



GORDON RESEARCH CONFERENCES

FINAL PROGRESS REPORT
Department of Energy
Physical Metallurgy GRC/GRS

Grant Number DE-SC0019899

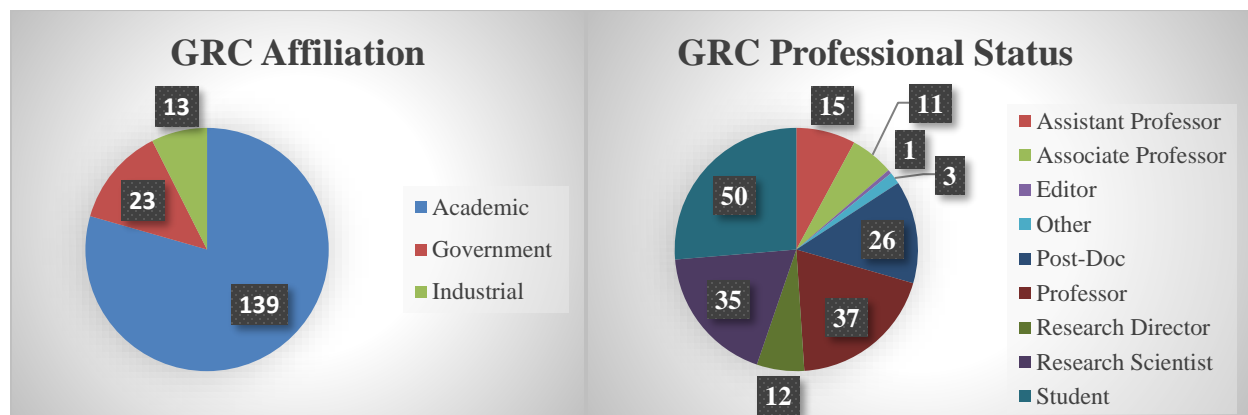
Operational Summary

The Gordon Research Conference (GRC) and Gordon Research Seminar (GRS) on Physical Metallurgy were held at Southern New Hampshire University in Manchester, New Hampshire from July 6-12, 2019. The meeting covered a variety of scientific topics and the content presented was highly rated by participants.



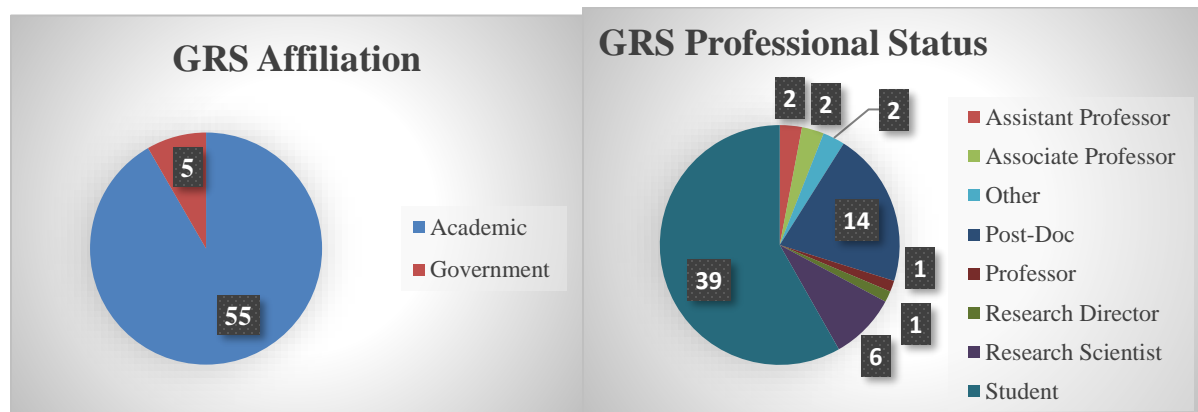
Conference Participants

The Conference was well-attended with 190 participants. Scientists from academia represented 73% of the participants while attendees from government accounted for 12% and those from industry totaled 7%. The meeting also attracted a strong mix of young investigators and senior scientists. Students and post-docs accounted for 40% of all attendees. Approximately 27% of the participants at the 2019 meeting were women.



Seminar Participants

The Seminar was well-attended with 67 participants. Scientists from academia represented 82.9% of the participants while attendees from government accounted for 8%. Students and post docs combined accounted for 79% of all attendees. Approximately 40% of the participants at the 2019 seminar were women.



