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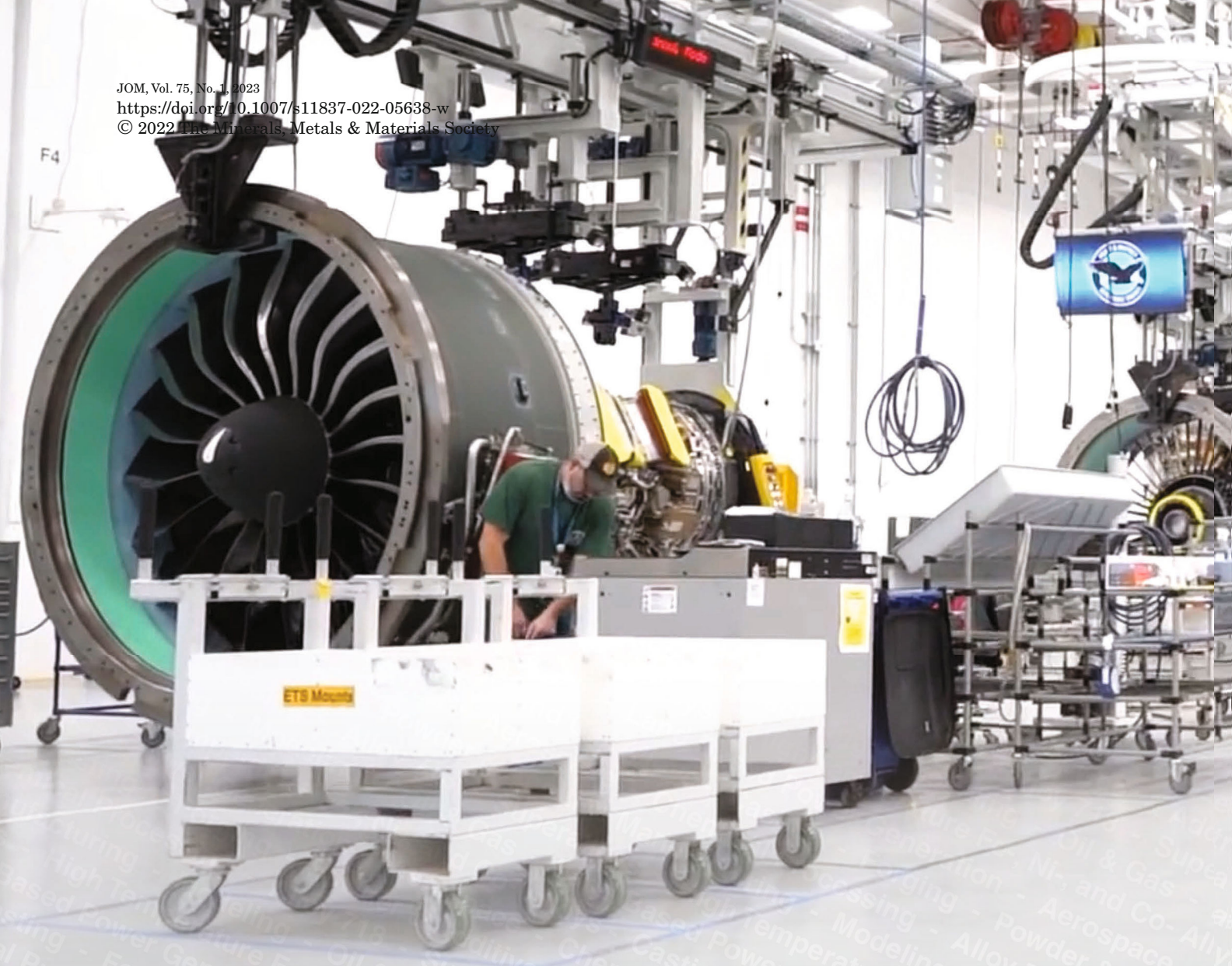
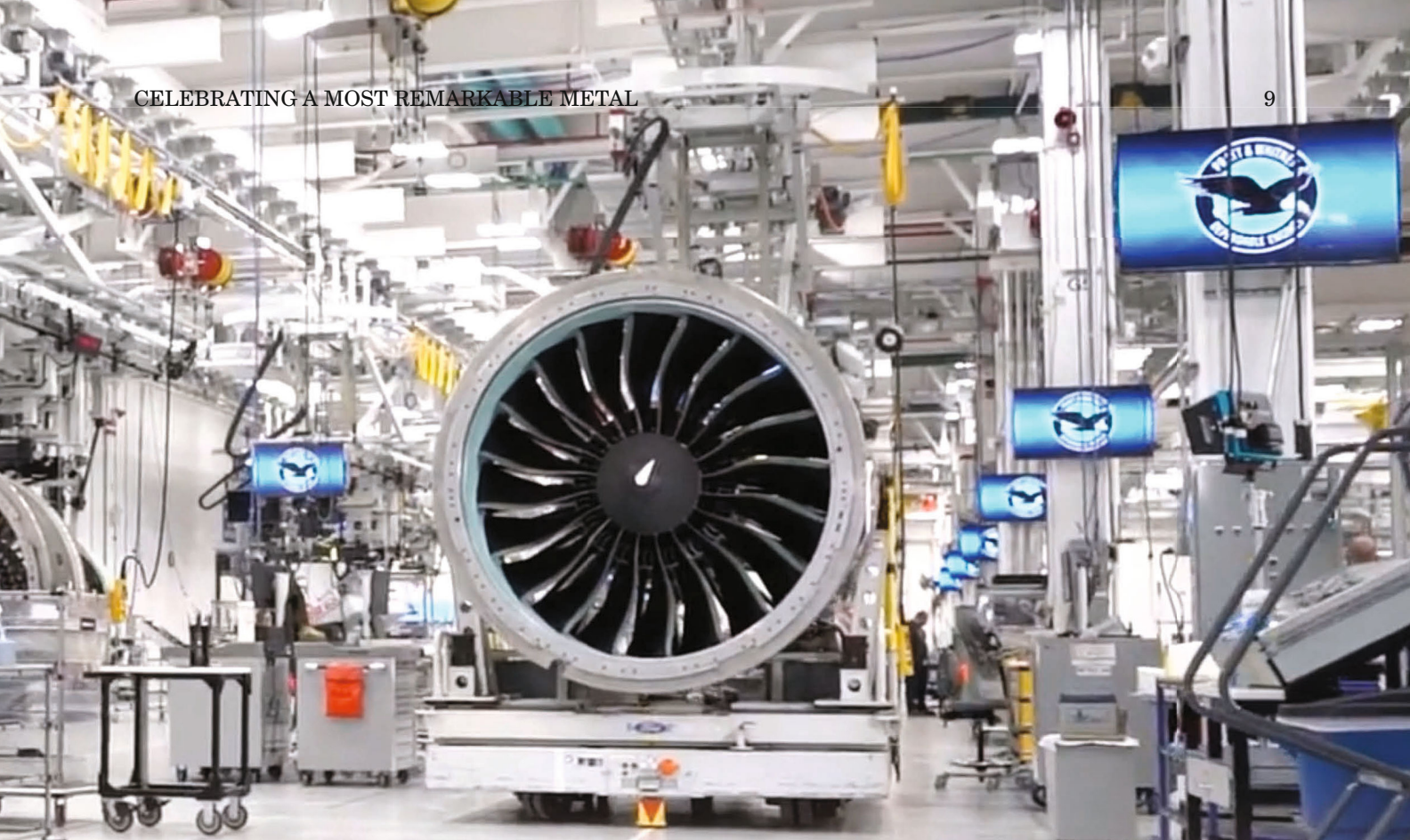



