

AM BENCH 2022

ADDITIVE MANUFACTURING BENCHMARKS

August 14-18, 2022

Hyatt Regency Bethesda | Bethesda, Maryland, USA

TECHNICAL PROGRAM

www.tms.org/AMBench2022

CORPORATE SPONSOR:



TMS

AM-Bench 2022 is sponsored by the TMS Additive Manufacturing Committee, Process Technology and Modeling Committee, and Integrated Computational Materials Engineering Committee, in collaboration with National Institute of Standards and Technology (NIST), the National Aeronautics and Space Administration (NASA) - Langley, the Air Force Research Laboratory (AFRL), and the Lawrence Livermore National Laboratory (LLNL).

Monday Plenary

Monday AM
August 15, 2022

Room: Regency Ballroom I & II
Location: Hyatt Regency Bethesda

Session Chair: Gregory Wagner, Northwestern University

8:00 AM Introductory Comments

See Session Sign for details.

8:30 AM Plenary

The ExaAM Challenge Problem: AM Process Modeling at the Fidelity of the Microstructure: *James Belak*¹; John Turner²; ¹Lawrence Livermore National Laboratory; ²UT-Battelle / Oak Ridge National Lab

9:00 AM Plenary

Combining Modeling & Measurement in Metals Additive: *Anthony Rollett*¹; Joseph Pauza¹; Carter Cocke²; Ricardo Lebensohn³; Ashley Spear²; ¹Carnegie Mellon University; ²University of Utah; ³Los Alamos National Laboratory

9:30 AM Plenary

Energy Efficiency of Polymer Additive Manufacturing by Material Extrusion: *David Kazmer*¹; Amy Peterson¹; Austin Colon¹; ¹UMass Lowell

10:00 AM Break

Monday Benchmarks

Monday AM
August 15, 2022

Room: Regency Ballroom I & II
Location: Hyatt Regency Bethesda

Session Chair: Edwin Schwalbach, Air Force Research Laboratory

10:20 AM Plenary

Supporting the Simulation Community with Benchmark Measurements for Additive Manufacturing: *Lyle Levine*¹; Brandon Lane¹; ¹National Institute of Standards and Technology

10:45 AM Plenary

Metal 3D Builds and In-situ Measurements for the 2022 Additive Manufacturing Benchmark Challenges: *Brandon Lane*¹; Ho Yeung¹; David Deisenroth¹; Sergey Mekhontsev¹; Lyle Levine¹; Thien Phan²; ¹National Institute of Standards and Technology; ²Lawrence Livermore National Laboratory

11:20 AM Plenary

Voxel-scale Precision in Vat Photopolymerization Additive Manufacturing: *Jason Killgore*¹; Callie Higgins¹; Ben Caplins¹; Cameron Miller²; Yuqin Zong¹; Jeff Stansbury³; Gannon Kehe⁴; ¹National Institute of Standards and Technology; ²University of Virginia; ³University of Colorado, Anschutz

11:50 AM Question and Answer Period

Mechanical Behavior I

Monday PM
August 15, 2022

Room: Regency Ballroom I & II
Location: Hyatt Regency Bethesda

Session Chair: Orion Kafka, National Institute of Standards and Technology

1:30 PM Invited

Mechanical Property Modeling of AM Alloys and its Application in Accelerated Qualification and Certification: *Abhinav Saboo*¹; Qiaofu Zhang¹; Tanner Kirk²; Jiadong Gong³; Gregory Olson⁴; ¹QuesTek Innovations LLC; ²Texas A&M University; ³Questek Innovations LLC; ⁴Massachusetts Institute of Technology

2:00 PM

Use of Extreme Value Analysis to Determine Data Requirements for Defect Characterization and Predict Variation in Fatigue Performance: *Tharun Reddy*¹; Mahya Shahabi²; David Scannapieco³; Austin Ngo³; Anthony Rollett¹; John Lewandowski³; Sneha Prabha Narra¹; ¹Carnegie Mellon University; ²Worcester Polytechnic Institute; ³Case Western Reserve University

2:20 PM

Process-Structure-Properties Simulations for Predicting Fatigue Indicator Parameters of Additive Manufactured Ti-6Al-4V with Quantified Uncertainty: *Joshua Pribe*¹; Saikumar Yeratapally¹; Brodan Richter²; Patrick Leser²; George Weber²; Edward Glaesgen²; ¹National Institute of Aerospace; ²NASA Langley Research Center

2:40 PM

Decoupling the Effect of Geometry and Texture on the Mechanical Response of Additively Manufactured IN625 Thin-walled Elements: *Arunima Banerjee*¹; Mo-Rigen He¹; Jeff Rossin²; William Musinski³; Paul Shade³; Marie Cox³; Tresa Pollock²; Kevin Hemker¹; ¹Johns Hopkins University; ²UCSB; ³Air Force Research Laboratory

3:00 PM Break

Materials I: Phase Evolution

Monday PM
August 15, 2022

Room: Regency Ballroom III & IV
Location: Hyatt Regency Bethesda

Session Chair: Anthony Rollett, Carnegie Mellon University

1:30 PM Invited

Predicting Material Behavior with Improved Solidification Models for the AM Process Window: *Adam Hope*¹; Kaisheng Wu¹; Jan Julin²; Johan Jeppsson²; Paul Mason¹; ¹Thermo-Calc Software Inc; ²Thermo-Calc Software AB

2:00 PM Invited

Stable Nitride Precipitation in Additively Manufactured Nickel Superalloys: *James Zuback*¹; ¹National Institute of Standards and Technology

2:30 PM Invited

Role of Composition in High Temperature Heat-treatment Response of Additively Manufactured 17-4 PH Stainless Steel: *Derek Shaffer*¹; *Todd Palmer*²; ¹Pennsylvania State University

3:00 PM Break

Powders I

Monday PM
August 15, 2022

Room: Cabinet/Judiciary Suite
Location: Hyatt Regency Bethesda

Session Chair: Maxwell Praniewicz, National Institute of Standards and Technology

1:30 PM

Spatially-resolved Mapping and Statistically-based Analysis of Powder Layer Density by Transmission X-ray Imaging: Ryan Penny¹; Daniel Oropeza²; Reimar Weissbach³; Patrick Praegla⁴; Christoph Meier⁴; Wolfgang Wall⁴; *John Hart*³; ¹Massachusetts Institute of Technology; ²NASA Jet Propulsion Laboratory; ³Massachusetts Institute of Technology; ⁴Technical University of Munich

1:50 PM

Quantifying the Size, Shape, and Porosity of Metal Powder Particles using X-ray Computed Tomography: *Newell Moser*¹; Orion Kafka¹; Edward Garboczi¹; Lyle Levine¹; Nik Hrabec¹; Jake Benzing¹; Nicholas Derimow¹; ¹National Institute of Standards and Technology

