MateriAlZ Seminar Series

Enabling Science Based Qualification in Metal Additive Manufacturing

Friday, January 29, 2021, 11:00 am MST

Abstract

Qualification of an AM material is a key challenge that must be overcome before wide-spread introduction of AM-produced parts in property-critical applications. Historically, manufactured parts have been qualified for use through a process-based strategy. In this strategy, strict guidelines in manufacturing are imposed which, when followed, guarantee that the part will meet performance requirements. Such process-based strategies have been successful but were developed over decades or even centuries of iterative 'trial and error' experiments where the effects of small variations in processing on performance were noted.

With modern technology there is a maturing understanding of how traditional processing approaches lead to microstructure which dictates the properties which, in turn, controls performance. These interconnected relationships are called process-structure-property-performance, or PSPP relationships. Despite this new knowledge, the process-based qualification strategy is still nearly exclusively used in all industrial manufacturing processes.

The challenge for certifying and qualifying of AM parts is the lack of experience in this innovative new approach. The decades and centuries of experimental results on AM materials are not available. The potential solution is to qualify a product rather than a process. By connecting targeted experiments with advanced simulation tools, a predictive modeling architecture can be developed for AM PSPP relationships. The simulations would then provide processing conditions based on performance requirements. This approach can be termed science-based qualification (SBQ). In this talk, this topic will be explored through three examples utilizing additively manufactured stainless steel.

Dr. John Carpenter

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John S. Carpenter is a scientist within the manufacturing science and metallurgy division at Los Alamos National Laboratory (LANL). Dr. Carpenter received his Ph.D. in Materials Science and Engineering from Ohio State University in 2010 after performing his undergraduate studies at Virginia Tech. He has managed several programs at LANL including ones associated with severe plastic deformation, friction stir welding, and additive manufacturing. Often his role is to enable advanced manufacturing concepts through integrated experiments that employ novel processing techniques, advanced in situ diagnostics, ex situ characterization and small scale mechanical testing. He has more than sixty journal publications, one book chapter, and thirty five invited technical talks to his credit. He is an active member of TMS and was the 2012 recipient of the Young Leaders Professional Development Award for the extraction and processing division of TMS.

Zoom link: https://arizona.zoom.us/j/85360155090