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

Center/Site: CANFSA/Colorado School of Mines

Tracking No.: 26-L Deformation Mechanisms in Refractory-Based Complex Concentrated Alloy	**Phone :** (303) 273 - 3770	**E-mail :** fcoury@mymail.mines.edu

Center/Site Director: M. Kaufman/P. Collins/A. Clarke	**Type: (Continuing)**
Project Leader: Francisco Coury	**Proposed Budget**: $100,000 Partially Leveraged

Project Description: High Entropy Alloys (HEAs), or Complex Concentrated Alloys (CCAs)are new classes of structural metallic materials that show remarkable property combinations. Yet, the most interesting compositions reported so far have been found by trial and error. In this work, high-throughput methodologies for predicting strength and ductility of refractory CCAs (RCCAs) are being developed. Several alloys were produced, and the capability of different models for predicting strength were tested. The production of some new, targeted compositions is attempted based on the combined experimental and modeling results.

Experimental plan: Multi-scale microstructural characterization, thermodynamic simulations, and mechanical testing coupled with strength and plasticity modelling.

Related work elsewhere: There are attempts in the literature to explain the strength of CCAs by atomic size mismatch. Also, there are two models available in the literature for predicting solid solution strengthening of HEAs, which are implemented and tested in this work.

How this project is different: A large dataset of mechanical properties (hardness, compression and tension) will be obtained from a series of RCCAs - samples will be tested at different temperatures to extract the thermal and athermal components of the deformation behavior.

Milestones for the current proposed year: Perform the mechanical testing of all the RCCAs produced in this project. Implement and, if needed, modify the strength and ductility prediction models to better represent the experimental behavior of RCCAs.

Deliverables for the current proposed year: The stress-strain curves for the different RCCAs produced in this project will be obtained. Values for the thermally activated and athermal deformation parameters that describe these alloys and how they compare with conventional materials will also be obtained.

How the project may be transformative and/or benefit society: Having a better understanding of how to control strength and ductility in RCCAs will allow for improved alloy and process design to manufacture metallic alloys with higher specific strengths for aerospace applications, leading to better fuel efficiency.

Research areas of expertise needed for project success: Computational thermodynamics, scanning and transmission electron microscopy, x-ray diffraction, mechanical testing, deformation and plasticity modeling of solid solution strengthening, materials processing.

Potential Member Company Benefits: Improved ability to down-select promising RCCAs for manufacturing that will have desirable mechanical properties compared to conventional refractory alloys.

Progress to Date: The microstructural characterization of the RCCAs produced in this work has been completed. The mechanical testing and strength modeling is underway.

Estimated Start Date: Summer 2016	**Estimated Knowledge Transfer Date**: Summer 2018