2:10 PM

Optimizing Roller-based Spreading of Fine, Cohesive Metal Powders via DEM Simulations: Reimar Weissbach¹; Patrick Praegla²; Ryan Penny¹; Christoph Meier²; Wolfgang Wall²; *John Hart*¹; ¹Massachusetts Institute of Technology; ²Technical University of Munich

In-Process Measurements and Models

Monday PM
August 15, 2022Room: Old Georgetown Room
Location: Hyatt Regency Bethesda

Session Chair: Ho Yeung, National Institute of Standards and Technology

1:30 PM Invited

In-situ Monitoring of the Laser Powder Bed Fusion Process by Thermography, Optical Tomography, Melt Pool Monitoring and Eddy Current Testing for Defect Detection: *Nils Scheuschner*¹; Frank Heinrichsdorf²; Anzhelika Gordei³; Jaroslaw Kochan³; Henrik Ehlers¹; Hamid Jahangir⁴; Matthias Pelkner¹; Toni Röpke¹; Christiane Maierhofer²; Kai Hilgenberg¹; ¹Bundesanstalt für Materialforschung und -prüfung (BAM); ²Siemens AG; ³Fraunhofer IPK; ⁴Siemens Energy Global GmbH & Co. KG

2:00 PM

Improving Part Quality in Laser Powder Bed Fusion using Model-based Feedforward Control of Thermal History: Alexander Riensche¹; Benjamin Bevans¹; Ziyad Smoqi¹; Reza Yavari²; *Prahalad Rao*¹; Ajay Krishnan³; ¹University of Nebraska; ²Vulcan Forms; ³Edison Welding Institute

2:20 PM

Digitally Twinned Additive Manufacturing: Real-time Detection of Flaws in Laser Powder Bed Fusion by Combining Thermal Simulations with In-situ Meltpool Sensor Data: Reza Yavari¹; *Prahalad Rao*¹; Alex Riensche¹; Emine Tekerek²; Lars Jacquemetton³; Ziyad Smoqi¹; Vignesh Perumal²; Antonios Kontsos²; Harold (Scott) Halliday⁴; Kevin Cole¹; ¹University of Nebraska; ²Drexel University; ³Sigma Labs; ⁴Navajo Technical University

2:40 PM

Online Prediction of Porosity in Laser Powder Bed Fusion using Physics-informed Meltpool Signatures and Machine Learning: *Prahalad Rao*¹; Ziyad Smoqi¹; Aniruddha Gaikwad¹; Benjamin Bevans¹; Md Humaun Kobir¹; James Craig²; Alan Abul-Hajj³; Alonso Peralta⁴; ¹University of Nebraska; ²Stratronics; ³ARA Engineering; ⁴Honeywell

3:00 PM Break

Alternate AM Methods and Materials I

Monday PM
August 15, 2022Room: Cabinet/Judiciary Suite
Location: Hyatt Regency Bethesda

Session Chair: Allison Beese, Pennsylvania State University

3:30 PM Invited

Multiscale Material Modeling of Laser Powder Bed Fusion Additive Manufacturing Soft Magnetic Composites: *Li Ma*¹; Caleb Andrew²; Ryan Carter¹; Mitra Taheri²; Joe Sopcisak¹; ¹Johns Hopkins University Applied Physics Laboratory; ²Johns Hopkins University

4:00 PM

Linkage of Microstructural Features and Mechanical Properties of BinderJet Fabricated 316 Stainless Steel Through Ultrasound Measurements: *Nancy Huang*¹; Olivia Cook¹; Robert Smithson²; Christopher Kube¹; Andrea Argüelles¹; Allison Beese¹; ¹Pennsylvania State University; ²3M Company

4:20 PM

Porosity Characterization of BinderJet Additive Manufacturing Parts via Ultrasonic Methods: Olivia Cook¹; Nancy Huang¹; Robert Smithson²; Christopher Kube¹; Allison Beese¹; *Andrea Argüelles*¹; ¹Pennsylvania State University; ²3M Company

AM Bench 2022 Data Management I

Monday PM
August 15, 2022Room: Old Georgetown Room
Location: Hyatt Regency Bethesda

Session Chair: Lyle Levine, National Institute of Standards and Technology

3:30 PM Invited

Data Management for AM Bench 2022: *Gretchen Greene*¹; Lyle Levine²; Chandler Becker²; Gerard Lemson³; Jai Won Kim³; Arik Mitschang³; Ben Long²; Kevin Brady²; Brandon Lane²; Andrew Reid²; ¹National Institute of Standards and Technology; ²National Institute of Standards and Technology; ³Johns Hopkins University

4:00 PM Invited

SciServer Analysis on AM-Bench Data: *Chandler Becker*¹; Gretchen Greene¹; Miyu Mudalamane²; Jordan Raddick³; Gerard Lemson³; Lyle Levine¹; ¹National Institute of Standards and Technology; ²University of Delaware; ³Johns Hopkins University

4:30 PM Question and Answer Period

Materials II: Microstructural Engineering

Monday PM
August 15, 2022Room: Regency Ballroom III & IV
Location: Hyatt Regency Bethesda

Session Chair: Jake Benzing, National Institute of Standards and Technology

3:30 PM

(On Demand) Investigation of Co-free High Entropy Alloys Produced by Selective Laser Melting for Nuclear Applications: *Hiroshi Oka*¹; Naoyuki Hashimoto¹; Shigehito Isobe²; Shinichiro Yamashita²; ¹Hokkaido University; ²Japan Atomic Energy Agency

3:50 PM Invited

Microstructural Engineering in Steel 3D Printing with PBF Method: High-throughput Computational Design: *Hamed Hosseinzadeh*¹; Mark Horstemeyer²; ¹University of South Carolina; ²Liberty University

4:20 PM

Microstructural, Tribological and Electrochemical Analyses of Additive Manufactured Metallic Alloys for Engineering Applications: Waseem Haider¹; *Ali Raza*¹; ¹Central Michigan University

Mechanical Behavior II

Monday PM
August 15, 2022

Room: Regency Ballroom I & II
Location: Hyatt Regency Bethesda

Session Chair: Nicholas Derimow, National Institute of Standards and Technology

3:30 PM Invited

Fast and Effective Sensitivity and Uncertainty Quantification for Metal-based Additive Manufacturing: *David Restrepo*¹; Juan Sebastian Rincon Tabares¹; Matthew Balcer¹; Mauricio Aristizabal¹; Arturo Montoya¹; Harry Millwater²; ¹The University of Texas at San Antonio; ²University of Texas at San Antonio

4:00 PM

Elimination of Solidification Cracking in AA 6061 Alloy During the Laser Powder Bed Fusion Additive Manufacturing Process: Sivaji Karna¹; Rimah Al-Aridi¹; Tianyu Zhang¹; Timothy Krentz²; Dale Hitchcock²; Andrew Gross³; *Lang Yuan*¹; ¹University of South Carolina; ²Savannah River National Lab

