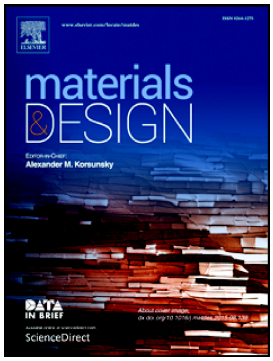

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Effect of Scan Pattern on the Microstructure and Mechanical Properties of Powder Bed Fusion Additive Manufactured 17-4 Stainless Steel

Andelle Kudzal[1,2], Brandon McWilliams[3], Clara Hofmeister[1], Frank Kellogg[4], Jian Yu[3], Joshua Taggart-Scarff[1], Jianyu Liang[2]

1. Oak Ridge Institute for Science and Education, Belcamp, MD 21017

2. Dept. of Mechanical Engineering, Worcester Polytechnic Institute, Worcester, MA 01609

3. Weapons and Materials Research Directorate, US Army Research Laboratory, Aberdeen Proving Ground, MD 21005, USA

4. SURVICE Engineering, Belcamp, MD 21017

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Abstract

Additive manufacturing (AM) of metallic parts is generating significant interest due to the ability to produce complex parts in a short period of time with minimal finishing required. However, the effect of laser scan strategy on the properties of finished parts is not well understood. In this paper the effects of laser scan line strategy on the microstructure and mechanical properties of stainless steel produced using metal Powder Bed Fusion (PBF) AM were characterized. Microstructure and phase identification were measured using x-ray diffraction and quantitative optical microscopy which found that all samples had a dual phase austenite-ferrite composition. Shorter scan lines perpendicular to the load direction resulted in 25% retained austenite, while elongated scan lines parallel to the load direction more than doubled the amount of austenite retained. A change of direction within the scan line path resulted in increased delamination porosity along the melt pool boundary and changes in volume fraction of retained austenite. Fractography, revealed cracks that propagated along melt pool boundaries. Understanding the effect of strategy on the microstructure and mechanical properties allows the producer of AM parts to implement materials by design strategies.