# CELEBRATING A MOST REMARKABLE METAL

Lynne Robinson



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**Superalloys have made many of the signature technologies of the modern age possible. Suited for the most punishing operating conditions, this iron, cobalt or nickel-based alloy system can be pushed to the highest fraction of its melting point and also operate effectively at cryogenic temperatures, all the while offering superior corrosion and oxidation resistance. Because of these remarkable properties, superalloys have enabled us to connect the world through jet travel, probe the possibilities of space, explore energy sources deep beneath the earth and sea, and ensure the energy generation necessary to sustain our way of life.[1]**

**TMS has long supported the superalloys technical community in its mission to improve the performance and production of these metals in the face of evolving service conditions and economic challenges. The next milestone on this journey is the 10th International Symposium on Superalloy 718 & Derivatives (Superalloy 718 & Derivatives 2023).**

## BUILDING ON A LEGACY OF EXCELLENCE

Joel Andersson

"The conference has a legacy of a high standard research within the field and covers a broad range of manufacturing processes of structural components of high importance to aerospace as well as the energy sector," noted Joel Andersson, organizing committee chair for Superalloys 718 & Derivatives 2023. "It's also very well-balanced in academic and industrially oriented research, with a very friendly and welcoming atmosphere."

Andersson speaks from experience to the legacy and impact of this conference, crediting its "welcoming atmosphere" coupled with high-quality technical content as factors in his own career development. "My first conference was Superalloys 718, 635, 706 & Derivatives in 2005, chaired by E.A. Loria," he said. "It was a great experience for me as a young grad student to meet all the important people in the world in relation to superalloys. I still remember the kindness and impressive knowledge Dr. Loria possessed and gladly shared."

"During the conference I joined TMS and have been a member ever since," Andersson continued. "After the 2005 conference, I started my Ph.D. studies at Chalmers University of Technology, and in collaboration with Volvo Aero Corporation (GKN Aerospace Sweden), pursued research in welding and weldability testing of precipitation hardening Ni- and Ni-Fe- based superalloys—an area which is still very close to my heart and where I nowadays supervise several Ph.D. students on my own."

Joel Andersson (right) with E.A. Loria at the first conference that Andersson attended—Superalloys 718, 635, 706 & Derivatives in 2005, chaired by Loria.

A *JOM: THE MAGAZINE* INTERVIEW

David Furrer

## DAVID FURRER, SUPERALLOYS 718 & DERIVATIVES 2023 KEYNOTE SPEAKER

David Furrer is Senior Fellow Discipline Lead at Pratt & Whitney. In the following interview, he previews his keynote talk, "Application of Computational Materials and Process Modeling to Current and Future Aero-engine Component Development and Validation," which he is slated to deliver at Superalloys 718 & Derivatives 2023.

JOM

**Integrated computational materials engineering (ICME) is a relatively new discipline that is growing in its adoption. What have been some of the key milestones in its evolution so far, particularly as it relates to superalloys?**

Furrer

Actually, ICME is not new. It has been around for decades in various forms and fashion. The identification of the utility and value of formally linking materials and process models to other engineering discipline workflows (e.g., design, structures, manufacturing, quality, etc.) has made the formalized concept of ICME more visible. I feel that a number of critical technologies have now matured sufficiently and are being individually adopted to allow for ICME to effectively be more fully deployed. These enabling technologies include enhancements in physics-based understanding of materials mechanisms (physics-based models), advanced characterization methods that are supporting physics-based model development and validation, new software and computational methods for efficient simulation and prediction capabilities, and focus and advancement of materials and process data management and analytics (AI/ML).

Today, Andersson is a professor of Materials Science, Head of the Division of Welding Technology and Director of Production Technology at University West in Trollhättan Sweden. As a way of giving back for the professional experiences that shaped him, he joined the Superalloys 718 and Derivatives organizing committee in 2014 and has been committed to this conference's development ever since. "It feels great to work and learn from all these knowledgeable people on the committee," he said. "I try my best to contribute to the high standard that this conference holds as its reputation."