4:20 PM

(On-Demand) A Study on Tensile and Fracture Behaviour of AL 2024 – Ram 2 Alloy Fabricated Through Laser Powder Bed Fusion: *Saurabh Gairola*¹; R. Jayaganthan¹; ¹Indian institute of technology Madras

4:40 PM Invited

A Combined Experimental and Simulation Campaign of As-built AM IN625 Connecting Microstructure to Part Scale Response: *Robert Carson*¹; James Belak¹; Matthew Rolchigo²; Leonidas Zisis³; Michael Sangid³; Darren Pagan⁴; ¹Lawrence Livermore National Laboratory; ²Oak Ridge National Laboratory; ³Purdue University; ⁴Pennsylvania State University

Tuesday Plenary

Tuesday AM
August 16, 2022

Room: Regency Ballroom I & II
Location: Hyatt Regency Bethesda

Session Chair: David Deisenroth, National Institute of Standards and Technology

8:30 AM Plenary

Combining Multi-Physics Simulations with Data-Driven Models for Accelerated AM Process Prediction: *Gregory Wagner*¹; Zhengtao Gan²; Wing Liu¹; ¹Northwestern University; ²University of Texas at El Paso

9:00 AM Plenary

In-Situ Spatial Monitoring and Layer-to-Layer Control of Additive Manufacturing Processes: *Robert Landers*¹; Douglas Bristow²; Edward Kinzel³; Cody Lough⁴; Tengfei Luo⁵; Sandipan Mishra⁵; ¹University of Notre Dame; ²Missouri Univ of Science & Technology; ³Univ. of Notre Dame; ⁴Kansas City national Security Campus; ⁵Rensselaer Polytechnic Institute

9:30 AM Plenary

Suppressing Filament Defects in Embedded 3D Printing: *Leanne Friedrich*¹; Ross Gunther²; Jonathan Seppala¹; ¹National Institute of Standards and Technology; ²Georgia Institute of Technology

10:00 AM Break

Tuesday Benchmarks

Tuesday AM
August 16, 2022

Room: Regency Ballroom I & II
Location: Hyatt Regency Bethesda

Session Chair: Brian Simonds, National Institute of Standards and Technology

10:20 AM Plenary

Laser-Scanned Tracks and Pads and In-situ Measurements for the 2022 Additive Manufacturing Benchmark Challenges: *David Deisenroth*¹; Jordan Weaver¹; Ho Yeung¹; Sergey Mekhontsev¹; Brandon Lane¹; Lyle Levine¹; ¹National Institute of Standards and Technology

10:50 AM Plenary

Characterizing the Post-build Microstructures of the AM Benchmark Artifacts: *Mark Stoudt*¹; Maureen Williams¹; Lyle Levine¹; Sandra Young¹; ¹National Institute of Standards and Technology

11:20 AM Plenary

AM Bench 2022 Thermoplastic Material Extrusion Challenge: *Jonathan Seppala*¹; Orion Kafka¹; Newell Moser¹; Edward Garboczi¹; ¹National Institute of Standards and Technology

11:50 AM Question and Answer Period

Mechanical Behavior III

Tuesday PM
August 16, 2022

Room: Regency Ballroom I & II
Location: Hyatt Regency Bethesda

Session Chair: Jake Benzing, National Institute of Standards and Technology

1:30 PM Invited

Powder Oxygen Heterogeneities and Significant Intra-build Tensile Strength Variation from Common EB-PBF Ti-6Al-4V Powder Reuse Methods: *Nicholas Derimow*¹; Jake Benzing¹; Newell Moser¹; Orion Kafka¹; Nik Hrabe¹; Priya Pathare²; Frank DelRio²; ¹National Institute of Standards and Technology; ²Sandia National Laboratories

2:00 PM

Combining Fractal and Topological Analyses to Quantify Fracture Surfaces in Additively Manufactured Ti-6Al-4V: Ian Wietecha-Reiman¹; Albert Segall¹; Xiaoliang Zhao²; *Todd Palmer*³; ¹The Pennsylvania State University; ²Intelligent Automation; ³Pennsylvania State University

2:20 PM

Effect of Process-specific Defects on the Tensile and Constant-amplitude Fatigue Behavior of As-built Ti-6Al-4V Alloy Produced by Laser Powder Bed Fusion Process: *Saikumar Reddy Yeratapally*¹; Erik Frankforter²; George Weber²; Peter Spaeth²; Christopher Lang²; Albert Cerrone³; Edward Glaessgen²; ¹National Institute of Aerospace; ²NASA Langley Research Center; ³University of Notre Dame

2:40 PM

Tunable PBF-EB Ti-6Al-4V Fatigue Performance via Controlled Powder Recovery: Nicholas Derimow¹; Keenan Hanson²; Jake Benzing¹; Newell Moser¹; Orion Kafka¹; *Nik Hrabe*¹; ¹National Institute of Standards and Technology; ²Stryker Orthopaedics

3:00 PM Break

Residual Strain/Stress and Distortion I: Diffraction-Based Measurements

Tuesday PM
August 16, 2022

Room: Cabinet/Judiciary Suite
Location: Hyatt Regency Bethesda

Session Chair: Donald Brown, Los Alamos National Laboratory

1:30 PM Invited

Evaluation of Strains in AM-Bench Samples via Energy Dispersive Diffraction at Cornell High Energy Synchrotron Source: Hazar Seren¹; Thien Phan²; *Amlan Das*³; Kelly Nygren¹; Peter Ko¹; Katherine Shanks³; Lyle Levine⁴; ¹Cornell High Energy Synchrotron Source; ²Lawrence Livermore National Laboratory; ³Cornell University; ⁴National Institute of Standards and Technology

2:00 PM Invited

Neutron Diffraction Stress Measurements on an AM Bench 2022 Bridge Artifact: *Thomas Gnaupel-Herold*¹; Thien Phan¹; Lyle Levine¹; Jeffrey Bunn²; Paris Cornwell³; ¹National Institute of Standards and Technology; ²Oak Ridge National Laboratory; ³Oak Ridge National Lab

2:30 PM Invited

In Situ High-energy X-ray Diffraction during Compression of Additively Manufactured Inconel 625 at Temperature: *Darren Pagan*¹; Katherine Shanks²; Robert Carson³; James Belak³; ¹Pennsylvania State University; ²Cornell University; ³Lawrence Livermore National Laboratory

3:00 PM Break

Materials III: Dendrite Scale

Tuesday PM
August 16, 2022

Room: Regency Ballroom III & IV
Location: Hyatt Regency Bethesda

Session Chair: David Rowenhorst, Naval Research Laboratory

1:30 PM Invited

Simulating Spot Melts in 3D with Dendrite-scale Resolution: *Stephen DeWitt*¹; Christopher Newman²; Stephen Nichols¹; Jean-Luc Fattebert¹; Balasubramaniam Radhakrishnan¹; James Belak³; John Turner¹; ¹Oak Ridge National Laboratory; ²Los Alamos National Laboratory; ³Lawrence Livermore National Laboratory

