I/UCRC Executive Summary - Project Synopsis	**Date**: October 2020
Center/Site: CANFSA/Iowa State University	
Tracking No.: Project 36b-L: Rationalization of Liquid/Solid and Solid/Solid Interface Instabilities During Thermal-Mechanical Transients of Metal Additive Manufacturing	**E-mail :** pcollins@iastate.edu **Phone :** (515) 294 - 5127
Center/Site Director: CANFSA/M. Kaufman/P. Collins/A. Clarke	**Type: (Continuing)**
Project Leader: Peter Collins	**Proposed Budget**: N/A
Project Description: The length and time scales in additive manufacturing, as compared to other manufacturing techniques such as welding, casting, powder metallurgy, etc., create unique relationships between the resulting thermal gradients and microstructure. The goal of this project is to understand the science behind the relation between thermal gradients in AM builds, as a function of different scan strategies, and the microstructure and texture evolution, using Ti-6Al-4V and Inconel 738.	
Experimental plan: Ti-6Al-4V and Inconel 738 samples were made using a powder bed, electron beam, additive manufacturing system, using 3 different scanning strategies (raster, dehoff and random). ISU has been working on the characterization of these samples across different length scales (using equipment such as a serial sectioning robotic arm in conjunction with an optical microscope, SEM, TEM and SRAS). The latest observations have been about different types of pores and defects present in the titanium samples and how they influence the texture and grain growth, as well as being stress concentrators.	
Related work elsewhere: The majority of previous work has been focused on changing build parameters to improve individual build operations without a basic science study on the effects of AM on microstructural development.	
How this project is different: The MURI project is focused on understanding and expanding the basic science and phenomena through the thermomechanical gyrations materials experience during the AM processes.	
Milestones for the current proposed year: Comprehensive understanding of lack of fusion defects and spherical pores in both formation and behavior when present in AM parts. Characterization and comparison of Inconel 738 samples with "printed" defects in precise locations.	
Deliverables for the current proposed year: 2-3 papers on different observations of defects in Ti-6Al-4V. At least one draft paper on Inconel 738.	
How the project may be transformative and/or benefit society: Optimization of the final cost and mechanical properties of AM components as well as reducing the trial and error phase of AM design and manufacture curve. Fill in knowledge gaps in AM.	
Research areas of expertise needed for project success: Microstructural characterization. Understanding of composition-microstructure-property relationships. Ability to analyze texture. Phase transformation behavior during solidification. Sources of defects in AM builds.	
Potential Member Company Benefits: Deeper understanding of AM processes.	
Progress to Date: ISU team has work on characterization (2D and 3D) that is now being translated into papers. One paper has already being accepted in the Metallurgical and Materials Transactions A journal, and another one will be submitted for publication next week.	
Estimated Start Date: Fall 2018	**Estimated Knowledge Transfer Date**: Fall 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.**