



MANUFACTURING & MATERIALS  
JOINING INNOVATION CENTER



June 2-3, 2021  
IAB Meeting of the NSF I/UCRC:

# Manufacturing and Materials Joining Innovation Center (Ma²JIC)

Virtual Event | AGENDA

DAY 1: Wednesday, June 2, 2021 all times EDT	
10:00-10:20am	<p><b>Welcome &amp; Center Overview</b></p> <p><b>Jorge Penso</b>, Shell, IAB Chair <b>Antonio Ramirez</b>, OSU, Ma2JIC Director</p>
10:20-10:25am	<p><b>Student Award Criteria Review</b></p> <p><b>Stephen Tate</b>, EPRI</p>
MATERIAL/JOINT PERFORMANCE	
10:25-11:55am	<p><b>Chair:</b> Mike Buehner, TechnipFMC; <b>Co-Chair:</b> Boian Alexandrov, OSU</p> <p><b>Thrust Area Update (5-minutes)</b></p> <p><b>Student Presentations</b> <i>15-minute presentation + 5-minute Q&amp;A</i></p> <p><b>Chris DiGiovanni</b>, UW, “Zinc Effects of Mechanical Behavior of AHSS Welds,” 06-UW-012018 <b>Chris Farnin</b>, Lehigh, “Effect of Interstitial Elements on the Weldability of Nickel Base Alloys,” 02-LU-082020 <b>Stan Hawkes</b>, OSU, “Friction Stir Welding for Armor Applications Phase II,” 01-OSU-062019</p> <p><i>10-minute presentation + 5-minute Q&amp;A</i></p> <p><b>Will Siefert</b>, OSU, “Qualification of Dissimilar Metal Welds for Service in Hydrogen Containing Environment Phase II: Dissimilar Metal Welds with Improved Resistance to Hydrogen Assisted Cracking,” 01-OSU-022020</p>
HOT TOPICS	
12:00-12:30pm	<p><b>Presentations on relevant topics from researchers new to the center</b></p> <p><i>10-minute presentation + 5-minute Q&amp;A</i></p>

	<p><b>Bradley Jared</b>, UTK, "Spanning Scales in Metal Additive Manufacturing"  <b>Tony Schmitz</b>, UTK, "Hybrid Manufacturing: Connecting Additive Manufacturing, Machining, and Metrology"</p>
12:30-1:00pm BREAK	
<b>PROJECT PROPOSALS &amp; EXTENSIONS</b>	
1:00-1:45pm	<p><i>Proposal: 10-minute presentation, 5-minute Q&amp;A</i>  <b>Todd Palmer</b>, PSU, "Controlling Solidification and Selective Alloying Element Vaporization in the Additive Manufacturing of High Strength Aluminum Alloys"</p> <p><i>Extension: 7-minute presentation, 5-minute Q&amp;A</i>  <b>Xun Liu</b>, 01-OSU-082018, "Effect of Niobium on the Weld Metal Toughness of Pipeline Steels"  <b>Antonio Ramirez</b>, 13-OSU-012017, "Integrated Modeling Framework for Automotive Multi-process Joining"  <b>Antonio Ramirez</b>, 04-OSU-012019, "Welding of Hyper-Duplex Stainless Steels"  <b>Carolyn Fink, Boyd Pantan, John Lippold</b>, 01-OSU-062018, "Development of Computational Tools for LBW and EBW"</p>
<b>CENTER ADMINISTRATION</b>	
1:45-2:45pm	<p><b>Separate IAB, PI &amp; Student meetings</b>  Attendees will be sent to appropriate breakout rooms for discussion</p>

**WORKSHOP: Wednesday, June 2, 2021**

3:00-4:00pm EDT

**“Integrating Computational Thermodynamics into Additive Manufacturing Models”**

**Adam Hope, PhD**, Thermo-Calc; **Jim Rule, PhD**, Thermo-Calc

The publication by the National Academies in 2008 on Integrated Computational Materials Engineering (ICME) highlighted the need for better multiscale materials modeling to capture the process-structures-properties-performance of a material. This is especially true in the case of additive manufacturing where it is almost impossible to model the process without considering solidification, thermal cycling and material changes in an integrated fashion. Computational thermodynamics, and specifically CALPHAD, allows for the prediction of the thermodynamic properties and phase stability of an alloy, under both stable and metastable conditions.

Additionally, the CALPHAD approach can also be extended to model atomic mobilities and diffusivities in a similar way. By combining thermodynamic and mobility data, kinetic reactions during solidification and subsequent heat treatment processes can then be simulated. By integrating computational thermodynamics and CALPHAD based tools into an ICME framework, it is possible to optimize alloy compositions and solution heat treatment temperature ranges, as well as predict optimal solidification processes without performing many time-consuming and costly experiments. This presentation will highlight selected case-study examples where CALPHAD tools have been applied to better understand and solve materials challenges relevant to additive manufacturing, and fusion based processes in general.

- Improving Finite Element modelling with CALPHAD data. Using the CALPHAD approach, properties such as density, specific heat, and enthalpy can be calculated, as a function of composition and temperature. These can then be used in lieu of handbook values to provide more accurate data for FEM/FEA simulations.
- Predicting phase balance during multiple heating/cooling cycles which are symptomatic of the additive process, which makes both controlling and predicting the resultant microstructure more difficult.
- Predicting optimal post-build heat treatments, particularly where typical stress relief heat treatment temperatures are not suitable due to local inhomogeneities in alloy composition arising from rapid solidification.

