DREXEL UNIVERSITY
Materials Science and Engineering
College of Engineering

Department of Materials Science and Engineering
Fall Seminar Series

3:00 PM, Wednesday, October 18
PISB 106

"Processing-Structure-Property Relationships in Additively Manufactured Metals: Building Reliable & Reproducible Microstructures"

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Abstract: Additive manufacturing (AM) has received significant attention in recent years because of its potential to transform the commercial production of components, particularly for high-value, low-volume applications, where part geometries and other requirements make them difficult or impossible to produce via conventional processing methods. One inherent drawback to current AM technology is the reproducibility of microstructures and properties of materials created via the additive process. This is because most of the alloys currently in use for AM applications were originally developed for dramatically different processing routes, namely conventional cast and/or wrought processes. Thus, the microstructures and properties of alloys built using AM processes can be dramatically different than nominally identical wrought counterparts. In many cases, properties also show significant variation from build to build using the same AM process, making component design using such materials impossible. In the present work, we investigate the processing-structure-relationships in additively manufactured materials, focusing on thermal processing in the solid state, i.e. post-built material. Specifically, Inconel 625 and 17-4 PH stainless steel are investigated. As expected, as-built microstructures are comparable to welded materials, and they respond in a similar manner to thermal processing as welded alloys. However, differences are also observed, resulting in the unique processing history of AM alloys compared to conventional materials. For example, composition differences arising from the gas atomization of powder feedstock. Using both computational modeling and experimental investigation the differences in microstructural evolution behavior of conventional and AM materials are highlighted; and post-build thermal processing regimens are identified to develop more uniform predictable AM-produced microstructures. Finally, the future of AM will also be discussed, where the dream is to employ alloys specifically designed to take advantage of AM processing instead of repurposing alloys designed for other applications. Some possible considerations for AM alloy design will be discussed.

Bio:
Dr. Eric Lass is a Materials Research Engineer at the National Institute of Standards and Technology (NIST) in Gaithersburg, MD. Prior to his arrival at NIST, he received a B.S. in Materials Science & Engineering from Michigan Technological University (Michigan Tech) in 2001 and an M.S. in Materials Engineering from Rensselaer Polytechnic Institute (RPI) in 2003. He then moved to the University of Virginia (UVa), where he received a Ph.D. in Materials Science and Engineering in 2008 while working for Prof. Gary Shiflet. His dissertation focused on the thermodynamics and atomic structure of metallic glasses. Dr. Lass was awarded a National Research Council (NRC) postdoctoral fellowship in 2009 at NIST studying the application of magnesium-based metallic glasses as potential hydrogen storage materials. He joined the NIST staff in 2011, and leads much of the experimental effort in the Thermodynamics and Kinetics Group (TKG) of the Materials Science and Engineering Division (MSED) at NIST.

Dr. Lass is currently the leader of the Advanced Materials Design: Structural Applications project in TKG, which is focused on the application of ICME-based tools to materials development. His research interests are in processing-structure-property relationships, specifically the application of thermodynamics and kinetics to microstructural evolution and phase transformations in metals and alloys. Current research activities includes understanding of microstructural evolution in additively manufactured metals and alloys and gamma-prime strengthened Co-based superalloys.

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