2:00 PM Invited

Prediction of Large Domain Microstructure Morphology by a Novel 3-Dimensional Cellular Automata-phase Field Modeling Approach: *Shunyu Liu*¹; Yung Shin²; ¹Clemson University; ²Purdue University

2:30 PM

(On-Demand) Modelling of Chemical Species Mixing During In-situ Alloying of Ternary Alloys and Effect on Rapid Grain Growth: *Junji Shinjo*¹; Chinnapat Panwisawas²; ¹Shimane University; ²University of Leicester

2:50 PM Break

Polymer AM I

Tuesday PM
August 16, 2022

Room: Old Georgetown Room
Location: Hyatt Regency Bethesda

Session Chair: Kalman Migler, National Institute of Standards and Technology

1:30 PM Invited

In-situ Observation of the Extrusion Processes of Acrylonitrile Butadiene Styrene and Polylactic Acid for Material Extrusion Additive Manufacturing: *Cheng Luo*¹; ¹University of Texas at Arlington

2:00 PM

Investigating the Strength of Individual Welds of Polycarbonate Made with Fused Filament Fabrication: *Ojaswi Agarwal*¹; Zheliang Wang; Lichen Fang¹; Sung Kang¹; Jonathan Seppala²; Thao Nguyen³; Kevin Hemker¹; ¹Johns Hopkins University; ²National Institute of Standards and Technology; ³Johns Hopkins University

2:20 PM

Meshfree Models for Viscoelastic Filament Extrusion and Solidification: *Eric Palermo*¹; Thomas O'Connor²; ¹Carnegie Mellon University

2:40 PM

Morphology Evolution of Droplets in a Polymer Based Extensional Flow: *David Bigio*¹; Harsha Bharadwaj; ¹University of Maryland

3:00 PM Break

Materials IV: Grain Scale

Tuesday PM
August 16, 2022

Room: Regency Ballroom III & IV
Location: Hyatt Regency Bethesda

Session Chair: Stephen DeWitt, Oak Ridge National Laboratory

3:30 PM Invited

Methods for Collecting High Resolution Large Area EBSD Maps: *David Rowenhorst*¹; Dillon Watring¹; ¹Naval Research Laboratory

4:00 PM Invited

Modeling of Location-specific Grain Shape and Texture Development in the AMB2018-01 Bridge Specimen: *Matthew Rolchigo*¹; John Coleman¹; Gerald Knapp¹; Alex Plotkowski¹; James Belak²; ¹Oak Ridge National Laboratory; ²Lawrence Livermore National Laboratory

4:30 PM Invited

Integrated Monte Carlo Microstructure and Analytical Temperature Simulations of Additive Manufacturing: Brodan Richter¹; *Joshua Pribe*²; Wesley Tayon¹; Samuel Hocker¹; Saikumar Reddy Yeratapally²; Edward Glaessgen¹; ¹National Aerospace and Space Administration; ²National Institute of Aerospace

Residual Strain/Stress and Distortion II

Tuesday PM
August 16, 2022

Room: Cabinet/Judiciary Suite
Location: Hyatt Regency Bethesda

Session Chair: Darren Pagan, Pennsylvania State University

3:30 PM Invited

Residual Stress Measurements in the IN718 AM-Bench Component and a Novel Approach for Determining Three Orthogonal Components of Residual Stress by Coupling the Contour and Energy Dispersive Diffraction Techniques: *Christopher D'Elia*¹; Nicholas Bachus²; Lyle Levine³; Michael Hill⁴; ¹Department of Mechanical and Aerospace Engineering, University of California; ²University Of California Davis; ³National Institute of Standards and Technology; ⁴University of California Davis

4:00 PM Invited

Measurement and Comparison of Residual Strain and Stress within AM-Bench Components Composed of SS15-5PH and IN625: *Nicholas Bachus*¹; Maria Strantza²; Bjorn Clausen³; Christopher D'Elia¹; Michael Hill¹; Jun Young Ko⁴; Lyle Levine⁵; John Okasinski⁶; Jun-Sang Park⁶; Thien Phan⁵; Donald Brown³; ¹University Of California Davis; ²Lawrence Livermore National Laboratory; ³Los Alamos National Laboratory; ⁴Cornell High Energy Synchrotron Source; ⁵National Institute of Standards and Technologies; ⁶Argonne National Laboratory

4:30 PM Invited

Part Deflection of 3D Builds of IN718 from the 2022 AM Benchmark Test Series: *Maxwell Pranievicz*¹; J Fox¹; J Tarr¹; ¹National Institute of Standards and Technology

Melt-Pool Scale I

Tuesday PM
August 16, 2022

Room: Regency Ballroom I & II
Location: Hyatt Regency Bethesda

Session Chair: Jordan Weaver, National Institute of Standards and Technology

3:30 PM Invited

Optical Metrology of Laser-matter Interactions in LPBF: Challenges and Opportunities: *David Deisenroth*¹; ¹National Institute of Standards and Technology

4:00 PM

Simultaneous Computational Fluid and Particle Dynamics Simulation for Laser Powder Bed Fusion: *Wenda Tan*¹; ¹The University of Michigan

4:20 PM

X-ray Image Based Ray-tracing Model for Absorption Prediction in Laser Melting: *Zhengtao Gan*¹; ¹Northwestern University

4:40 PM

Pseudo-function of Laser Heat Input for Computational Metal Additive Manufacturing: *Hamed Hosseinzadeh*¹; Mark Horstemeyer²; ¹University of South Carolina; ²Liberty University

Polymer AM II

Tuesday PM
August 16, 2022

Room: Old Georgetown Room
Location: Hyatt Regency Bethesda

Session Chair: David Kazmer, University of Massachusetts - Lowell

3:30 PM Invited

A Rheological Approach for Measuring Cure Depth of Filled and Unfilled Photopolymers at Additive Manufacturing Relevant Length Scales: *Daniel Rau*¹; John Reynolds¹; Jackson Bryant¹; Michael Bortner¹; Christopher Williams¹; ¹Virginia Tech

4:00 PM

The Effect of Nozzle Size and Print Speed on the Fiber Orientation and Porosity During Large-scale Additive-compression Manufacturing: *Pritesh Yeole*¹; *Joshua Crabtree*²; David Nuttall; Uday Vaidya¹; Merlin Theodore²; Vlastimil Kunc; Vipin Kumar²; ¹University of Tennessee; ²Oak Ridge National Laboratory

4:20 PM

Process-induced Crystallization in Thermoplastic Material Extrusion: *Jonathan Seppala*¹; ¹National Institute of Standards and Technology

Wednesday Plenary

Wednesday AM
August 17, 2022

Room: Regency Ballroom I & II
Location: Hyatt Regency Bethesda

Session Chair: Leanne Friedrich, National Institute of Standards and Technology

8:30 AM Plenary

Additive Manufacturing - A world Full of Computational Opportunities and Challenges: *Ferdinando Auricchio*¹; ¹University of Pavia

