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# TMS2023

152nd Annual Meeting & Exhibition

MARCH 19–23, 2023
SAN DIEGO CONVENTION CENTER &
HILTON SAN DIEGO BAYFRONT
SAN DIEGO, CALIFORNIA, USA
#TMSANNUALMEETING

## SUBMIT AN ABSTRACT BY JULY 1 FOR THE FOLLOWING TMS2023 SYMPOSIUM:

### ADDITIVE TECHNOLOGIES

## Quantifying Microstructure Heterogeneity for Qualification of Additively Manufactured Materials

The transient heat transfer conditions encountered in additive manufacturing (AM) result in unusual microstructures and textures that can have different properties from conventional wrought or cast processes. The unique microstructure results from the combination of rapid melting and solidification from the AM process. The directional heat transfer results in strongly textured columnar grains, and this microstructure affects the mechanical properties of the final part. Conventionally processed products have been considered superior compared to AM in many of the most demanding and safety-critical engineering applications due to the heterogeneity and orientation dependency of mechanical properties, potential for life-limiting defect content, and qualification challenges. This limits adoption of AM parts where they could otherwise offer an advantage, for example in weight savings or reduction in final machining. Mechanical anisotropy results from the strong crystallographic texture in as-fabricated AM parts, and this anisotropy can be influenced with an optimization of the laser scanning strategy or a post fabrication heat treatment. Because the initial microstructures from AM are different from conventional processes, optimal heat treatment times and temperatures for AM materials can differ from those used in conventional thermomechanical processing. The lack of standardization between machines creates an additional level of complexity. As a result, the qualification of materials from AM would benefit from an accurate digital twin of the process, capable of predicting defect probabilities and local microstructure heterogeneity.

This symposium will explore the unique thermal sequence of AM materials and their distinctive microstructures, which affect their performance. Contributions are sought that address microstructure development during AM from experimental and computational perspectives, including but not limited to:

- Quantitative microstructure characterization
- Mechanisms of defect formation
- Correlation of in-situ process monitoring data with microstructure
- Defect probability predictions
- Uncertainty quantification
- Multiphysics simulations, both of the manufacturing process and the effects of microstructure on performance.


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