I/UCRC Executive Summary - Project Synopsis		Date: April 3, 2018
Center/Site: CANFSA/Colorado School of Mines		
Tracking No.: 30-L Microstructural Evolution of Metallic Alloys during Rapid Solidification	**Phone :** (843) 618-7968	**E-mail :** chloejohnson@mymail.mines.edu
Center/Site Director: M. Kaufman/P. Collins/A. Clarke		**Type: (Continuing)**
Project Leader: Chloe Johnson		**Proposed Budget**: $240,000 Leveraged

Project Description: The final microstructure and properties of a metallic alloy are largely dependent on the as-solidified structure and its determination of subsequent solid-state phase transformations. Because of this, understanding the solidification pathway of a metal is paramount to optimizing final properties. This becomes especially important for far from equilibrium processing, where novel metastable phases are formed that greatly affect the solid-state phase transformation behavior. In situ studies of model aluminum alloys during solid-liquid and solid-state phase transformations during far from equilibrium and equilibrium processing will be used to evaluate the mechanisms controlling phase transformations and microstructural development during these processes.

Experimental plan: Using in-situ techniques across different length and time scales for bulk and thin film samples, solid-liquid and solid-state phase transformations will be observed and studied for Al-Cu, Al-Ag, and Al-Cu-Ag alloys as model alloy systems. Equilibrium and far from equilibrium processing conditions will be employed.

Related work elsewhere: Previous work has been done on in-situ imaging of rapidly solidified aluminum alloys using various techniques by this group. There has also been work done using various imaging techniques (in situ or otherwise) to understand precipitation behavior in aluminum alloys. Some post mortem analysis has been done on solid-liquid and subsequent solid-state phase transformations of rapidly solidified alloys.

How this project is different: This project will connect the as-solidified structure during rapid solidification to solid-state phase transformations using novel in situ techniques.

Milestones for the current proposed year: Current work has focused on becoming familiar with solidification theory, as well as the chosen aluminum alloy systems. This year, our goal is to obtain material and begin initial in-situ experiments to start evaluating rapidly solidified microstructures.

Deliverables for the current proposed year: Samples for solidification studies are currently being obtained. Dynamic Transmission Electron Microscopy sample preparation will also be performed by our collaborators at Lawrence Livermore National Laboratory. A proposal has been submitted to use the Advanced Photon Source at Argonne National Laboratory to perform rapid solidification studies. Some initial post mortem solidification studies will be done at Mines to allow for an initial evaluation of the effect of solidification conditions on as-solidified microstructures.

How the project may be transformative and/or benefit society: Understanding how rapidly solidified microstructural evolution impacts subsequent solid-state phase transformations could be especially important for processes like additive manufacturing where these conditions are encountered.

Research areas of expertise needed for project success: Solidification; phase transformations; microstructural development; precipitation behavior of aluminum alloys; in-situ characterization; advanced electron microscopy; materials processing

Potential Member Company Benefits: The fundamental knowledge explored in this project can be applied to Al or other metallic alloys to help predict final microstructures and properties for processes where equilibrium or far from equilibrium conditions are encountered.

Progress to Date: An initial literature review is complete, along with initial alloy selection. Discussions for use of the DTEM at Lawrence Livermore National Laboratory (LLNL) are underway, and a proposal has been submitted to use an in-situ additive manufacturing experimental apparatus at APS.

Estimated Start Date: Fall 2017	**Estimated Knowledge Transfer Date**: Spring 2021