9:00 AM Plenary

Understanding Variation in the Additive Manufacturing Supply Chain for Improved Modeling Performance: *Donald Godfrey*¹; ¹SLM Solutions Americas

9:30 AM Plenary

Predicting Mechanical Properties of Material Extrusion-fabricated Structures with Limited Information: *Amy Peterson*¹; David Kazmer¹; Austin Colon¹; Ahmed Adisa¹; ¹University of Massachusetts Lowell

10:00 AM Break

Wednesday Benchmarks

Wednesday AM
August 17, 2022

Room: Regency Ballroom I & II
Location: Hyatt Regency Bethesda

Session Chair: Jian Cao, Northwestern University

10:20 AM Plenary

3-Dimensional Microstructure Characterization of Laser Powder Bed Fusion IN625 and IN718: *Edwin Schwalbach*¹; Michael Chapman²; Megna Shah²; Michael Uchic²; Lyle Levine³; Nik Hrabe³; Orion Kafka³; Newell Moser³; James Belak⁴; ¹Air Force Research Labroatory; ²Air Force Research Laboratory; ³National Institute of Standards and Technology; ⁴Lawrence Livermore National Laboratory

10:50 AM Plenary

AM Bench 2022 -04 Overview of Mechanical Measurements on PBF-L Inconel 625: *Nik Hrabe*¹; Robert Carson²; Darren Pagan³; Saadi Habib⁴; Jordan Weaver⁵; Jake Benzing¹; Li-Anne Liew¹; Newell Moser¹; Orion Kafka¹; Nicholas Derimow¹; ¹National Institute of Standards and Technology; ²Lawrence Livermore National Laboratory; ³Pennsylvania State University

11:20 AM Plenary

Elastic Residual Strain Measurements of 3D Additive Manufacturing Builds of IN718 AM-Benchmark Artifact: An Overview and Comparison Between Measurement Techniques and Submitted Simulation Results: *Thien Phan*¹; Mehmet Hazar Seren²; Thomas Gnaupel-Herold³; Michael Hill⁴; Nicholas Bachus⁵; Christopher D'Elia⁶; Kelly Nygren²; Darren Pagan⁷; J Peter Ko²; Lyle Levine³; ¹Lawrence Livermore National Laboratory; ²Cornell High Energy Synchrotron Source; ³National Institute of Standards and Technology; ⁴Univ Of California Davis; ⁵University Of California Davis; ⁶University of California, Davis; ⁷Pennsylvania State University

11:50 AM Question and Answer Period**Mechanical Behavior IV**

**Wednesday PM
August 17, 2022**

**Room: Regency Ballroom I & II
Location: Hyatt Regency Bethesda**

Session Chair: Newell Moser, National Institute of Standards and Technology

1:30 PM Invited

AM Bench 2022 Subcontinuum Mesoscale Tensile Challenge, Part 1: Measurement Description: *Jake Benzing*¹; Li-Anne Liew¹; Newell Moser¹; Orion Kafka¹; Nicholas Derimow¹; Jordan Weaver¹; Ross Rentz¹; Nik Hrabe¹; ¹National Institute of Standards and Technology

2:00 PM Invited

AM Bench 2022 Subcontinuum Mesoscale Tensile Challenge, Part 2: Predictions and Trends: *Orion Kafka*¹; Jake Benzing¹; Newell Moser¹; Nicholas Derimow¹; Li-Anne Liew¹; Jordan Weaver¹; Nik Hrabe¹; ¹National Institute of Standards and Technology

2:30 PM

Micro-void Deformation Prediction: A Possible Future Asynchronous AM Benchmarking Challenge: *Orion Kafka*¹; Jake Benzing¹; Newell Moser¹; Nicholas Derimow¹; Jordan Weaver¹; Edward Garboczi¹; Nik Hrabe¹; ¹National Institute of Standards and Technology

2:50 PM Break**Residual Strain/Stress and Distortion III**

**Wednesday PM
August 17, 2022**

**Room: Cabinet/Judiciary Suite
Location: Hyatt Regency Bethesda**

Session Chair: Thien Phan, Lawrence Livermore National Laboratory

1:30 PM Invited

In-situ Heat Treatment of Additively Manufactured Ti-6Al-4V: *Donald Brown*¹; Maria Strantzis²; M Rafailov³; Eloisa Zepeda-Alarcon¹; Darren Pagan⁴; ¹Los Alamos National Laboratory; ²Lawrence Livermore National Laboratory; ³Nuclear Research Center; ⁴Cornell University

2:00 PM

Design for Printing Success Using Additive Manufacturing Process Simulation: *Xueyong Qu*¹; Jacob Rome¹; Glenn Bean¹; ¹The Aerospace Corporation

2:20 PM

(On-Demand) The Effect of Heat Input on Residual Stress Buildup in Selective Laser Melting of Ti6AL4V: *Londiwe Motibane*¹; ¹CSIR

2:40 PM

(On Demand) Computationally Derived Correlations Between Segregation, Microstructure Variations and Process-induced Cracks in AM: *Chizhou Fang*; Hector Basoalto¹; Magnus Anderson¹; Yu Lu²; Prashant Jadhav¹; Sourabh Supanekar²; Mohammad Ahmed²; ¹University of Sheffield; ²University of Birmingham

Metals Multi-Scale Simulation

**Wednesday PM
August 17, 2022**

**Room: Regency Ballroom III & IV
Location: Hyatt Regency Bethesda**

Session Chair: Matthew Rolchigo, Oak Ridge National Laboratory

1:30 PM Invited

The Additive Manufacturing Moment Measure Approach to Laser Powder Bed Fusion Process Qualification: *Samuel Hocker*¹; Brodan Richter¹; Joseph Zalameda¹; Wesley Tayon¹; Erik Frankforter¹; Peter Spaeth¹; Edward Glaessgen¹; ¹NASA Langley Research Center

2:00 PM

DigitalClone for Additive Manufacturing (DC-AM): an Integrated Computational Materials Engineering Platform to Model Metal AM Process and Performance: *Jingfu Liu*¹; Ziyi Liu¹; Behrooz Jalalahmadi¹; ¹Sentient Science

2:20 PM

Formation of Crystal Defects in Rapid Solidification: Tatu Pinomaa¹; Matti Lindroos¹; Paul Jreidini²; Matias Haapalehto¹; Kais Ammar³; Lei Wang⁴; Samuel Forest³; Nikolas Provatas²; Anssi Laukkanen¹; *Napat Vajragupta*¹; ¹VTT Technical Research Centre of Finland Ltd; ²McGill University; ³CNRS Mines ParisTech; ⁴Federal Institute for Materials Research and Testing (BAM)

2:40 PM

Multiphysics Modeling of Multicomponent Powder Beds for Metal Additive Manufacturing: *Arash Samaei*¹; Zhongsheng Sang¹; Jon-Erik Mogonye²; Gregory Wagner¹; ¹Northwestern University; ²Army Research Laboratory