Conference Program

The past few years have witnessed a dramatic increase of the pace of application of advanced data science methods such as machine learning to digital microstructures and related properties. In addition, *in situ* and *in operando* experimental techniques to characterize 3D microstructures and measure time-dependent evolution under applied fields are providing completely new research platforms to quantify deformation and damage mechanisms in

alloy systems. The field of Physical Metallurgy is rapidly evolving and in many respects is leading the way at the intersection of these new technologies in emerging paradigms such as Integrated Computational Materials Engineering and the U.S. Materials Genome Initiative. This confluence of science and technology advances related to the digital frontier of materials informatics is expected to broadly and fundamentally transform both the education and research and development enterprises. A primary goal of this Gordon Research Conference was to explore demonstrated advances in coupling computation, data science and experiments to enhance our depth of scientific understanding and the rate of its acquisition. Another aim was to explore potential intersections of emerging technologies and methods to frame essential questions regarding how these intersections might further develop and how collaborative efforts might be configured to take full advantage of the power of their coupling. Issues regarding complexity of relating material structure with associated properties or responses are at the core of modern Physical Metallurgy. These issues demand much deeper and quantitative understanding of fundamental unit processes and mechanisms that control thermodynamic driving forces and kinetics of microstructure evolution for various applications. This is essential to support materials design or improvement. Grain boundary complexity will be pursued as a session topic owing to its expression of high dimensionality of structure and structure-response relations. High entropy alloys or complex multi-component alloys offer a fruitful emergent class of materials which are quite promising, and yet deformation and failure mechanisms are not fully understood. Other sessions focused on how data science adds value to materials discovery, including applications of machine learning to alloy discovery, design, and development, as well as recent advances in *in situ* and *in operando* experimental methods such as TEM, x-ray diffraction tomography, and phase contrast tomography. Foundational principles of thermodynamics and kinetics will weave as a connective thread throughout the presentations and discussions at oral and poster sessions.

The Gordon Research Seminar on Physical Metallurgy was a unique forum for graduate students, post-docs, and other scientists with comparable levels of experience and education to present and exchange new data and cutting-edge ideas. The past few years have witnessed a dramatic increase of the pace of application of advanced data science methods such as machine learning to digital microstructures and related properties. In addition, *in situ* and *in operando* experimental techniques to characterize 3D microstructures and measure time-dependent evolution under applied fields are providing completely new research platforms to quantify deformation and damage mechanisms in alloy systems. This confluence of science and technology advances related to the digital frontier of materials informatics is expected to broadly and fundamentally transform both the education and research and development enterprises. A primary goal of this Gordon Research Seminar was to provide the attending researchers an exploration of these demonstrated advances in coupling computation, data science and experiments to enhance depth of scientific understanding and the rate of its acquisition as a primer to the Gordon Research Conference on the same topic. As a part of the mentorship and profession development component of this Gordon Research Seminar, programming was provided to foster an educational and open discussion around the topic of diversity in the field of Physical Metallurgy, particularly regarding the support, understanding, and advancement of racial, ethnic, gender, and lesbian, gay, bisexual, transgender, and queer (LGBTQ+) minorities.

Conference Budget

Funding provided by the Department of Energy supported partial registration for 1 assistant professor, 11 graduate students, and 5 post docs at the GRC and partial registration for 14 graduate students, 1 research scientists and 4 post docs at the GRS.

Conference Feedback

Participants had an opportunity to provide feedback at the end of the Conference. The feedback collected from the meeting was extremely positive. Evaluations included numerous positive remarks regarding the poster presentations. Evaluations from the GRS included positive comments regarding the discussions.

GRC would like to thank the Department of Energy for its continued support of the meetings. The contributions received have been critical to the success of the conferences and are having a measurable impact in advancing the frontiers of science worldwide.

Dr. Carol Handwerker, GRC Chair
Purdue University

Dr. Dierk Raabe, GRC Chair
Max Planck Institute for Iron Research

Dr. Thomas Reeve, GRS Chair
Lawrence Livermore National Laboratory

Dr. Aerial Murphy-Leonard, GRS Chair
Naval Research Laboratory

Dr. Nancy Ryan Gray
President and Chief Executive Officer
Gordon Research Conferences

