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TMS 2023

152nd Annual Meeting & Exhibition

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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

Additive Manufacturing of Refractory Metallic Materials

As metal Additive Manufacturing (AM) technology evolves and is showing itself as a technically and economically viable option for actual component production, technology boundaries are being expanded towards more challenging materials, like refractory metallic materials, both alloys, and pure metals. As manufacturing involving refractory alloys has been a persistent challenge, the use of additive manufacturing for the production of complex parts presents itself as a potentially economically viable alternative, and for some key applications, AM seems to be one of the few options available. The exploration and development of metal additive manufacturing of alloys based on W, Mo, and Nb, among others, has attracted many researchers and this symposium would allow them to share their work, achievements, and challenges while enabling researchers and engineers on private and government organizations to understand the state of the art, the current limitations and the path forward.

The growing interest and research activity on AM for refractory alloys has been driven in part by the growing interest in high-performance turbine engines, hypersonic technology for many defense and commercial applications, in addition to space power generation, and the need to implement nuclear propulsion for long-range space exploration. However, many other applications involve these materials, like the production of superconductive resonance cavities for particle accelerators and even quantum computing. Refractory metals present unique inherent challenges like elevated reactivity, low ductility, and high melting temperatures. As a result, the printing of these materials has shown to be quite challenging. For example, W is known for having an elevated ductile-to-brittle transition temperature what makes powder-bed fusion printing of this material a cracking nightmare. Developments have been proposed using preheating to elevated temperatures to minimize cracking while printing of refractory alloys, which further enhances oxidation. Other approaches like alloy re-designing and smart thermal engineering during printing could be the solution. Some of the cracking phenomena associated with printing are still unclear and therefore robust solutions have been elusive.

Finally, the final obtained microstructures from AM, are unique in several aspects and their influence on performance has also been a matter of study.

This symposium will bring together the additive manufacturing community that has engaged in the fundamental and applied aspects associated with refractory metals printing. Topics of interest include, but are not limited to:

- The varied and complex cracking phenomena associated with solidification and solid-state low ductility on the different refractory alloy systems during AM
- Alloy elements and impurities effect on refractory alloys printability
- Alloy design for improved printability and performance of refractory alloys
- The use of conventional and advanced phase transformation models on the design and optimization of refractory alloys is better suited for different AM processes
- Relationships between solidification structure, impurities segregation, solid-state crystallographic structure, and defect formation during AM and the use of fundamental understanding to propose engineering solutions
- Modeling and simulation of the printing process and phase transformations associated with AM refractory alloys
- Specific applications or development for key components

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