I/UCRC Executive Summary - Project Synopsis	**Date**: September 11th 2018

Center/Site: CANFSA/Colorado School of Mines

Tracking No.: 26: Deformation Mechanisms in Refractory-Based Complex Concentrated Alloy	**Phone :** (303) 273-3770	**E-mail : fgcoury@hotmail.com**

Center/Site Director: CANFSA/M. Kaufman/P. Collins/A. Clarke	**Type: Completed**
Project Leader: Francisco Gil 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 developed. Several alloys were produced, and the capability of different models for predicting strength were tested. The production of some new, targeted compositions was performed, based on 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 CCAs, which are implemented and tested in this work.

How this project is different: A large dataset of mechanical properties (hardness, compression and tension) was obtained from a series of refractory CCAs, or RCCAs. Samples were 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: Model for solid solution strengthening successfully applied to experimental stress-strain data for RCCAs and FCC HEAs.

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 lightweighting, better fuel efficiency, and performance in extreme environments.

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: Project Finished

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

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.**