Physical Metallurgy GRS Registration List

Name	Organization	Participation
Aguiar, Jeffery A	Idaho National Laboratory	Poster Presenter
Aldaz, Mayela	University of California Santa Barbara	Poster Presenter
Ananthanarayanan, Durga	KTH Royal Institute of Technology	Poster Presenter
Anthony, Benjamin T	North Carolina State University	Poster Presenter
Bodunrin, Michael Oluwatosin	University of the Witwatersrand	Poster Presenter
Brodie, Julian L	The Ohio State University	Discussion Leader
Chadwick, Alexander F	Northwestern University	Poster Presenter
Chen, Xi	Purdue University	Poster Presenter
Chou, Kathleen	University of Michigan	Discussion Leader
Clark, Trevor	Sandia National Laboratories	Discussion Leader
DeCost, Brian L.	National Institute of Standards and Technology	Speaker
Egan, Ashton J	The Ohio State University	Poster Presenter
Fan, Yaohui	Purdue University	Poster Presenter
Gerlt, Austin RC	AFRL/UES	Poster Presenter
Ghazisaeidi, Maryam	Ohio State University	Speaker
Goins, Philip E	Army Research Laboratory	Poster Presenter
Gong, Yilun	University of Oxford	Poster Presenter
Gunda, Naga Sri Harsha	University of California Santa Barbara	Poster Presenter
Gwalani, Bharat	Pacific Northwest National Laboratory	Poster Presenter
Handwerker, Carol A	Purdue University	Poster Presenter
Harvey, Cayla	University of Nevada, Reno	Speaker
Huang, Ziyun	Purdue University	Poster Presenter
Ihsan, Ahmad Zainul	TU Bergakademie Freiberg	Poster Presenter
Ji, Kaihua	Northeastern University	Poster Presenter
Jin, Ke-Wei	Carnegie Mellon University	Poster Presenter
Johnson, Nathan S	Colorado School of Mines	Poster Presenter
Kadirvel, Kamalnath	Ohio State University	Poster Presenter
Kaufmann, Kevin R	University of California, San Diego	Poster Presenter
Khosravani, Ali	Georgia Institute of Technology	Speaker
Komarasamy, Mageshwari	Pacific Northwest National Laboratory	Attendee
Lewis, Alexis C	National Science Foundation	Speaker
Lieberman, Evan J	Los Alamos National Laboratory	Poster Presenter
Linne, Marissa	University of Michigan	Speaker
Liu, Mengying	Texas A&M University	Poster Presenter
Madison, Jonathan D	Sandia National Laboratories	Speaker
Mathaudhu, Suveen N	University of California, Riverside	Speaker
Matsunaga, Sae	Purdue University	Poster Presenter
McClure, Zachary	Purdue University	Poster Presenter
Miller, Victoria M	University of Florida	Speaker
Milligan, Brian K	Colorado School of Mines	Poster Presenter
Mukhopadhyay, Semanti	The Ohio State University	Poster Presenter
Murphy-Leonard, Aerial D	Naval Research Laboratory	Chair
Norkett, Justin E	NC State University	Poster Presenter
Panwisawas, Chinnapat	University of Oxford	Poster Presenter
Ramos, Evander H	UC Riverside	Poster Presenter
Rao, You	The Ohio State University	Speaker

Reeve, Thomas C	Lawrence Livermore National Laboratory	Chair
Reeve, Sam	Lawrence Livermore National Laboratory	Poster Presenter
Ricciardi, Denielle	The Ohio State University	Attendee
Rullik, Lisa	Lund University	Speaker
Sabarou, Hooman	Worcester Polytechnic Institute	Poster Presenter
Salvador, Heather	University of California Riverside	Poster Presenter
Sims, Zachary	University of Tennessee Knoxville	Poster Presenter
Stan, Tiberiu	Northwestern University	Speaker
Stricker, Markus	École Polytechnique Fédérale de Lausanne	Poster Presenter
Tang, Yuanbo T	Department of Materials, University of Oxford	Poster Presenter
Thyagatur Kidigannappa, A	University of Nevada , Reno	Poster Presenter
Titus, Michael S	Purdue University	Speaker
Tripathi, Shivam	Purdue University	Poster Presenter
Varma, Soumya	University of Nevada Reno	Poster Presenter
Wang, Congying	Purdue University	Discussion Leader
Whelan, Gary	Georgia Institute of Technology	Attendee
Wilson, Laura G	Case Western Reserve University	Poster Presenter
Woryk, Larissa M	University of Pennsylvania	Poster Presenter
Wu, Yifan	Purdue University	Poster Presenter
Yaeger, Alyssa N	Purdue University	Poster Presenter
Yu, Anqi	University of California, Riverside	Poster Presenter

67 Attendees

Physical Metallurgy GRC Registration List

Name	Organization	Participation
Agnew, Sean R	University of Virginia	Poster Presenter
Aguiar, Jeffery A	Idaho National Laboratory	Attendee
Aldaz, Mayela	University of California Santa Barbara	Poster Presenter
Ananthanarayanan, Durga	KTH Royal Institute of Technology	Poster Presenter
Anderson, Kevin	Mercury Marine, Brunswick Corporation	Discussion Leader
Anthony, Benjamin T	North Carolina State University	Poster Presenter
Beese, Allison M	Pennsylvania State University	Poster Presenter
Behera, Amit	QuesTek Innovations	Poster Presenter
Belgasam, Tarek M	Honda R&D America, Inc.	Poster Presenter
Berdichevsky, Victor L	Wayne State University	Attendee
Bhattacharyya, Jishnu J	University of Virginia	Poster Presenter
Blendell, John E	Purdue University	Attendee
Bodunrin, Michael Oluwatosin	University of the Witwatersrand	Poster Presenter
Britton, Thomas	Imperial College London	Poster Presenter
Brodie, Julian L	The Ohio State University	Poster Presenter
Carter, Jennifer L	Case Western Reserve University	Poster Presenter
Chadwick, Alexander F	Northwestern University	Poster Presenter
Chakraborty, Supriyo	The Ohio State University	Poster Presenter
Chatain, Dominique	Aix-Marseille University / CNRS	Speaker
Chen, Xi	Purdue University	Poster Presenter
Chen, Long-Qing	The Pennsylvania State University	Speaker
Chen, Dengke	Georgia Institute of Technology	Poster Presenter
Cheng, Tianle	National Energy Technology Laboratory	Attendee
Chou, Kathleen	University of Michigan	Poster Presenter
Clark, Trevor	Sandia National Laboratories	Poster Presenter
Cohn, Ryan	Carnegie Mellon University	Poster Presenter
Curtin, William A	Swiss Institute of Technology	Vice Chair
Daly, Samantha H	University of California, Santa Barbara	Speaker
DeCost, Brian L.	National Institute of Standards and Technology	Poster Presenter
Detor, Andrew J	GE Research	Poster Presenter
Devaraj, Arun	Pacific Northwest National Laboratory	Poster Presenter
Diehl, Martin	Max-Planck-Institut fuer Eisenforschung GmbH	Poster Presenter
Dowding, Robert J	US Army Research Laboratory	Attendee
Eastman, Christopher M	TimkenSteel Corporation	Poster Presenter
Egan, Ashton J	The Ohio State University	Poster Presenter
Fan, Yaohui	Purdue University	Poster Presenter
Fisher, Charles R	Naval Surface Warfare Center - Carderock Division	Attendee
Fukumasu, Newton K	University of Sao Paulo - Fundação para o Desenvolvimento Tecnológico da Engenharia	Poster Presenter
Furuhara, Tadashi	Institute for Materials Research, Tohoku University	Speaker
Galera-Rueda, Clara	Imdea materials	Poster Presenter
Gaskey, Bernard	Nanyang Technological University	Poster Presenter
Gerlt, Austin RC	AFRL/UES	Poster Presenter
Ghazisaeidi, Maryam	Ohio State University	Attendee
Gianola, Daniel S	University of California, Santa Barbara	Discussion Leader

