I/UCRC Executive Summary - Project Synopsis	**Date**: April 2022
Center/Site: CANFSA/Colorado School of Mines	
Tracking No.: 36H-L: Additive Manufacturing of Refractory Multi-Principal Element Alloys	**E-mail :** mlecorre@mines.edu **Phone :** (770) 570–0473
Center/Site Director: CANFSA/M. Kaufman/P. Collins/A. Clarke	**Type: (New Project)**
Project Leader: Megan Le Corre	**Proposed Budget**: $320K Leveraged
Project Description: Refractory multi-principal element alloys (RMPEAs) are a relatively new area of metallurgical development that offer promising properties at very high operating temperatures. Despite their potential benefits, they have limited workability at room temperature, significantly limiting their manufacturability by traditional methods. Production of these alloys by additive manufacturing offers the potential to circumvent these workability challenges and to produce novel and complex geometries. Additive manufacturing conditions will be simulated by laser track melts of conventional and novel refractory alloys to determine solidification behavior. Once an understanding of this behavior is established, alloy composition will be optimized for additive manufacturing processing.	
Experimental plan: Laser track melts will be produced on commercially produced alloys acquired via ATI and/or arc-melted buttons. Resulting solidification morphology and microsegregation will be analyzed with SEM, EBSD, and EDS. Complementary solidification modeling will also be performed.	
Related work elsewhere: Previous work has identified promising RMPEA compositions. A current and on-going CANFSA project supported by the office of Naval Research is evaluating the thermomechanical processing response of RMPEAs. The alloy selection will be leveraged in this work.	
How this project is different: This project seeks to evaluate the solidification response of RMPEAs under additive manufacturing conditions, rather than by more traditional processing methods.	
Milestones for the current proposed year: Production of conduction mode laser melts in Nb-47Ti and C103. SEM, EBSD, and EDS of melt cross-sections.	
Deliverables for the current proposed year: Correlation of SEM, EBSD, and EDS data to IMS and CET models to predict solidification conditions resulting from additive manufacturing conditions.	
How the project may be transformative and/or benefit society: New knowledge of solidification behavior of novel refractory alloys will reduce implementation time of new technologies requiring ultra-high operation temperatures. This work will also advance our knowledge about AM processing of RMPEAs.	
Research areas of expertise needed for project success: Access to arc-melter, laser welder, and SEM with EBSD and EDS capabilities. Laser track melting at high laser travel speeds potentially encountered during additive manufacturing and the role of pre-heating may also be explored.	
Potential Member Company Benefits: Understanding of unique solidification behavior of ultra-high temperature alloys that may be applied directly to production of AM components.	
Progress to Date: Model showing expected solidification morphologies of Nb-47Ti as a function of G and V has been produced. CET of Nb-47Ti has also been modeled. Three track melts Nb-47Ti have been produced.	
Estimated Start Date: Fall 2021	**Estimated Knowledge Transfer Date**: August 2025

The Executive Summary is used by corporate stakeholders in evaluating the value of their leveraged investment in the center and its projects. It also enables stakeholders to discuss and decide on the projects that provide value to their respective organizations. **Ideally, the tool is completed and shared in advance of IAB meetings to help enable rational decision making.**