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Mechanical deformation of the 316L stainless steel prototype produced by 3-D additive manufacturing (AM) printing

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3-D additive manufacturing (AM) printing, Direct Energy Deposition (DED) or Powder Bed Fusion (PBF) are effective for producing complex engineering components of 316L stainless. It is reported that the physical metallurgy, microstructure in particular, of SS316L induced by the powder-based 3-D AM printings, Laser Engineering Net Shaping (LENS), one of the DED, or PBF, is quite complex, relative to those SS316L produced by the traditional ingot casting.

Our study show that the LENS or PBF- solidified microstructure generally consists of interactive molten metal fusion interfaces, fine-spaced columnar solidified cells, epitaxial grown grains, and highly tangled dislocation networks. The resultant AM microstructural combination is highly dependent on localized thermal transport and heat distribution caused by laser-material interaction. Most significantly, we found the variation in microstructural combination impacts the mechanical behavior and deformation mechanism of the 316L prototype.

In this talk, we will present experimental discoveries and discuss the mechanical behavior and tensile deformation mechanism of the LENS- and PBF- 316L. In addition, we will discuss the influence of AM metallurgical characteristics on 316L system engineering.

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