Goins, Philip E	Army Research Laboratory	Poster Presenter
Gong, Yilun	University of Oxford	Poster Presenter
Gordon, Jerard V.	Carnegie Mellon University	Poster Presenter
Greiner, Christian	Karlsruhe Institute of Technology (KIT)	Poster Presenter
Gu, Wendy	Stanford University	Poster Presenter
Gu, Tang	Georgia Institute of Technology	Poster Presenter
Gunda, Naga Sri Harsha	University of California Santa Barbara	Poster Presenter
Gupta, Ankit	Colorado School of Mines	Poster Presenter
Gwalani, Bharat	Pacific Northwest National Laboratory	Poster Presenter
Handwerker, Carol A	Purdue University	Chair
Harvey, Cayla	University of Nevada, Reno	Poster Presenter
Hegadekatte, Vishwanath	Novelis Inc.	Attendee
Hemker, Kevin	Whiting School of Engineering, Johns Hopkins University	Discussion Leader
Hernandez, Efrain	US Army Research Laboratory	Poster Presenter
Holm, Elizabeth A	Carnegie Mellon University	Speaker
Hu, Yong-Jie	University of Michigan	Poster Presenter
Huang, Ziyun	Purdue University	Attendee
Ihsan, Ahmad Zainul	TU Bergakademie Freiberg	Poster Presenter
Ji, Kaihua	Northeastern University	Poster Presenter
Jin, Ke-Wei	Carnegie Mellon University	Poster Presenter
Johnson, Nathan S	Colorado School of Mines	Poster Presenter
Jokisaari, Andrea	Idaho National Laboratory	Attendee
Kacher, Joshua	Georgia Institute of Technology	Speaker
Kadirvel, Kamalnath	Ohio State University	Poster Presenter
Kalidindi, Surya	Georgia Institute of Technology	Discussion Leader
Kaoumi, Djamel	North Carolina State University	Poster Presenter
Kaplan, Wayne D	Technion - Israel Institute of Technology	Attendee
Kappes, Branden B	Colorado School of Mines	Poster Presenter
Kareh, Kristina Maria	Nature Communications	Attendee
Karma, Alain	Northeastern University	Speaker
Kaufmann, Kevin R	University of California, San Diego	Poster Presenter
Key, Jordan W	Georgia Institute of Technology	Poster Presenter
Khosravani, Ali	Georgia Institute of Technology	Poster Presenter
Komarasamy, Mageshwari	Pacific Northwest National Laboratory	Attendee
Korte-Kerzel, Sandra	RWTH Aachen University	Speaker
Kwiatkowski da Silva, Alisson	Max-Planck-Institut fuer Eisenforschung GmbH (MPIE)	Poster Presenter
Legros, Marc	Centre d'Elaboration de Matériaux et d'Etudes Structurales	Speaker
Lewis, Daniel J	Rensselaer Polytechnic Institute	Poster Presenter
Lewis, Alexis C	National Science Foundation	Attendee
Li, Lin	The University of Alabama	Poster Presenter
Lieberman, Evan J	Los Alamos National Laboratory	Poster Presenter
Linne, Marissa	University of Michigan	Poster Presenter
Liu, Mengying	Texas A&M University	Poster Presenter
Llorca, Javier	IMDEA Materials Institute/Polytechnic University of Madrid	Attendee
Luo, Jian	University of California, San Diego	Attendee
Machado, Izabel F	University of Sao Paulo/ FUNDAÇÃO PARA O Desenvolvimento Tecnológico da Engenharia	Poster Presenter

