ¹Danish-Chinese Center for Nanometals, Section for Materials Science and Advanced Characterization, Dept. of Wind Energy, Technical University of Denmark; ²School of Materials Science and Engineering, Harbin Institute of Technology; ³Ecole des Mines de Saint Etienne

4:50 PM

Experimental Investigation of the Applicability of the MacPherson-Srolovitz Relation to Grain Growth in Al: *Jules Dake*¹; Jette Oddershede²; Henning Sørensen³; Søren Schmidt²; Carl Krill¹; ¹Ulm University; ²Technical University of Denmark; ³University of Copenhagen

5:10 PM

How Much Does an Individual Grain Boundary Junction Tell Us About the Growth Kinetics of Its Polycrystalline Microstructure?: *Dana Zöllner*¹; Peter Streitenberger¹; ¹Otto von Guericke University Magdeburg

5:30 PM

Investigating Recovery Processes in Aluminium Using Dark-field X-ray Microscopy: *Hugh Simons*¹; Carsten Detlefs²; Søren Schmidt¹; Erik Lauridsen¹; Andrew King³; Irina Snigirev²; Anatoly Snigirev²; Wolfgang Ludwig⁴; Wolfgang Pantleon¹; Henning Poulsen¹; ¹DTU; ²ESRF; ³Soleil; ⁴INSA Lyon

5:50 PM

Comparison of 3D Time-lapse Imaging and Simulation of Grain Growth in Strontium Titanate: *Melanie Syha*¹; Andreas Trenkle²; Barbara Loedermann¹; Werner Augustin¹; Daniel Weygand¹; Wolfgang Ludwig³; Peter Gumbsch¹; ¹Karlsruhe Institute of Technology; ²Karlsruhe Institute for Technology; ³European Synchrotron Radiation Facility

6:10 PM

Growth Path Envelope Analysis of Grain Growth in Titanium from 3DXRD Determination of Grain Volume Distributions: *Allan Lyckegaard*¹; Burton Patterson²; Erik Lauridsen¹; Robert DeHoff²; ¹Technical University of Denmark; ²University of Florida

Session 16: Microstructure/Property Relationship in 3D: Characterization and Simulation IV
Tuesday PM
July 1, 2014Room: Salle Verdi
Location: Imperial Palace Congress Center

4:10 PM

3D Discrete Element Simulation of Strength and Toughness of Porous Ceramics: David Jauffres¹; Denis Roussel¹; *Christophe Martin*¹; Aaron Lichtner²; Rajendra Bordia³; ¹Grenoble-INP; ²University of Washington; ³Clemson University

4:30 PM

Chalk, a Natural Porous Material: Can we Capture the Essential Properties by 3D Imaging?: *Henning Sørensen*¹; Dirk Mütter¹; Kim Dalby¹; Diwaker Jha¹; Ralph Harti¹; Reza Gooya¹; Julio Da Silva²; Manuel Guizar-Sicairos²; Mirko Holler²; Heikki Suhonen³; Robert Feidenhans¹; S. Stipp¹; ¹University of Copenhagen; ²Paul Scherrer Institut; ³European Synchrotron Radiation Facility

4:50 PM

4D Imaging of Fluid Flow Dynamic in Natural Porous Media by Ultra-fast X-ray Microtomography: *Souhail Youssef*¹; Rezki Oughanem¹; Elisabeth Rosenberg¹; Eric Maire²; Rajmund Mokso³; IFP Energies Nouvelles; ²INSA-Lyon MATEIS CNRS UMR 5510; ³Swiss Light Source, Paul Scherrer Institut

5:10 PM

Discrete Electrochemical Modeling of Porous SOFC Electrodes Based on X-ray Tomography 3D Images: *Denis Roussel*¹; David Jauffres¹; Christophe Martin²; Aaron Lichtner³; Rajendra Bordia⁴; ¹Université de Grenoble / CNRS; ²Other; ³University of Washington; ⁴Clemson University

5:30 PM

Investigation of the Nucleation of Intermetallics in Al-Si-Fe Alloys using High Speed In situ Microtomography: Ani Darlapudi¹; Sofiane Terzi²; Michelle Alvarez³; Pierre Lhuissier³; *Luc Salvo*³; Elodie Boller⁴; ¹Materials Engineering; ²ILL; ³SIMAP; ⁴ESRF

5:50 PM

Reliable Pore-size Measurements Based on a Procedure Specifically Designed for Electron Tomography Measurements of Nanoporous Samples: *Geert Van Eyndhoven*¹; Kees Joost Batenburg²; Cynthia Van Oers³; Mert Kurttepel⁴; Sara Bals⁴; Pegie Cool³; Jan Sijbers¹; ¹University of Antwerp; ²Centrum Wiskunde & Informatica; ³Laboratory of Adsorption and Catalysis, University of Antwerp; ⁴Electron Microscopy for Materials Research (EMAT), University of Antwerp

6:10 PM

Characterization of 3D Flow During Friction Stir Welding: *Richard Fonda*¹; David Rowenhorst¹; Keith Knippling¹; ¹Naval Research Laboratory