3:00 PM

Advanced Computational Module for Microstructural Prediction in Metal Additive Manufacturing: *Hamed Hosseinzadeh*¹; Mark Horstemeyer²; ¹University of South Carolina; ²Liberty University

3:20 PM Break**Melt-Pool Scale II**

**Wednesday PM
August 17, 2022**

**Room: Old Georgetown Room
Location: Hyatt Regency Bethesda**

Session Chair: Jason Fox, National Institute of Standards and Technology

1:30 PM Invited

Topographic Measurements of Laser Tracks in Alloy 725 Bare Plate for an Additive Manufacturing Benchmark: *Richard Ricker*¹; David Deisenroth¹; Brandon Lane¹; Jordan Weaver¹; Lyle Levine¹; ¹National Institute of Standards and Technology

2:00 PM

Characterization of Laser Powder Bed Fusion Surfaces: *Edwin Glaubitz*¹; Joy Gockel¹; Jason Fox²; Orion Kafka²; ¹Colorado School of Mines; ²National Institute of Standards and Technology

2:20 PM

(On-Demand) Investigation of Particle Dynamics During Laser Powder Bed Fusion via a Novel Smooth Particle Hydrodynamics Modeling Approach: *Christoph Meier¹; Patrick Praegla¹; Reimar Weissbach²; John Hart²; Wolfgang Wall¹*; ¹Technical University of Munich; ²Massachusetts Institute of Technology

2:40 PM

Mixed Interface-capturing/Interface-tracking Formulation for Metal Additive Manufacturing on NIST 22 Benchmark Challenge Problems: *Qiming Zhu¹; Jinhui Yan¹*; ¹University of Illinois Urbana-Champaign

3:00 PM Break

AM-Bench Discussion

Wednesday PM
August 17, 2022

Room: Regency Ballroom I & II
Location: Hyatt Regency Bethesda

Session Chairs: James Belak, Lawrence Livermore National Laboratory & Wing Kam Liu, Northwestern University, Lyle Levine, National Institute of Standards and Technology; Brandon Lane, National Institute of Standards and Technology

3:30 PM Panel Discussion I:

Simulations for Additive Manufacturing

4:15 PM Panel Discussion II:

Directions for Future Benchmark Measurements

Thursday Plenary & Benchmarks

Thursday AM
August 18, 2022

Room: Regency Ballroom I & II
Location: Hyatt Regency Bethesda

Session Chair: Nikolas Hrabe, National Institute of Standards and Technology

8:30 AM Plenary

Material Property Control in Directed Energy Deposition: *Jian Cao¹*; ¹Northwestern University

9:00 AM Plenary

In-situ Characterization of Melt Pool Dynamics by High-speed Synchrotron X-ray Imaging and Diffraction: *Lianyi Chen¹*; ¹University of Wisconsin-Madison

9:30 AM Plenary

Experimental Data for the Asynchronous AM Bench Challenge: Coupling Laser Absorption with High-speed X-ray Imaging: *Brian Simonds¹; Jack Tanner²; Paul Williams; Niranjan Parab³; Tao Sun²*; ¹National Institute of Standards and Technology; ²TBD; ³Argonne National Laboratory

10:00 AM Question and Answer Period

10:10 AM Break

Data-Driven Approaches I

Thursday AM
August 18, 2022

Room: Cabinet/Judiciary Suite
Location: Hyatt Regency Bethesda

Session Chair: To Be Announced

10:30 AM Invited

Benchmarking Machine Learning Modeling Approaches to Additive Manufacturing Research, Development, and Qualification: *Aaron Stebner¹*; ¹Georgia Institute of Technology

11:00 AM

Physics-Based Compressive Sensing and Physics-constrained Dictionary Learning to Monitor Laser Powder Bed Fusion Process: *Yanglong Lu¹; Sungjin Hong²; Sung-Hoon Ahn³; Yan Wang⁴*; ¹Hong Kong University of Science & Technology; ²Georgia Institute of Technology; ³Seoul National University; ⁴Georgia Institute of Technology

11:20 AM

Defect Prediction on the Base of Thermographic Features in Laser Powder Bed Fusion Utilizing Machine Learning Algorithms: *Simon Oster¹; Tina Becker¹; Philipp Breese¹; Nils Scheuschner¹; Christiane Maierhofer¹; Tobias Fritsch¹; Gunther Mohr¹; Simon Altenburg¹*; ¹Bundesanstalt für Materialforschung und -prüfung

11:40 AM

Modeling Strengthening and Elevated Temperature Properties of Single and Polycrystalline Additively Manufactured Refractory High Entropy Alloy Microstructures: *Anssi Laukkanen¹; Tatu Pinomaa¹; Matti Lindroos¹; Tom Andersson¹; Tomi Suhonen¹*; ¹VTT Technical Research Center of Finland

12:00 PM

Numerical Investigation of L-PBF Processing of High Speed Steels to Produce Crack Free Parts: *Pravin Kumar¹; Akash Bhattacharjee¹; Himanshu Nirgudkar¹; Surya Ardhama¹; Pramod Zagade¹; BP Gautham¹; Gerald Tennyson¹*; ¹TCS Research, Tata Consultancy Services, Pune, India

Mechanical Behavior V

Thursday AM
August 18, 2022

Room: Regency Ballroom I & II
Location: Hyatt Regency Bethesda

Session Chair: Nikolas Hrabe, National Institute of Standards and Technology

10:30 AM Invited

AM Bench 2022 Macroscale Tensile Challenge at Different Orientations , Part 1: Measurement Description: *Jake Benzing¹; Nicholas Derimow¹; Newell Moser¹; Orion Kafka¹; Jordan Weaver¹; Ross Rentz¹; Nik Hrabe¹*; ¹National Institute of Standards and Technology

11:00 AM Invited

AM Bench 2022 Macroscale Tensile Challenge at Different Orientations, Part 2: Predictions and Trends: *Newell Moser¹; Jake Benzing¹; Nicholas Derimow¹; Orion Kafka¹; Nik Hrabe¹; Jordan Weaver¹*; ¹National Institute of Standards and Technology

11:30 AM

NAFEMS Benchmarks for Metal Additive Manufacturing Simulation: a Complementary Set of Cases: *Sjoerd Van Der Veen¹; Jacob Rome²*; ¹Airbus Operations SAS; ²Aerospace Corporation

11:50 AM

Analysis of Existing Hot Tearing Tests and Their Transferability to Additive Manufacturing: *Andrew Wall¹; Michael Benoit¹*; ¹UBC Okanagan

Melt-Pool Scale III

Thursday AM
August 18, 2022

Room: Old Georgetown Room
Location: Hyatt Regency Bethesda

Session Chair: Brodan Richter, National Aerospace and Space Administration

10:30 AM Invited

Cross-sectional Melt Pool Geometry of Laser-Scanned Tracks and Pads for the 2022 Additive Manufacturing Benchmark Challenges:

