I/UCRC Executive Summary - Project Synopsis	**Date**: October 2019

Center/Site: CANFSA/Colorado School of Mines

Tracking No.: 34: In-situ Observation of 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**: $ 240,000

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® b3500 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. Finally, perform in-situ high-energy diffraction microscopy (HEDM) of AGG at a synchrotron source.

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: The progress of a grain neighborhood that evolves into AGG during forging and supersolvus treatment will be observed in-situ with HEDM, complemented by ex-situ studies of microstructure evolution associated with thermos-mechanical processing.

Milestones for the current proposed year: Thermomechanical processing and heat treating to consistently produce AGG. Interrupted heat treatments of a constant area to track progression of AGG. Performed computer simulations to explore the possible role of preferred precipitate dissolution in AGG.

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. Provide local strain, strain rates, and temperatures within the specimen by FEA.

Research areas of expertise needed for project success: Thermo-mechanical processing, finite element analysis, electron microscopy, high-energy synchrotron x-ray analyses.

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

Progress to Date: Initial literature review, as-received material characterization and thermo-mechanical processing to create AGG. Microstructural analysis of post-deformation material is underway.

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