Reflecting on how topic areas have changed since his first conference, Andersson said, "In 2005, there was a tremendous amount of research on 718Plus which made a strong impression on me. The focus on 718Plus then gradually shifted to Haynes 282 by the conference in 2010. Now, in the last few iterations, there has been a shift in process focus, particularly with regards to additive manufacturing."

Powder and Additive Manufacturing once again figures in the list of technical topics to be explored at Superalloys 718 & Derivatives 2023 meeting. In addition, industry-focused topics, such as Aerospace, Land-Based Power Generation, and Oil and Gas, are joined by topics such as Modeling and Data Analytics that examine emerging tools and techniques. "There are also some very interesting papers within my own favorite area of welding and welding-based additive manufacturing which I very much look forward to listening and learning more from," said Andersson.

As with past conferences, all papers presented undergo rigorous peer review, with all speakers required to submit full manuscripts for the proceedings.

SUPERALLOY 718 and Derivatives

## CONTRIBUTE TO BREAKING NEWS

A call for breaking news abstracts will open for Superalloys 718 & Derivatives 2023 on January 18 and close on March 31, 2023. If you missed the opportunity to contribute a paper, this is your chance to share your insights at this prestigious meeting, sponsored by the TMS Structural Materials Division and High-Temperature Materials Committee.

Visit www.tms.org/Superalloy718-2023 for details and to submit your abstract.

JOM

**What are some of the current challenges to ICME's growth and deployment?**


Industrially practical (fast, accurate, and cost effective) software tools are an important part of deployment and adoption of ICME-type technologies and capabilities. This is readily occurring at all the existing software companies who have traditionally supported other engineering disciplines with finite element (FE), computational fluid dynamics (CFD), and other methods. Materials and process specific software tools are also continuing to advance in capability and functionality, including thermodynamic and kinetics modeling tools, as well as continuum process modeling packages.

Two major hurdles exist for continued implementation of ICME. Workflows that can link modeling tools and associated simulation prediction are ad hoc as best, and largely left to individual organizations to manage with no standards. Additionally, deterministic treatment of ICME will provide answers to only so many questions (a huge number, by the way), but to provide the ultimate benefit from ICME tools there is a need for full linkage between material, process, and product design in a probabilistic manner.

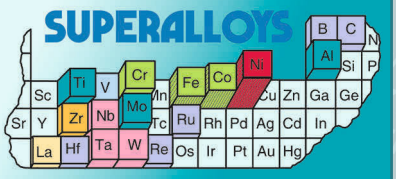
Statistical material science and engineering must be more completely adopted. Average grain size and other microstructural features and processing parameters do not provide sufficient information to fully answer the questions asked of the materials community by our other engineering discipline counterparts, leaving the requirement for huge amounts of testing, empirical design systems, and complex qualification/certification processes. This challenge is being overcome with tools and methods such as statistically equivalent representative volume elements (SERVEs) tools and frameworks.

Additional conference highlights include two keynotes. Melissa Martinez, Vice President, Product & Process Technology, ATI Metals, U.S. will present a historical overview in "Meeting the Challenges of the Future by Understanding Our Past" What the future may hold is the focus of the keynote talk delivered by David Furrer, Senior Fellow Discipline Lead, Materials and Propulsion Technology, Pratt & Whitney, U.S. (**Editor's Note:** The question-and-answer interview with Furrer as part of this article offers a preview of his keynote topic.)

"I'm looking forward to listening to our keynote speakers—They span an impressive breath of experience and knowledge from superalloy production aspects to end user perspectives," commented Andersson.

Chantal Sudbrack

Chantal Sudbrack, conference co-chair, has been involved with organizing Superalloys 718 & Derivatives since its 2018 installment, when she was recruited to the organizing committee because of her symposium organizing experience and involvement with the TMS High Temperature Alloys Committee and her own research into Alloy 718. Currently a research engineer with the U.S. Department of Energy National Energy Technology Laboratory (NETL) and principal investigator for NETL's advanced materials development and advanced turbines programs, Sudbrack points to the sister conference of Superalloys 718 & Derivatives, as a formative early career experience.




