Additive Manufacturing of Refractory Metal Alloys Using Powder Bed Fusion – Laser Beam

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Abstract

The Additive Manufacturing technology Powder Bed Fusion - Laser Beam (PBF-LB) enables the production of complex-shaped components that surpass the limitations of conventional manufacturing methods. PBF-LB is ideally suited for producing functionally optimized parts for cutting-edge high-tech applications, especially when using high-performance materials such as the refractory metals molybdenum and tungsten.

However, a drawback of PBF-LB-manufactured pure molybdenum and tungsten components is that they currently cannot compete with conventional powder metallurgical parts due to their coarse-grained, columnar microstructure, which is prone to cracking. To suppress the formation of such an unfavorable microstructure, it is necessary to tailor the material to the unique solidification conditions of the PBF-LB process.

In this presentation, the underlying mechanisms for defect formation in molybdenum and tungsten are discussed. Furthermore, different alloying concepts are presented to, first, induce grain refinement, thereby suppressing the formation of a coarse-grained microstructure, and second, to purify the grain boundaries from impurities and thus preventing crack formation. Both theoretical foundations and experimental results are presented.