High Strain Rate Signatures of Additively Manufactured High Entropy Alloys

Alec Mangan

Advisor: Dan Thoma

University of Wisconsin-Madison

asmangan@wisc.edu

Abstract:

New results on the signatures associated with Laser Powder Bed Fusion (LPBF) manufactured High Entropy Alloys (HEAs) exposed to high strain rates will be presented. LPBF is a method of additive manufacturing that produces high precision parts, and it presents a unique challenge to nuclear safeguards. This study focuses on equiatomic CoCrFeMnNi HEA which is documented to be both strong and ductile as well as having exceptional performance in extreme environments. Samples were produced using LPBF under seven different processing conditions within the optimal processing window based on prior high throughput experiments at UW-Madison. Each condition was exposed to high strain rate testing by collaborators at Los Alamos National Laboratory. Using a combination of optical and electron microscopy, signatures were identified and their correlations with spall strength and resulting material damage were measured. This study identified that micro-cracking above a 0.1% cross-sectional area led to a 10% reduction in spall strength. Understanding which signatures correlate with material properties and how this information can be used to monitor the LPBF process will be discussed.