*Jordan Weaver*¹; D Deisenroth²; S Mekhontsev²; B Lane²; L Levine²; ¹National Institute of Standard and Technology; ²National Institute of Standards and Technology

11:00 AM Invited

AM-CFD: a Well-validated Thermal-fluid Simulator for Additive Manufacturing Part Qualification: *Wing Liu*¹; ¹Northwestern University

11:30 AM

On-line Melt Pool and Microstructure Sensing of Powder Bed Fusion Grade 91 Stainless Steel: Nathan Kizer¹; *Christopher Kube*¹; Abdalla Nassar¹; Edward Reutzel¹; Corey Dickman¹; ¹Penn State University

11:50 AM

(On-Demand) A High Fidelity Melt Pool Dynamics Model with Experimental Validation Results Against NIST Benchmark AMB2018-2: Kyung-min Hong¹; Corbin Grohol¹; *Yung Shin*¹; ¹Purdue University

Qualification & Certification

Thursday PM
August 18, 2022

Room: Regency Ballroom I & II
Location: Hyatt Regency Bethesda

Session Chair: Edward Glaessgen, NASA Langley Research Center & Michael Gorelik, FAA

1:30 PM Introductory Comments

1:40 PM

Regulatory Perspective-Michael Gorelik: *Michael Gorelik*¹; ¹FAA

2:00 PM

Computational Materials in AM: the Incremental Path to Certification Use: *Douglas Wells*¹; ¹NASA - Marshall Space Flight Center

2:20 PM

Computational Materials for Qualification and Certification (CM4QC) Steering Group: *Edward Glaessgen*¹; Michael Gorelik²; ¹NASA Langley Research Center; ²FAA

2:40 PM

Lockheed Martin Workflows Incorporating ICME: *Derrick Lamm*¹; Jeffery Aguiar¹; ¹Lockheed Martin

3:00 PM

Model-Assisted Validation and Certification of AM Components: *David Furrer*¹; ¹Pratt & Whitney

3:20 PM Break

3:40 PM Panel Discussion

4:40 PM Concluding Comments

Poster & Exhibitor Session

Monday PM
August 15, 2022

Room: Regency Ballroom Foyer
Location: Hyatt Regency Bethesda

Non-destructive, Low-cost Qualification of AM Material and Processes Using RF Measurements: *Nandagopal Matavalam*¹; Paul Carriere¹; Pedro Frigola¹; Sergey Kutsaev¹; Alexander Smirnov¹; Aurora Araujo¹; ¹Radiabeam Technologies

Experimental Evaluation of Mechanical Properties of Additively Manufactured 17-4 PH Stainless Steel: *Bijit Kalita*¹; Gaurav Singh¹; Jayaganthan R.¹; ¹Indian Institute of Technology Madras

Powder Blown Laser DED Sensor Development for Mass Flow Monitoring and Defect Detection: *Zachary Brunson*¹; Aaron Stebner¹; ¹Georgia Institute of Technology

- A**
- Abul-Haj, A 3
 Adisa, A 6
 Agarwal, O 5
 Aguiar, J 9
 Ahmed, M 7
 Ahn, S 8
 Al-Aridi, R 4
 Altenburg, S 8
 Ammar, K 7
 Anderson, M 7
 Andersson, T 8
 Andrew, C 3
 Araujo, A 9
 Ardham, S 8
 Argüelles, A 3
 Aristizabal, M 4
 Auricchio, F 6
- B**
- Bachus, N 6, 7
 Balcer, M 4
 Banerjee, A 2
 Basoalto, H 7
 Bean, G 7
 Becker, C 3
 Becker, T 8
 Beese, A 3
 Belak, J 2, 4, 5, 6
 Benoit, M 8
 Benzing, J 2, 4, 7, 8
 Bevans, B 3
 Bharadwaj, H 5
 Bhattacharjee, A 8
 Bigio, D 5
 Bortner, M 6
 Brady, K 3
 Breese, P 8
 Bristow, D 4
 Brown, D 6, 7
 Brunson, Z 9
 Bryant, J 6
 Bunn, J 5
- C**
- Cao, J 8
 Caplins, B 2
 Carriere, P 9
 Carson, R 4, 5, 7
 Carter, R 3
 Cerrone, A 4
 Chapman, M 6
 Chen, L 8
 Clausen, B 6
 Cocke, C 2
 Cole, K 3
 Coleman, J 5
- Colon, A 2, 6
 Cook, O 3
 Cornwell, P 5
 Cox, M 2
 Crabtree, J 6
 Craig, J 3
- D**
- Das, A 5
 Deisenroth, D 2, 4, 6, 7, 9
 D'Elia, C 6, 7
 DelRio, F 4
 Derimow, N 2, 4, 7, 8
 DeWitt, S 5
 Dickman, C 9
- E**
- Ehlers, H 3
- F**
- Fang, C 7
 Fang, L 5
 Fattebert, J 5
 Forest, S 7
 Fox, J 6, 7
 Frankforter, E 4, 7
 Friedrich, L 4
 Frigola, P 9
 Fritsch, T 8
 Furrer, D 9
- G**
- Gaikwad, A 3
 Gairola, S 4
 Gan, Z 4, 6
 Garboczi, E 2, 4, 7
 Gautham, B 8
 Glaessgen, E 2, 4, 7, 9
 Glaubitz, E 7
 Gnaupel-Herold, T 5, 7
 Gockel, J 7
 Godfrey, D 6
 Gong, J 2
 Gordei, A 3
 Gorelik, M 9
 Greene, G 3
 Grohol, C 9
 Gross, A 4
 Gunther, R 4
- H**
- Haapalehto, M 7
 Habib, S 7
 Haider, W 3
 Halliday, H 3
 Hanson, K 4
 Hart, J 2, 3, 8
- Hashimoto, N 3
 Heinrichsdorf, F 3
 He, M 2
 Hemker, K 2, 5
 Higgins, C 2
 Hilgenberg, K 3
 Hill, M 6, 7
 Hitchcock, D 4
 Hocker, S 5, 7
 Hong, K 9
 Hong, S 8
 Hope, A 2
 Horstemeyer, M 3, 6, 7
 Hosseinzadeh, H 3, 6, 7
 Hrabe, N 2, 4, 6, 7, 8
 Huang, N 3
- I**
- Isobe, S 3
- J**
- Jacquemetton, L 3
 Jadhav, P 7
 Jahangir, H 3
 Jalalahmadi, B 7
 Jayaganthan, R 4
 Jeppsson, J 2
 Jreidini, P 7
 Julin, J 2
- K**
- Kafka, O 2, 4, 6, 7, 8
 Kalita, B 9
 Kang, S 5
 Karna, S 4
 Kazmer, D 2, 6
 Kehe, G 2
 Killgore, J 2
 Kim, J 3
 Kinzel, E 4
 Kirk, T 2
 Kizer, N 9
 Knapp, G 5
 Kobir, M 3
 Kochan, J 3
 Ko, J 6
 Kontsos, A 3
 Ko, P 5
 Krentz, T 4
 Krishnan, A 3
 Kube, C 3, 9
 Kumar, P 8
 Kumar, V 6
 Kunc, V 6
 Kutsaev, S 9