Session 17: New Experimental Techniques II

Wednesday AM
July 2, 2014

Room: Salle de l'Europe
Location: Imperial Palace Congress Center

8:00 AM

X-Ray Nanotomography: *Peter Cloetens*¹; ¹ESRF

8:30 AM

3D Neutron Diffraction - 3DND: *Alberto Cereser*¹; Axel Steuwer²; Stephen Hall³; Markus Strobl⁴; Søren Schmidt¹; ¹Technical University of Denmark; ²MAX IV Laboratory; ³Lund University; ⁴ESS-AB

8:50 AM

Diffraction Contrast Tomography on a Laboratory X-ray Microscope: Arno Merkle¹; Christian Holzner¹; Michael Feser¹; Kevin Fahey¹; *Erik Lauridsen*²; Peter Reischig²; Henning Poulsen²; ¹Carl Zeiss X-ray Microscopy; ²Xnovo Technology

9:10 AM

Characterization of 2-micrometer Thick Layers of Metallic Thin Films within Polymer Capsules using Confocal MXRF and X-ray CT: *Brian Patterson*¹; George Havrilla¹; Kimberly Obrey¹; Igor Usov¹; Nikolaus Cordes¹; ¹Los Alamos National Laboratory

9:30 AM Break

Session 18: Analysis at the Atomic Scale

Wednesday AM
July 2, 2014

Room: Salle Verdi
Location: Imperial Palace Congress Center

8:00 AM Invited

3D Imaging and Analysis of Materials with Atom Probe Tomography: *Emmanuelle Marquis*¹; ¹University of Michigan

8:30 AM

Application of Atom Probe Tomography to Study Solute Segregation at Boundaries and Interfaces in Metals: *Elena Pereloma*¹; ¹University of Wollongong

8:50 AM

Multiscale Microstructure Engineering of Steels Using 3D APT: *Ilana Timokhina*¹; Hossein Beladi¹; ¹Deakin University

9:10 AM Break

Session 19: Analysis at the Nanoscale II

Wednesday AM
July 2, 2014

Room: Salle de l'Europe
Location: Imperial Palace Congress Center

10:00 AM Invited

Focused Ion Beam Nano-Tomography using Different Detectors: *Marco Cantoni*¹; ¹EPFL-CIME

10:30 AM

Metrology of Three-dimensional Techniques in Focused Ion Beam Microscopy: *Helen Jones*¹; Ken Mingard¹; David Cox¹; Bartłomiej Winiarski²; Ali Gholinia³; ¹National Physical Laboratory; ²University of Manchester; ³University of Manchester

10:50 AM

Microstructural Evolution of Nanoporous Gold During Coarsening: *Markus Ziehm*¹; Kaixiong Hu¹; Ke Wang²; Jürgen Markmann²; Erica Lilleodden¹; ¹Helmholtz-Zentrum Geesthacht; ²TU Hamburg-Harburg

11:10 AM

3D Structure of Nanoporous Sintered Silver and its Evolution during Aging: *James Carr*¹; Séverine Boyer²; Pascal Gadaud²; Michel Gerland²; Peter Lee¹; George Thompson¹; Xavier Milhet²; ¹The Manchester University; ²Prime Institute UPR CNRS 3346

11:30 AM

Ostwald Ripening \8722 A Direct Comparison of Experiment and Simulation: *Thomas Werz*¹; Michael Heinze²; Nan Wang³; Long-Qing Chen³; Stefan Odenbach²; Carl Krill III¹; ¹Ulm University; ²Dresden University of Technology; ³Pennsylvania State University

11:50 AM

3D Microstructural Characterization of In Situ TiC and Graphite Reinforced Nickel Matrix Composites: Tushar Borkar¹; John Sosa²; Sundeep Gopagoni¹; Jamie Tiley³; Hamish Fraser²; *Rajarshi Banerjee*¹; ¹University of North Texas; ²The Ohio State University; ³U.S. Airforce Research Laboratory

12:10 PM Lunch (On Your Own)

Session 20: Microstructure/Property Relationship in 3D: Characterization and Simulation V

Wednesday AM
July 2, 2014

Room: Salle Verdi
Location: Imperial Palace Congress Center

10:00 AM Invited

Using High Energy X-ray Diffraction and Finite Elements and Forward Modeling Methods to Understand Crystal Scale Plasticity: *Matthew Miller*¹; Paul Dawson¹; ¹Cornell University

10:30 AM

Image Based Modeling of Plasticity in Polycrystals in 2D and 3D: *Sylvain Dancette*¹; ¹Mateis, Université de Lyon, INSA Lyon

10:50 AM

Underpinning and Benchmarking Crystal Plasticity Simulations with Micro-mechanical Experiments: David Eastman¹; Jessica Krogstad¹; William Lenthe²; Tresa Pollock²; *Kevin Hemker*¹; Paul Shade; Todd Turner; Michael Uchic; ¹Johns Hopkins University; ²University of California Santa Barbara

