I/UCRC Executive Summary - Project Synopsis	**Date**: October 2, 2018

Center/Site: CANFSA/Colorado School of Mines

Tracking No.: 14: Measurement and Modeling of Anisotropy in Ti-6Al-4V Forgings	**Phone :** (303) 273-3770	**E-mail : concampb@mymail.mines.edu**

Center/Site Director: CANFSA/M. Kaufman/P. Collins/A. Clarke	**Type: Continuing**
Project Leader: Connor Campbell	**Proposed Budget**: $240,000

Project Description: Outliers caused by microstructural inhomogeneities are found throughout the titanium forging industry. Industrial thermomechanical processes are designed to suppress these inhomogeneities, but the inherent anisotropy of alpha/beta titanium alloys– particularly the lamellar microstructure produced by cooling from above the beta transus– makes these structures difficult to homogeneously deform in a reliable fashion. Soft-oriented colonies can provide a path for shear to localize, complicating the breakdown process intended to produce a uniform microstructure. This project seeks to deform and characterize Ti-6Al-4V samples comprised of large alpha colonies to observe how they interact during deformation, observing how grain size, shape, and orientation evolve in regions that have undergone geometric dynamic recrystallization, as well as the conditions under which these regions form.

Experimental plan: Isothermal uniaxial compression of samples will be performed, and the deformed microstructures will be characterized via electron backscatter diffraction to observe the change in grain size distribution and crystallographic texture in regions that have recrystallized.

Related work elsewhere: A significant volume of research has been conducted on heterogeneous deformation in alpha/beta Ti alloys by aerospace alloy and component manufacturers to improve processes to produce homogeneous microstructures with predictable properties and high inspectability.

How this project is different: Prior work has not quantified the volume fraction of these dynamically recrystallized regions, or the grain size and texture evolution therein. These factors impact mechanical and fatigue properties, and the formation of defects during subsequent processing.

Milestones for the current proposed year: Complete characterization of the deformed microstructures, analysis of local strains, and correlation of the degree and extent of recrystallization to local strain.

Deliverables for the current proposed year: Dataset containing grain size distributions, texture changes, and volume fractions of recrystallized regions in alpha colonies deformed at various temperatures and deformation conditions..

How the project may be transformative and/or benefit society: Knowledge of how microstructural heterogeneities form will allow for production to be optimized to avoid them, increasing performance of titanium products and reducing probability of rejection due to microstructural inhomogeneity.

Research areas of expertise needed for project success: Metallurgy of alpha/beta titanium alloys, industrial forging practices, electron microscopy, orientation imaging analysis, finite element analysis

Potential Member Company Benefits: Enhanced understanding of conditions that lead to microstructural heterogeneity may provide insight into how to avoid it, increasing mechanical and fatigue response, as well as ultrasonic inspectability.

Progress to Date: Compression experiments have been completed, and multiple samples have been characterized. Initial orientation maps have shown alpha colonies deforming heterogeneously, and colonies in various states of geometric dynamic recrystallization.

Estimated Start Date: Spring 2016	**Estimated Knowledge Transfer Date**: May 2019

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.**