Madison, Jonathan D	Sandia National Laboratories	Poster Presenter
Marquis, Emmanuelle A	University of Michigan	Discussion Leader
Martin, John H	HRL Laboratories	Attendee
Mathaudhu, Suveen N	University of California, Riverside	Vice Chair
Matsunaga, Sae	Purdue University	Poster Presenter
McClure, Zachary	Purdue University	Poster Presenter
McCue, Ian	Johns Hopkins University Applied Physics Laboratory	Speaker
McDowell, David L	Georgia Institute of Technology	Attendee
Menou, Edern	Safran	Attendee
Meredig, Bryce	Citrine Informatics	Speaker
Miller, Victoria M	University of Florida	Poster Presenter
Milligan, Brian K	Colorado School of Mines	Poster Presenter
Mills, Sean H	Colorado School of Mines	Poster Presenter
Miracle, Daniel B	Air Force Research Laboratory	Discussion Leader
Moridi, Atieh	Cornell University	Attendee
Mottura, Alessandro	University of Birmingham	Poster Presenter
Mukhopadhyay, Semanti	The Ohio State University	Poster Presenter
Murphy-Leonard, Aerial D	Naval Research Laboratory	Poster Presenter
Neugebauer, Joerg	Max-Planck-Institut fuer Eisenforschung	Speaker
Niezgoda, Stephen	The Ohio State University	Poster Presenter
Norkett, Justin E	NC State University	Poster Presenter
Okumura, Ryota	DENSO International America, Inc.	Attendee
Olsson, Eva M	Chalmers University of Technology	Speaker
Panwisawas, Chinnapat	University of Oxford	Poster Presenter
Park, Jiwon	Korea Institute of Materials Science	Attendee
Pathak, Sid	University of Nevada, Reno	Poster Presenter
Patil, Chaitali S.	The Ohio State University	Poster Presenter
Phillpot, Simon	University of Florida	Speaker
Pollock, Tresa M	University of California, Santa Barbara	Discussion Leader
Poole, Warren J	University of British Columbia	Attendee
Poorganji, Behrang	GE Additive	Attendee
Preuss, Michael	University of Manchester	Poster Presenter
Qi, Liang	University of Michigan	Poster Presenter
Raabe, Dierk R	Max Planck Institute for Iron Research	Chair
Ramos, Evander H	UC Riverside	Poster Presenter
Rao, You	The Ohio State University	Poster Presenter
Reeve, Sam	Lawrence Livermore National Laboratory	Poster Presenter
Reeve, Thomas C	Lawrence Livermore National Laboratory	Poster Presenter
Ricciardi, Denielle	The Ohio State University	Attendee
Rickman, Jeff	Lehigh University	Attendee
Rios, Orlando	Oak Ridge National Laboratory	Speaker
Rohatgi, Aashish	Pacific Northwest National Laboratory	Attendee
Ross, Frances M	Massachusetts Institute of Technology	Speaker
Rowenhorst, Dave	US Naval Research Lab	Attendee
Rullik, Lisa	Lund University	Poster Presenter
Rupert, Timothy J	University of California, Irvine	Speaker
Sabarou, Hooman	Worcester Polytechnic Institute	Attendee
Sakidja, Ridwan	Missouri State University	Poster Presenter

Salvador, Heather	University of California Riverside	Poster Presenter
Sndfeld, Stefan	Micromechanical Materials Modelling, TU Bergakademie FreibergSpeaker	
Schwaiger, Ruth	Karlsruhe Institute of Technology	Attendee
Seita, Matteo	Nanyang Technological University	Poster Presenter
Sen, Fatih G	Novelis	Attendee
Seriacopi, Vanessa	University of Sao Paulo / Federal Institute of Sao Paulo	Poster Presenter
Shi, Yeqi	University of Wisconsin	Poster Presenter
Shi, Shan	Hamburg University of Technology	Poster Presenter
Shin, Dongwon	Oak Ridge National Laboratory	Poster Presenter
Sims, Zachary	University of Tennessee Knoxville	Poster Presenter
Sinclair, Chad	The University of British Columbia	Poster Presenter
Singh, Saransh	Lawrence Livermore National Lab	Poster Presenter
Srolovitz, David	City University of Hong Kong	Speaker
Stan, Tiberiu	Northwestern University	Poster Presenter
Strachan, Alejandro	Purdue University	Speaker
Stricker, Markus	École Polytechnique Fédérale de Lausanne	Poster Presenter
Subramanian, P R	GE Global Research	Attendee
Sugiyama, Masaaki	Osaka University	Attendee
Sushko, Peter V	Pacific Northwest National Laboratory	Poster Presenter
Suzuki, Akane	GE Research	Attendee
Taheri, Mitra L	Johns Hopkins University	Poster Presenter
Tamirisakandala, Sesh A	ARCONIC	Attendee
Tang, Yuanbo T	Department of Materials, University of Oxford	Poster Presenter
Tavener, Jacob P	Colorado School of Mines	Attendee
Thirumalai, Neeraj S	ExxonMobil Research and Engineering Company	Attendee
Thyagatur Kidigannappa, Anugraha	University of Nevada, Reno	Poster Presenter
Titus, Michael S	Purdue University	Poster Presenter
Trinkle, Dallas R.	Univ. Illinois, Urbana-Champaign	Poster Presenter
Tripathi, Shivam	Purdue University	Poster Presenter
Turner, John A.	UT-Battelle / Oak Ridge National Lab	Poster Presenter
Varma, Soumya	University of Nevada Reno	Poster Presenter
Vecchio, Kenneth S	UC San Diego	Attendee
Vedanti, Pawan	Wayne State University	Poster Presenter
Volkert, Cynthia A	University of Goettingen	Speaker
Voorhees, Peter W	Northwestern University	Discussion Leader
Wang, Congying	Purdue University	Poster Presenter
Wang, Fulin	University of California Santa Barbara	Poster Presenter
Warren, James A	National Institute of Standards and Technology	Discussion Leader
Whelan, Gary	Georgia Institute of Technology	Attendee
Wilson, Laura G	Case Western Reserve University	Poster Presenter
Woryk, Larissa M	University of Pennsylvania	Poster Presenter
Wu, Yifan	Purdue University	Attendee
Wu, Kaisheng	Thermo-Calc Software Inc.	Attendee
Wynblatt, Paul	Carnegie Mellon University	Poster Presenter
Xie, Kelvin	Texas A&M University	Poster Presenter
Yaeger, Alyssa N	Purdue University	Poster Presenter
Yang, Shengfeng	Indiana University Purdue University Indianapolis	Poster Presenter

