I/UCRC Executive Summary - Project Synopsis	**Date**: March 24, 2018

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@mymail.mines.edu

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

Project Description: Abnormal grain growth 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 abnormal grain growth is yet to be established. The goal of this project is to better the understanding abnormal grain growth and help provide routes to avoid the phenomena.

Experimental plan: Perform thermomechanical processing in the Gleeble 3500 to create abnormal grain growth in a controlled manner. Utilize TEM and SEM-EBSD for ex-situ material characterization at various steps along the processing route. Finally, perform in-situ HEDM of abnormal grain growth occurring while in a synchrotron source.

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

How this project is different: The progress of a grain neighborhood that evolves into abnormal grain growth during the forging and supersolvus treatment will be observed in-situ with HEDM.

Milestones for the current proposed year: The first year will focus on creating repeatable conditions for abnormal grain growth in addition to performing ex-situ measurements on the microstructure. Ex-situ measurements will include information regarding the state of the relevant phases, both before and after heat treating.

Deliverables for the current proposed year: Provide a range of processing conditions for inducing abnormal grain growth. Provide local strain, strain rates, and temperatures within the specimen by FEA.

How the project may be transformative and/or benefit society: Increasing the reliability of turbine discs is of interest to the commercial and military aviation industry.

Research areas of expertise needed for project success: Thermomechanical processing, finite element analysis, electron microscopy, high-energy synchrotron source testing and data analysis.

Potential Member Company Benefits: Understand the phenomena of abnormal grain growth to better process the material in a manner to avoid the issue. This will provide the aerospace industry with higher quality material.

Progress to Date: Initial literature review, material characterization and thermomechanical processing has been performed. In the process of repeating forging conditions to create abnormal grain growth.

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