11:10 AM

High Resolution Reciprocal Space Mapping of Single Grains: *Ulrich Lienert*¹; Felix Thiel²; Torben Fischer³; Wolfgang Pantleon²; ¹Deutsches Elektronen-Synchrotron; ²Technical University of Denmark; ³Helmholtz-Zentrum Geesthacht

11:30 AM

Investigation of Stress Relaxation through X-ray Scattering: *Armand Beaudoin*¹; Wenli Tang¹; Kamalika Chatterjee¹; Dallas Trinkle¹; Margaret Koker²; Ulrich Lienert³; Peter Kenesei⁴; ¹University of Illinois at Urbana-Champaign; ²Cornell University; ³Deutsch Elektronen Synchrotron; ⁴Argonne National Laboratory

11:50 AM

Characterization of Strain Mechanisms in Lead-free Piezoceramics: *Marta Majkut*¹; Jette Oddershede¹; John Daniels²; Søren Schmidt¹; ¹Technical University of Denmark; ²University of New South Wales

12:10 PM Lunch (On Your Own)

Session 21: Acquisition and Handling of 3D Data III

Wednesday PM
July 2, 2014

Room: Salle de l'Europe
Location: Imperial Palace Congress Center

2:00 PM Invited

A Generalized Forward Projector for the Electron Back-scatter Diffraction Modality: *Marc De Graef*¹; ¹Carnegie Mellon University

2:30 PM

Quantitative Fractography of Corrosion-Resistant Alloys for Oilfield Applications: *Wei Chen*¹; John Williard¹; Somesh Mukherjee¹; John Stevens¹; Ting Chen²; Xingbo Liu²; ¹Baker Hughes; ²West Virginia University

2:50 PM Break

Session 22: Diffraction and Related Techniques IV

Wednesday PM
July 2, 2014

Room: Salle Verdi
Location: Imperial Palace Congress Center

2:00 PM Invited

Advances in Analysis of 3D Orientation Data Sets Obtained by FIB-EBSD Tomography: *Peter Konijnenberg*¹; Guillaume Stechmann¹; Stefan Zaefferer¹; Dierk Raabe¹; ¹Max-Planck-Institute for Iron Research

2:30 PM

Optimized Set-up for Static 3D EBSD in a FIB SEM: *Julien Guyon*¹; Nathalie Gey¹; Jean Claude Menard²; Daniel Goran³; Fabian Pérez-Willard⁴; Smail Chalal⁵; ¹LEM3; ²NewTec Scientific; ³Bruker Nono GmbH; ⁴Carl Zeiss Microscopy; ⁵Carl Zeiss S.A.S.

2:50 PM

Reconstruction of Local Orientation in Grains using a Discrete Representation of Orientation Space: *Nicola Viganò*¹; Wolfgang Ludwig¹; Kees Batenburg²; ¹INSA Lyon, ESRF Grenoble; ²CWI Amsterdam, University Antwerp

3:10 PM Break

Closing Session and Panel Discussion

Wednesday PM
July 2, 2014

Room: Salle de l'Europe
Location: Imperial Palace Congress Center

3:30 PM Invited

3D Materials Science: Where We've Been, Where We Are Now, and Where We Need to Go: *George Spanos*¹; David Howe¹; ¹TMS

4:00 PM Panel Discussion

Panelists: George Spanos, TMS; Philip Withers, University of Manchester; Mike Uchic, U.S. Air Force Research Lab.; Marc de Graf, Carnegie Mellon University; Tony Rollett, Carnegie Mellon University

strontium doped lanthanum III-IV nitride materials crystal growth cobalt metamaterials
 organo-r illics tantalum alloys cerium polishing powder thin film osynthetics
 sodium spong eprosium pellets atomic layer deposition semiconducti
 battery lithi rospace ultra-light alloys iridium crucible erbium
 ovskite scandium-aluminum green technology single crystal s
 mischmet K Ca Sc Ti V Cr Mn Fe Co Ni Cu Zn Ga Ge As Se Br Kr
 cathode Rb Sr Y Zr Nb Mo Tc Ru Rh Pd Ag Cd In Sn Sb Te I Xe
 solar ener vanadium Cs Ba La Hf Ta W Re Os Ir Pt Au Hg TI Pb Bi Po At Rn
 CIGS super alloys Ac Rf Db Sg Bh Hs Mt Ds Rg Cn Uut Fl Uup Lv Uus Uuo
 yttrium foil liquid gallium arsenide gallium lump
 optoelectronics laser crystals rare earth metals fuel cell materials hafnium tubing ultra
 targets silicon carbide germanium windows 99.999% ruthenium spheres erbium doped fiber optics
 dielectrics platinum ink quantum dots nickel foam ultra high purity met
 anti-ballistic ceramics osmium alternative energy ionic
 photovoltaics Nd:YAG catalog: americanelements.com
 shape memory alloys

Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Fl	Uup	Lv	Uus	Uuo
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu					
Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu				
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr				

Now Invent.™



The Materials Science Company®

catalog: americanelements.com

shape memory alloys



© 2001-2014, American Elements is a U.S. Registered Trademark.