Ying, Charles

Yu, Anqi

Zhang, Yin

Zhao, Ji-Cheng (JC)

Zou, Yu

190 Attendees

National Science Foundation

University of California, Riverside

Georgia Institute of Technology

University of Maryland

University of Toronto

Attendee

Poster Presenter

Poster Presenter

Attendee

Poster Presenter

Physical Metallurgy
Gordon Research Seminar
Coupling Computation, Data Science and Experiments in Physical Metallurgy

July 6 - 7, 2019

Chairs Thomas C. Reeve and Aerial D. Murphy-Leonard

Saturday

2:00 pm - 5:00 pm Arrival and Check-in

3:30 pm - 3:45 pm Introductory Comments by GRC Site Staff / Welcome from the GRS Chair

3:45 pm - 4:30 pm **Keynote Session: Building Connections Between Microscopic Physical Phenomena and Macroscopic Mechanical Behavior**

Discussion Leader: **Trevor Clark** (Sandia National Laboratories, USA)

3:45 pm - 4:15 pm **Maryam Ghazisaeidi** (Ohio State University, USA)

"High Entropy Alloys: Mechanical Properties and Phase Stability"

4:15 pm - 4:30 pm Discussion

4:30 pm - 6:00 pm **Poster Session**

6:00 pm - 7:00 pm Dinner

7:30 pm - 9:30 pm **Integrated Computational and Experimental Approaches for Alloy Design and Characterization**

Discussion Leader: **Julian Brodie** (The Ohio State University, USA)

7:30 pm - 7:50 pm **Brian DeCost** (National Institute of Standards and Technology, USA)

"Autonomous Scanning Droplet Cell for Data-Driven Experimental Alloy Design"

7:50 pm - 8:00 pm Discussion

8:00 pm - 8:20 pm **Esakkiraja Neelamegan** (Indian Institute of Science, India)

"The Newly Developed Pseudo-Binary and Pseudo-Ternary Diffusion Couple Methods in Multicomponent Diffusion:

Estimation of Diffusion Coefficients and a Tool for Combinatorial Method of Designing Alloys"

8:20 pm - 8:30 pm Discussion

8:30 pm - 8:50 pm **Cayla Harvey** (University of Nevada, Reno, USA)

"Understanding the Omega Phase Mechanical Properties of Titanium and Zirconium Through Spherical Nanoindentation and EBSD"

8:50 pm - 9:00 pm Discussion

9:00 pm - 9:20 pm **Marissa Linne** (University of Michigan, USA)

"Grain Boundary Sliding and Slip Transmission in High Purity Aluminum"

9:20 pm - 9:30 pm Discussion

Sunday

7:30 am - 8:30 am Breakfast

9:00 am - 11:00 am **Advanced Characterization and Computational Techniques for Material Design and Discovery**

Discussion Leader: **Congying Wang** (Purdue University, USA)

9:00 am - 9:20 am **You Rao** (The Ohio State University, USA)
"A First Principles Multi-Cell Monte Carlo Method for Phase Prediction"

9:20 am - 9:30 am Discussion

9:30 am - 9:50 am **Lisa Rullik** (Lund University, Sweden)
"Surface Characterization of Super Duplex Stainless Steel Throughout Heating"

9:50 am - 10:00 am Discussion

10:00 am - 10:20 am **Ali Khosravani** (Georgia Institute of Technology, USA)
"Multi Length-Scale and High Throughput Mechanical Characterization of Metallic Alloys"

10:20 am - 10:30 am Discussion

10:30 am - 10:50 am **Tiberiu Stan** (Northwestern University, USA)
"Solidification of Aluminum Alloys: 4D X-Ray Tomography and Machine Learning"

10:50 am - 11:00 am Discussion

11:00 am - 12:30 pm **Poster Session**
Coffee will be served in the poster area from 11:00 am - 11:30 am

