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

Center/Site: CANFSA/Colorado School of Mines

Tracking No.: 32 Development of Cabinet Based Computed Tomography Methods for Studies of Microstructures and Defects in Metals	**Phone :** (720) 363-3626	**E-mail :** chbecker@mines.edu

Center/Site Director: M. Kaufman/P. Collins/A. Clarke	**Type: (Continuing)**
Project Leader: Chandler "Gus" Becker	**Proposed Budget**: $240,000, Leveraged

Project Description: X-ray radiography and computed tomography (CT) will be used to characterize microstructures and defects and the links to materials processing and properties. The focus will be on learning and establishing high-energy x-ray radiography and CT in the laboratory at Mines, and the limitations of this technique for "seeing" microstructural characteristics of interest, such as defects produced by additive manufacturing. The ability to use this technique to study materials dynamics (e.g. during processing) will also be explored. Comparisons will be made to other imaging techniques, such as synchrotron x-ray, proton, and electron imaging. The techniques used in processing and reconstructing radiography data will be evaluated and the data obtained in this project will be used to inform and develop materials process models when appropriate.

Experimental plan: Processing and analyzing of data from previous in-situ radiography experiments is underway, which will be followed by performing experiments with AET-6 at LANL to gain familiarity with radiography and computed tomography. In the proposed project, this knowledge and these skills will be used to set up a laboratory capability for in-situ experiments at Mines.

Related work elsewhere: Experiments will be carried out at AET-6 at LANL and at APS at ANL. Similar experiments at CSM are an ultimate goal of this project. Comparisons with proton imaging may also be performed.

How this project is different: This project seeks to further develop x-ray radiography techniques by establishing state-of-the-art micro-focus x-ray imaging capabilities at Mines. Further understanding of microstructural and defect evolution related to solidification is also an interest in this project.

Milestones for the current proposed year: In the upcoming year, x-ray image processing will continue and processing techniques will be improved. More radiography data from existing radiography experiments will be uploaded to the CSM server for processing. Image analysis of processed radiographs will begin with interesting and important features identified. The x-ray cabinet has been donated by LANL, and procurement is underway to fit the cabinet with the necessary hardware for ultimate delivery to Mines.

Deliverables for the current proposed year: Deliverables for the current year include further image processing of available synchrotron x-ray and laboratory x-ray radiography data to continue developing and improving the methods needed for future experiments. Training at LANL in laboratory x-ray radiography and computed tomography is scheduled to begin next semester.

How the project may be transformative and/or benefit society: This project will enable the imaging of dynamic materials processes in the laboratory, without the need to always go to a synchrotron source at a national user facility. Laboratory x-ray imaging and computed tomography will also be useful for static imaging of metal parts to check for quality and potential defects.

Research areas of expertise needed for project success: Radiography, metallurgy, materials science, physics, materials processing, image analysis

Potential Member Company Benefits: This project is of direct interest to LANL, but non-destructive evaluation is also of interest to CANFSA's aerospace members that need to qualify and certify parts and identify performance-limiting defects.

Progress to Date: Literature review. Radiography data from previous experiments have been uploaded to the Mines server for campus access to authorized users. Scripting with ImageJ to process large datasets of radiography data in an efficient manner is being performed.

Estimated Start Date: Fall 2017	**Estimated Knowledge Transfer Date**: Spring 2021

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.**