

Laser Powder Bed Fusion of Refractory Metals

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Although refractory metals are difficult and expensive to process using conventional manufacturing methods they are used because of their unique properties, including high melting points, chemical resistance and high radiation blocking. The high melting points make casting difficult, while the high hardness of some refractory metals makes them difficult to machine. The high costs involved have limited the use of these materials and kept component designs simple to manufacture.

In this talk, we present work on the processing of both tantalum and tungsten using additive manufacturing laser powder bed methods. These methods use a laser to selectively melt a layer of powder, so as to build up the final component. The presentation will demonstrate that complex thin walled structures can be created in these materials, as can 10cm long blocks of material containing 0.6mm pinholes used as gamma ray and x-ray collimators, and porous lattice structures, in a similar way to titanium alloys and stainless steels. The microstructure produced with the associated epitaxy will also be discussed. The epitaxy occurs because of the growth of grains from the underlying substrate as each new layer is added. The effect of this structure on the properties of the parts will be discussed. Other problems that limit the functionality of the parts will also be considered.