12:30 pm - 1:30 pm Lunch

1:30 pm - 2:30 pm **Mentorship Component: Speed Networking**
Small group discussions facilitated by invited mentors in the field who will rotate from group to group throughout the session.
Discussion Leader: **Kathleen Chou** (University of Michigan, USA)

1:30 pm - 2:30 pm **Panel Discussion**
Fostering Small Group Discussions on Science, Careers, Diversity and Life Balance

- **Alexis Lewis** (National Science Foundation, USA)
- **Jonathan Madison** (Sandia National Laboratories, USA)
- **Suveen Mathaudhu** (University of California, Riverside, USA)
- **Victoria Miller** (North Carolina State University, USA)
- **Michael Titus** (Purdue University, USA)
- **Maryam Ghazisaeidi** (Ohio State University, USA)

2:30 pm - 3:00 pm

Evaluation Period

Fill in GRS Evaluation Forms

3:00 pm

Seminar Concludes

Contributors



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Physical Metallurgy
Gordon Research Conference
Coupling Computation, Data Science and Experiments in Physical Metallurgy

July 7 - 12, 2019

Chairs Carol A. Handwerker and Dierk R. Raabe

Vice Chairs Suveen N. Mathaudhu and William A. Curtin

GRC Program

Sunday

2:00 pm - 9:00 pm Arrival and Check-in

6:00 pm - 7:00 pm Dinner

7:30 pm - 7:40 pm Introductory Comments by GRC Site Staff / Welcome from the GRC Chair

7:40 pm - 9:30 pm **Transcending Historical Models via Data Science**
Discussion Leader: **Peter Voorhees** (Northwestern University, USA)

7:40 pm - 8:20 pm **Alejandro Strachan** (Purdue University, USA)
"Atomistic Simulations with Quantified Uncertainties for Science and Engineering Discovery"

8:20 pm - 8:35 pm Discussion

8:35 pm - 9:15 pm **Sandra Korte-Kerzel** (RWTH Aachen University, Germany)
"Damage in Metal Forming: On the Use of Artificial Intelligence to Expand the Reach of Experiments"

9:15 pm - 9:30 pm Discussion

Monday

7:30 am - 8:30 am Breakfast

9:00 am - 12:30 pm **Grain Boundary Complexity and Materials Design**
Discussion Leader: **Kevin Hemker** (Whiting School of Engineering, Johns Hopkins University, USA)

9:00 am - 9:40 am **David Srolovitz** (City University of Hong Kong, Hong Kong SAR China)
"Grain Boundary Dynamics: Deformation/Grain Boundary Coupling"

9:40 am - 10:00 am Discussion

10:00 am - 10:30 am Coffee Break

10:30 am - 11:10 am **Elizabeth Holm** (Carnegie Mellon University, USA)
"Data Science and Machine Learning to Advance Microstructural Science"

11:10 am - 11:30 am Discussion

11:30 am - 12:10 pm **Marc Legros** (Centre d'Elaboration de Matériaux et d'Etudes Structurales (CEMES), CNRS, France)
"Grain Boundary Structure, Motion and Mechanics"

12:10 pm - 12:30 pm Discussion

12:30 pm - 1:30 pm Lunch

1:30 pm - 4:00 pm Free Time

3:00 pm - 4:00 pm **The GRC Power Hour™**

The GRC Power Hour™ is designed to address challenges women face in science and issues of diversity and inclusion.

The program supports the professional growth of all members of our communities by providing an open forum for discussion and mentoring.

Organizer: **Samantha Daly** (University of California, Santa Barbara, USA)

4:00 pm - 6:00 pm **Poster Session**

6:00 pm - 7:00 pm Dinner

7:30 pm - 9:30 pm **Materials Discovery with the Aid of Data Science**

Discussion Leader: **Surya Kalidindi** (Georgia Institute of Technology, USA)

7:30 pm - 8:10 pm **Joerg Neugebauer** (Max-Planck-Institut fuer Eisenforschung, Germany)
"Machine Learning in Materials Screening and Discovery"

8:10 pm - 8:30 pm Discussion

8:30 pm - 9:10 pm **Ian McCue** (Johns Hopkins University Applied Physics Laboratory, USA)
"Processing Insights from Data Science: Teaching Old Materials New Tricks"

9:10 pm - 9:30 pm Discussion

Tuesday

7:30 am - 8:30 am Breakfast

9:00 am - 12:30 pm **In Situ Experimental Methods**

Discussion Leader: **Daniel Gianola** (University of California, Santa Barbara, USA)

9:00 am - 9:40 am **Frances Ross** (Massachusetts Institute of Technology, USA)
"Opportunities for Quantitative Analysis of Crystal Growth and Phase Transformations Using *In Situ* Electron Microscopy Techniques"

9:40 am - 10:00 am Discussion

10:00 am - 10:30 am Coffee Break

10:30 am - 11:10 am **Joshua Kacher** (Georgia Institute of Technology, USA)
"Relating Microstructure to Deformation and Corrosion Processes via Multiscale Electron Microscopy Techniques"

11:10 am - 11:30 am Discussion

11:30 am - 12:10 pm **Dominique Chatain** (Aix-Marseille University / CNRS, France)
"Grain Growth in FCC Thin Films: From Single Elements to High-Entropy Alloys"