**DAY 2: Thursday, June 3, 2021**  
all times EDT

10:00-10:05am	<p><b>Welcome &amp; Introduction</b></p> <p><b>Antonio Ramirez</b>, OSU, Ma2JIC Director</p>
10:05-10:20am	<p><b>Welcome Remarks</b></p> <p><b>Dr. W. Richard Polanin, CMfgE, CWI</b> Vice President of the American Welding Society / President, WRP Associates / CoPI The National Center for Welding Education and Training (Weld-Ed)</p> <p>Ma2JIC/Weld-Ed Partnership <i>Enhancing Welding Technician Education through the Transition of the National Center for Welding Education to a Resource Center</i></p>
<b>MATERIALS/MICROSTRUCTURE/WELDABILITY</b>	
10:20-11:50am	<p><b>Chair:</b> Jeff Rodelas, Sandia; <b>Co-Chair:</b> Carolin Fink, OSU</p> <p><b>Thrust Area Update (5-minutes)</b></p> <p><b>Student Presentations</b> <i>10-minute presentations + 5-minute Q&amp;A</i></p> <p><b>Luc Hagen</b>, CSM, "Characterization of Direct Energy Deposition for Pressure Boundary Components", 01-CSM-062020  <b>Rafael Giorjao</b>, OSU, "Weldability of FeMnAl Alloys for Armor Applications", 03-OSU-062020  <b>Colleen Hilla</b>, OSU, "Processing-Microstructure-Performance Relation of Additively Manufactured High Gamma Prime Nickel Superalloy," 03-OSU-012019  <b>Jacob Rindler</b>, OSU "Advanced microstructure control in the Directed Energy Deposition process", 04-OSU-012020</p> <p><i>15-minute presentation + 5-minute Q&amp;A</i></p> <p><b>Tate Patterson</b>, OSU, "Development of Computational Tools for LBW and EBW," 01-OSU-062018</p>
<b>CENTER ADMINISTRATION</b>	
11:50am-12:35pm	<p><b>Reports from Separate IAB, PI, &amp; Student Meetings</b> 10-minutes per group + 5-minute discussion</p>
12:35-1:15pm BREAK	
<b>ADDITIVE MANUFACTURING/PROCESS DEVELOPMENT/CONTROL</b>	
1:15-2:45pm	<p><b>Chair:</b> Andrzej Nycz, ONRL; <b>Co-Chair:</b> Bill Hammel, UTK</p> <p><b>Thrust Area Update (5-minutes)</b></p> <p><b>Student Presentations</b> <i>10-minute presentations + 5-minute Q&amp;A</i></p>

	<p><b>Eric Brizes</b>, OSU “Integrated Modeling Framework for Automotive Multi-process Joining,” 13-OSU-102017</p> <p><b>Andrew Kocak</b>, UTK, “ICWE Predictive Tools for FSW – from Process to Performance,” 16-UTK-2017</p> <p><b>Bryan Lara</b>, OSU, “Development of Interlayer Technology to Join Advanced Materials for the Transportation Industry,” 03-OSU-082018</p> <p><b>Jerry Kovacich</b>, OSU, “Anviloy Die Hardfacing Development for Aluminum Die Casting Heat Checking Resistance,” 03-OSU-012018</p> <p><b>Mike Moore</b>, OSU, “High Melting Rate Tandem GMA Additive Manufacturing of Advanced Materials,” 04-OSU-032019</p>
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**CENTER ADMINISTRATION**

<p>2:45-3:30pm</p>	<p><b>Attendee Feedback Survey</b> Tiffany Norman</p> <p><b>Student Awards</b> Stephen Tate, EPRI</p> <p><b>Meeting Wrap Up</b> Antonio Ramirez, OSU, Ma2JIC Director</p>
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**OPTIONAL PROJECT SPECIFIC MEETINGS**

**Friday, June 4, 2021**

all times EDT

All below meetings are led by [Dr. Boian Alexandrov](#) and will be conducted via Zoom. Please contact Dr. Alexandrov with any questions. These meetings are open to all Ma2JIC IAB members and may have guests present for portions. The purpose of these meetings is to do a deeper dive in to topics of interest for our meeting attendees, you'll hear details of research, applications, and future plans not always described our business meeting due to time limitations. Typically, when our meetings are held in person it is a convenient way to communicate information when we're geographically together.

\*Zoom information is forthcoming\*

8:30-10:00am	<b>Dissimilar Metal Welds</b> <a href="https://osu.zoom.us/j/93405284651?pwd=bDNZZmtGeTdFOWdvVy9CemdrNG5Zdz09">https://osu.zoom.us/j/93405284651?pwd=bDNZZmtGeTdFOWdvVy9CemdrNG5Zdz09</a> Meeting ID: 934 0528 4651 Password: 197593
10:30am-12:00pm	<b>Temperbead Welding</b> <a href="https://osu.zoom.us/j/92076007032?pwd=aEd1S1QrMmFTWnhxycytZa3MyRjNhQT09">https://osu.zoom.us/j/92076007032?pwd=aEd1S1QrMmFTWnhxycytZa3MyRjNhQT09</a> Meeting ID: 920 7600 7032 Password: 056813
1:00-2:30pm	<b>SRC/347</b> <a href="https://osu.zoom.us/j/97332091694?pwd=WDFHMIpkc1FoUFBuTjdJcjB6T3dodz09">https://osu.zoom.us/j/97332091694?pwd=WDFHMIpkc1FoUFBuTjdJcjB6T3dodz09</a> Meeting ID: 973 3209 1694 Password: 385817