I/UCRC Executive Summary - Project Synopsis	**Date**: April 2020

Center/Site: CANFSA/Colorado School of Mines

Tracking No.: 34: Phase and Texture Evolution Preceding Abnormal Grain Growth in Ni-based Aerospace Alloys	**Phone :** (303) 717-6273	**E-mail :** bmcarthu@mines.edu

Center/Site Director: CANFSA/M. Kaufman/P. Collins/ A. Clarke	**Type: (Continuing)**
Project Leader: Byron McArthur	**Proposed Budget**: $ 200,000

Project Description: Abnormal grain growth (AGG) can occur in industrial nickel-based superalloys and lead to grains that are orders of magnitude larger than intended. Excessive grain size causes a significant degradation in mechanical properties. The process parameters, such as strain rate, forging temperature, and supersolvus heating rate, are known to be influential; however, the microstructural mechanism that leads to AGG is yet to be established. The goal of this project is to better understand AGG and to help provide processing to avoid the phenomena.

Experimental plan: Perform thermomechanical processing in the Gleeble® 3500 to create AGG in a controlled manner. Utilize transmission electron microscopy (TEM) and scanning electron microscopy (SEM)-electron backscattered diffraction (EBSD) for ex-situ material characterization at various steps along the processing route. Utilize diffusion couples of various processed materials to explore interface characteristics.

Related work elsewhere: Huron et al. has performed similar experimental procedures for the ex-situ portion of this project on a similar material to determine strain rate and forging temperature ranges that produced AGG. Payton et al. and Charpagne et al. investigated microstructural mechanisms that may contribute.

How this project is different: A detailed mechanistic theory of how the microstructure evolves to create AGG is proposed and supported through novel thermo-mechanical experiments.

Milestones for the current proposed year: Strain rate sensitivity testing to explore deformation mechanisms in material. Performed diffusion couple experiments to determine phase and grain boundary stability and migration.

Deliverables for the current proposed year: Provide a range of processing conditions for inducing AGG. Generate local strain, strain rates, and temperatures within the specimen by finite element analysis (FEA). Develop a mechanistic theory describing the microstructural conditions that create AGG.

How the project may be transformative and/or benefit society: Provide a range of processing conditions for inducing AGG in RR1000. Provide a mechanistic understanding of AGG in nickel-based superalloys, which can aid in preventing occurrence in industrial processing.

Research areas of expertise needed for project success: Thermo-mechanical processing, finite element analysis, electron microscopy.

Potential Member Company Benefits: Understand the phenomena of AGG to improve processing and product quality for aerospace applications.

Progress to Date: Determined processing parameters to create AGG. Proposed hypothesis supported by previous literature and results in present study.

Estimated Start Date: Fall 2017	**Estimated Knowledge Transfer Date**: Fall 2020

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.**