12:10 pm - 12:30 pm Discussion

12:30 pm - 1:30 pm Lunch

1:30 pm - 4:00 pm Free Time

4:00 pm - 6:00 pm **Poster Session**

6:00 pm - 7:00 pm Dinner

7:30 pm - 9:30 pm **Grain Boundary Complexity and Data Science**
Discussion Leader: **Emmanuelle Marquis** (University of Michigan, USA)

7:30 pm - 8:10 pm **Alain Karma** (Northeastern University, USA)
"Microstructural Pattern Formation in Solidification: Predicting Grain-Boundary Evolution and Grain Structures"

8:10 pm - 8:30 pm Discussion

8:30 pm - 9:10 pm **Timothy Rupert** (University of California, Irvine, USA)
"Segregation-Induced Complexion Transitions: New Opportunities for Materials Design"

9:10 pm - 9:30 pm Discussion

Wednesday

7:30 am - 8:30 am Breakfast

8:30 am - 9:00 am Group Photo

9:00 am - 12:30 pm **Complex Engineering Alloys: Experiment and Simulation**
Discussion Leader: **Kevin Anderson** (Mercury Marine, Brunswick Corporation, USA)

9:00 am - 9:40 am **Tadashi Furuhashi** (Institute for Materials Research, Tohoku University, Japan)
"Some Key Issues to Understand Atomistic Mechanisms in Phase Transformation and Precipitation in High Strength Metallic Materials"

9:40 am - 10:00 am Discussion

10:00 am - 10:30 am Coffee Break

10:30 am - 11:10 am **Orlando Rios** (Oak Ridge National Laboratory, USA)
"Rapid Development Techniques Applied to Materials for Energy"

11:10 am - 11:30 am Discussion

11:30 am - 12:10 pm **Stefan Sandfeld** (Micromechanical Materials Modelling, TU Bergakademie Freiberg, Germany)
"From Materials Science to Materials Data and Back: Temporary Fashion or Paradigm Shift?"

12:10 pm - 12:30 pm Discussion

12:30 pm - 1:30 pm Lunch

1:30 pm - 4:00 pm Free Time

4:00 pm - 6:00 pm **Poster Session**

6:00 pm - 7:00 pm Dinner

7:00 pm - 7:30 pm **Business Meeting**
Nominations for the Next Vice Chair; Fill in Conference Evaluation Forms; Discuss Future Site and Scheduling
Preferences; Election of the Next Vice Chair

7:30 pm - 9:30 pm **Machine Learning in Alloy Discovery, Design and Development**
Discussion Leader: **Tresa Pollock** (University of California, Santa Barbara, USA)

7:30 pm - 8:10 pm **Simon Phillpot** (University of Florida, USA)
"Rational Design of Interatomic Potentials Through Multi-Objective Optimization"

8:10 pm - 8:30 pm Discussion

8:30 pm - 9:10 pm **Bryce Meredig** (Citrine Informatics, USA)
"Machine Learning and AI in Materials Discovery and Development"

9:10 pm - 9:30 pm Discussion

Thursday

7:30 am - 8:30 am Breakfast

9:00 am - 12:30 pm **High Throughput Materials Discovery and Development**
Discussion Leader: **Daniel Miracle** (Air Force Research Laboratory, USA)

9:00 am - 9:40 am **Cynthia Volkert** (University of Goettingen, Germany)
"Ultrahigh Cycle Fatigue of Cu Thin Films"

9:40 am - 10:00 am Discussion

10:00 am - 10:30 am Coffee Break

10:30 am - 11:10 am **Eva Olsson** (Chalmers University of Technology, Sweden)
"In Situ and High Spatial Precision Studies of Engineered Materials Structures and Properties"

11:10 am - 11:30 am Discussion

11:30 am - 12:10 pm **Samantha Daly** (University of California, Santa Barbara, USA)

"Examination of Deformation Twinning in Magnesium Through Clustering and Computer Vision"

12:10 pm - 12:30 pm Discussion

12:30 pm - 1:30 pm Lunch

1:30 pm - 4:00 pm Free Time

4:00 pm - 6:00 pm **Poster Session**

6:00 pm - 7:00 pm Dinner

7:30 pm - 9:30 pm **Thermodynamics and Kinetics: Key to Materials Design**
Discussion Leader: **James Warren** (National Institute of Standards and Technology, USA)

7:30 pm - 8:10 pm **Nele Moelans** (KU Leuven, Belgium)
"Phase-Field Modeling of Multi-Component and Multi-Phase Microstructures: Challenges and Recent Advances"

8:10 pm - 8:30 pm Discussion

8:30 pm - 9:10 pm **Long-Qing Chen** (The Pennsylvania State University, USA)
"Phase-Field Modeling of Deformation-Induced Microstructure Evolution"

9:10 pm - 9:30 pm Discussion

Friday

7:30 am - 8:30 am Breakfast

9:00 am Departure

Contributors



**Gordon Research
Conferences**
Frontiers of Science



Carl Storm
Underrepresented
Minority Fellowship
Program



NIST





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