L		O		Rossin, J.2	
Lamm, D	. . . . .9	O'Connor, T	. . . . .5	Rowenhorst, D	. . . . .5
Landers, R	. . . . .4	Oka, H	. . . . .3	S	
Lane, B	. . . . .2, 3, 4, 7, 8, 9	Okasinski, J	. . . . .6	Saboo, A	. . . . .2
Lang, C	. . . . .4	Olson, G	. . . . .2	Samaei, A	. . . . .7
Laukkanen, A	. . . . .7, 8	Oropeza, D	. . . . .2	Sangid, M	. . . . .4
Lebensohn, R	. . . . .2	Oster, S	. . . . .8	Sang, Z	. . . . .7
Lemson, G	. . . . .3	P		Scannapieco, D	. . . . .2
Leser, P	. . . . .2	Pagan, D	. . . . .4, 5, 7	Scheuschner, N	. . . . .3, 8
Levine, L	. . . . .2, 3, 4, 5, 6, 7, 8, 9	Palermo, E	. . . . .5	Schwalbach, E	. . . . .6
Lewandowski, J	. . . . .2	Palmer, T	. . . . .2, 4	Segall, A	. . . . .4
Liew, L	. . . . .7	Panwisawas, C	. . . . .5	Seppala, J	. . . . .4, 5, 6
Lindroos, M	. . . . .7, 8	Parab, N	. . . . .8	Seren, H	. . . . .5
Liu, J	. . . . .7	Park, J	. . . . .6	Seren, M	. . . . .7
Liu, S	. . . . .5	Pathare, P	. . . . .4	Shade, P	. . . . .2
Liu, W	. . . . .4, 9	Pathare, P	. . . . .4	Shaffer, D	. . . . .2
Liu, Z	. . . . .7	Pauza, J	. . . . .2	Shahabi, M	. . . . .2
Long, B	. . . . .3	Pelkner, M	. . . . .3	Shah, M	. . . . .6
Lough, C	. . . . .4	Penny, R	. . . . .2, 3	Shanks, K	. . . . .5
Luo, C	. . . . .5	Peralta, A	. . . . .3	Shinjo, J	. . . . .5
Luo, T	. . . . .4	Perumal, V	. . . . .3	Shin, Y	. . . . .5, 9
Lu, Y	. . . . .7, 8	Peter Ko, J	. . . . .7	Simonds, B	. . . . .8
M		Peterson, A	. . . . .2, 6	Singh, G	. . . . .9
Madore, C	. . . . .9	Phan, T	. . . . .2, 5, 6, 7	Smirnov, A	. . . . .9
Maierhofer, C	. . . . .3, 8	Pinomaa, T	. . . . .7, 8	Smithson, R	. . . . .3
Ma, L	. . . . .3	Plotkowski, A	. . . . .5	Smoqi, Z	. . . . .3
Mason, P	. . . . .2	Pollock, T	. . . . .2	Sopcisak, J	. . . . .3
Matavalam, N	. . . . .9	Praegla, P	. . . . .2, 3, 8	Spaeth, P	. . . . .4, 7
Meier, C	. . . . .2, 3, 8	Praniewicz, M	. . . . .6	Spear, A	. . . . .2
Mekhontsev, S	. . . . .2, 4, 9	Pribe, J	. . . . .2, 5	Stansbury, J	. . . . .2
Miller, C	. . . . .2	Provatas, N	. . . . .7	Stebner, A	. . . . .8, 9
Millwater, H	. . . . .4	Q		Stoudt, M	. . . . .4
Mishra, S	. . . . .4	Qu, X	. . . . .7	Strantza, M	. . . . .6, 7
Mitschang, A	. . . . .3	R		Suhonen, T	. . . . .8
Mogonye, J	. . . . .7	Raddick, J	. . . . .3	Sun, T	. . . . .8
Mohr, G	. . . . .8	Radhakrishnan, B	. . . . .5	Supanekar, S	. . . . .7
Montoya, A	. . . . .4	Rafailov, M	. . . . .7	T	
Moser, N	. . . . .2, 4, 6, 7, 8	Rao, P	. . . . .3	Taheri, M	. . . . .3
Motibane, L	. . . . .7	Räpke, T	. . . . .3	Tanner, J	. . . . .8
Mudalamane, M	. . . . .3	Rau, D	. . . . .6	Tan, W	. . . . .6
Musinski, W	. . . . .2	Raza, A	. . . . .3	Tarr, J	. . . . .6
N		Reddy, T	. . . . .2	Tayon, W	. . . . .5, 7
Narra, S	. . . . .2	Reid, A	. . . . .3	Tekerek, E	. . . . .3
Nassar, A	. . . . .9	Rentz, R	. . . . .7, 8	Tennyson, G	. . . . .8
Newman, C	. . . . .5	Restrepo, D	. . . . .4	Theodore, M	. . . . .6
Ngo, A	. . . . .2	Reutzel, E	. . . . .9	Turner, J	. . . . .2, 5
Nguyen, T	. . . . .5	Reynolds, J	. . . . .6	U	
Nichols, S	. . . . .5	Richter, B	. . . . .2, 5, 7	Uchic, M	. . . . .6
Nirgudkar, H	. . . . .8	Ricker, R	. . . . .7	V	
Nuttall, D	. . . . .6	Riensch, A	. . . . .3	Vaidya, U	. . . . .6
Nygren, K	. . . . .5, 7	Rincon Tabares, J	. . . . .4	Vajragupta, N	. . . . .7
		R., J.	. . . . .9	Van Der Veen, S	. . . . .8
		Rolchigo, M	. . . . .4, 5		
		Rollett, A	. . . . .2		
		Rome, J	. . . . .7, 8		

W		Y		Z	
Wagner, G	4, 7	Yamashita, S	3	Zagade, P	8
Wall, A	8	Yan, J	8	Zalameda, J	7
Wall, W	2, 3, 8	Yavari, R	3	Zepeda-Alarcon, E	7
Wang, L	7	Yeole, P	6	Zhang, Q	2
Wang, Y	8	Yeratapally, S	2, 4	Zhang, T	4
Wang, Z	5	Yeung, H	2, 4	Zhao, X	4
Watring, D	5	Young, S	4	Zhu, Q	8
Weaver, J	4, 7, 8, 9	Yuan, L	4	Zisis, L	4
Weber, G	2, 4			Zong, Y	2
Weissbach, R	2, 3, 8			Zuback, J	2
Wells, D	9				
Wietecha-Reiman, I	4				
Williams, C	6				
Williams, M	4				
Williams, P	8				
Wu, K	2				