I/UCRC Executive Summary - Project Synopsis	**Date**: April 2020
Center/Site: CANFSA/Colorado School of Mines	
Tracking No.: 36E-L: In-Situ Characterization of Microstructural Evolution During Simulated Additive Manufacturing in Model Alloys	**E-mail :** brodgers@mines.edu **Phone :** (720) 413-4542
Center/Site Director: CANFSA/M. Kaufman/P. Collins/A. Clarke	**Type: (Continuing)**
Project Leader: Brian Rodgers	**Proposed Budget**: $240,000 Leveraged
Project Description: Laser Powder bed fusion is a promising technique to create complex components, but fundamental understanding of microstructural evolution during processing is not yet fully developed. This project aims to further develop the understanding of how microstructure develops under laser powder bed fusion conditions and how to exact control.	
Experimental plan: *In-situ* x-ray imaging will be conducted using the additive manufacturing (AM) simulator at the Advanced Photon Source (APS) at Argonne National Laboratory. *Ex-situ* microstructural analysis and simulations of the experiments run at the APS will augment the *in-situ* work to develop a robust understanding of dynamic phenomena of interest during AM.	
Related work elsewhere: Several research sites are working on understanding laser powder bed fusion. This project is funded by a Multidisciplinary University Research Initiative (MURI) funded by the Office of Naval Research (ONR), so there is parallel work being conducted at other university sites in the U.S. and Australia.	
How this project is different: Most studies of additively manufactured metal focus on a particular alloy instead of using model alloys. The use of model alloys as a subject matter facilitates a deeper understanding of fundamental behavior, which may be generalized to several systems, including alloys which have yet to be developed.	
Milestones for the current proposed year: Begin simulation work using FLOW-3D and *ex-situ* microstructural characterization of the APS samples to link with the processing conditions used.	
Deliverables for the current proposed year: Simulations replicating steady-state molten pool geometry from *in-situ* samples, and imaging of the top surface of as-solidified melt pools from recent APS experiments.	
How the project may be transformative and/or benefit society: The capability to additively manufacture metals with controlled microstructures will allow the technology to be used for high-performance components and their qualification and certification, increasing the cost and material savings available to manufacturers.	
Research areas of expertise needed for project success: The APS and DTEM at Lawrence Livermore National Laboratory (LLNL) for *in-situ* experiments, FLOW-3D simulations to obtain thermal gradients, SEM, EBSD, and TEM for *ex-situ* analysis of samples.	
Potential Member Company Benefits: The ability to control the microstructure produced during AM will enable components for critical structural areas to be built with this technique, allowing for streamlined production and light-weighting of assemblies for the DoD and aerospace applications.	
Progress to Date: Simulations to develop experimental conditions for *in-situ* experiments have been performed. Experiments at the APS have also been completed on Ni-based and Al-Ag alloys.	
Estimated Start Date: Fall 2019	**Estimated Knowledge Transfer Date**: Spring 2023

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.**