Identifying Signatures of High Entropy Alloy Additive Manufacturing Using High Throughput Experiments

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Abstract:

Research into identifying the process window and signatures of Laser Powder Bed Fusion (LPBF) will be presented. The study will focus on an equimolar additively manufactured FeCoCrMnNi High-Entropy Alloy (Cantor HEA). Additive manufacturing presents a unique challenge to certain nuclear safeguards and it is of interest to understand the signatures that can identify when and how a part is created. First, this work uses a dimensionless number designed to estimate the ideal process window for LPBF Cantor HEA. High-throughput experiments that tested density and hardness of 235 samples over 16 hours then validated this estimate. Despite achieving good mechanical properties, low throughput electron microscopy experiments indicated microcracking defects within the process window. Subsequent studies to identify the acoustic signatures of the microcracking phenomenon will be discussed. Finally, this presentation will explore how the high-throughput experiments and acoustic signatures can be combined to create a rapid alloy development pipeline for LPBF.