## EXPLORE THE SUPERALLOYS PROCEEDINGS ARCHIVE

The Superalloys Conference Proceedings Archive offers a searchable, online collection of more than 1,000 technical articles that document the history of these important materials, starting with the 1968 International Symposium on the Structural Stability in Superalloys. The archive is free to all users through the support of the International Symposium on Superalloys Subcommittee. To access the archive, visit www.tms.org, navigate to the Publications tab, and select Superalloys Proceedings Archive under the Proceedings and Other Resources heading.

A JOM: THE MAGAZINE INTERVIEW

JOM **In the abstract for your talk, you note that materials modeling is starting to be applied to emerging supply chain processes. Could you provide a brief, high-level overview of this development and its potential impact?**

Furrer Metal additive manufacturing (AM), though actually an old process and concept, has seen a significant resurgence through enabling technologies such as advanced energy sources, automation, sensors, controls, etc. Modeling and simulation methods are being applied to AM in a significant way. The "emergence" of AM as a production manufacturing process is enabling the potential for a "clean sheet" approach to how components and associated processes should be designed, controlled and qualified/certified. Computational modeling is guiding the development of successful, robust build strategies for complex geometry components and highly alloyed materials. Additionally, process parameter sensitivities on a configuration-by-configuration basis can be assessed and "smart" quality control and certification test plans can be established. Computational modeling is enabling the viability of the highly flexible additive manufacturing process.

JOM **You also note in your abstract that computational modeling and simulation is being extended to component qualification and certification. Could you briefly comment on this development, its current prevalence, and its potential impact?**

Furrer Modeling and simulation tools can provide critical information regarding component location-specific microstructure and mechanical properties (or residual stresses, etc.), which can be used to assess regions of interest for testing and validation. Such up-front analysis can also guide engineers in the identification of critical to quality (CTQ) processing parameters that must be controlled individually or in combination ("stacked" tolerances) to ensure reliable capability of meeting engineering design intent. Enhanced understanding of manufacturing controls and spatial distribution of properties and associated uncertainties throughout component volumes by the means of modeling tools provide a roadmap for efficient, rapid qualification and certification plans. Through-process modeling and data management and analytics will provide a digital thread (fingerprint) that defines a component at both a part number and serial number basis that will be used to support and justify focused qualification and certification plans.

"As a graduate student, I was aware of the prestige of the International Symposium on Superalloys and I was thrilled to prepare a poster on my Ph.D. research for the Superalloys 2004 conference," she said.

Both TMS-affiliated superalloys conferences offer a high standard of technical programming, Sudbrack noted, but still feels that a key reason to participate is "socializing and networking with seasoned and emerging professionals and key experts in the field."

And another reason?

"Because superalloys are awesome!"

## REFERENCES

1. Kracke, Art; Superalloys, "The Most Successful Alloy System of Modern Times-Past Present and Future", *Proceedings of the 7th international Symposium on Superalloy 718 & Derivatives*, The Minerals, Metals & Materials Society, 2010.



**JOM: What is the main takeaway that you would like attendees to leave with after hearing your talk?**

**Furrer:** I would like attendees to understand that computational modeling capabilities are continuing to advance, and that they should be actively working to apply or further integrate such tools in their daily engineering, manufacturing, and quality functions. I feel the materials community can and should represent materials in a more statistical manner, which will also aid in understanding the full extent of material, process, and product capabilities.

**JOM: Is there anything else you would like to add?**

**Furrer:** I feel materials and process modeling, and materials informatics will allow for the materials science and engineering discipline to continue to integrate with other disciplines for holistic product design and realization. Modeling will also provide a path for more efficient, cost-effective and capable products that can rapidly evolve through introduction and acceptance of new materials, manufacturing processes, configurational designs and other technologies.



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