I/UCRC Executive Summary - Project Synopsis	**Date**: April 3, 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: 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 all throughout the titanium forging industry. Simulations of texture resulting from hot forming processes have been able to qualitatively predict resultant texture but usually under- or overestimate intensity while sometimes missing texture features entirely. This can be partially attributed to phase transformation and variant selection, the models for which have not been thoroughly tested. While they are consistent with the results of their respective papers, there is still room for improvement. This project seeks to build the effects of phase transformation into an industrially-relevant software package to make strides towards predicting localized microstructural inhomogeneities.

Experimental plan: First, a benchmark experiment from literature will be replicated to assess the viability of the current models. Then, an alternative forming process will be modeled to extend the capability of the model. The role of variant selection will be assessed and the accuracy of different selection schemes will be determined.

Related work elsewhere: Process simulation has a prominent role in industrial research, but phenomena such as variant selection occur at a length-scale well below what is often considered by such simulations. AFRL has put forth a significant amount of work into understanding microstructural evolution of Ti-6Al-4V.

How this project is different: Through collaboration with AFRL, SFTC, and industry, this project seeks a computationally inexpensive means to identify highly textured regions by means simple enough to be carried out by a process engineer.

Milestones for the current proposed year:
Systematic analysis of microstructural evolution during TMP of TI-6Al-4V to decide applicability of models
Benchmark simulation to verify validity of current implementation of crystal plasticity models

Deliverables for the current proposed year:
Simulation outputs from DEFORM that assess accuracy of current models relative to selected experiments

How the project may be transformative and/or benefit society: Knowledge of how these outliers form will allow production to be optimized to avoid them, increasing performance of titanium producers. Additionally, performing these calculations in widely-used software lowers the barrier to entry significantly.

Research areas of expertise needed for project success: Titanium metallurgy, industrial forging practices, finite element analysis, polycrystal plasticity calculations, and subroutine development

Potential Member Company Benefits: Increased production yield through knowledge of how and where regions of texture are going to form. Less ultrasonic noise during nondestructive inspection from textural anomalies.

Progress to Date: The benchmark simulation has been completed but more work needs to be done in order to remove several simplifying assumptions that are impeding the predictive capabilities of the models. Codes have been offered that will provide insight into the modeling of variant selection.

Estimated Start Date: Spring 2016	**Estimated Knowledge Transfer Date**: Fall 2020