I/UCRC Executive Summary - Project Synopsis	**Date**: April 2022
Center/Site: CANFSA/Colorado School of Mines	
Tracking No.:63-L: Experimentally Validating Phase Field Modeling of Dilute Al-Cu Alloys with Oxides Particles Present	**E-mail :** shunt1@mines.edu **Phone :** (248) 685–0900
Center/Site Director: CANFSA/M. Kaufman/P. Collins/A. Clarke	**Type: (Continuing)**
Project Leader: Spencer Hunt	**Proposed Budget**: $160,000 (Leveraged)
Project Description: Solidification and microstructure development during metal casting processes are affected by oxide inclusions and bi-films. We will perform controlled aluminum (Al-Cu) solidification experiments with intentionally varied oxide (and bi-film) distributions and characterize the effects on solidification and microstructure evolution. In parallel, molecular dynamics (MD) and quantitative phase-field modeling (PF) simulations will be performed to model oxide bi-film interactions in dilute Al-Cu alloys, validated with experimental outcomes.	
Experimental plan: Accumulative roll bonding (ARB) will be used to introduce controlled oxide distributions into Al-Cu sheets. Laser track melting, followed by characterization with electron-microscopy, will be used to better understand the interaction of oxides with the solidifying material. Future experiments may involve in-situ radiography of solidification using a newly installed x-ray cabinet at Mines.	
Related work elsewhere: Oxides can impact Al alloy solidification and produce deleterious mechanical properties. Further investigation is required to gain a basic understanding of oxide-melt interactions during solidification processing.	
How this project is different: This project implements both controlled experimentation and MD/PF simulations to better understand the interaction of oxides with solidifying Al alloys.	
Milestones for the current proposed year: Material has been rolled up to two ARB cycles. Laser track melts have been performed on 0, 1, and 2 ARB cycle material, along with characterization using SEM. Material for the project has been acquired. Basic imaging on test material using the x-ray cabinet has been performed.	
Deliverables for the current proposed year: Successfully roll material up to 8 ARB cycles to create various oxide dispersions. Using laser track melting, produce melt pools that are consistent and document the role of oxides on solidification structures. Begin building a furnace set-up for in-situ solidification radiography in the x-ray cabinet.	
How the project may be transformative and/or benefit society: This project will bring new understanding to the important role oxides play on solidifying microstructures in aluminum alloys, relevant to casting, directional solidification, and additive manufacturing.	
Research areas of expertise needed for project success: X-ray imaging and analysis. Laser track melting and solidification with various parameters used to inform the modeling. Rolling mill for ARB. Electron microscopy for microstructure characterization.	
Potential Member Company Benefits: A better understanding of how oxides interact with the solidification structures can be used to help improve Al casting quality and minimize defects.	
Progress to Date: Material has been rolled up to two ARB cycles. Laser track melts have been performed on 0, 1, and 2 ARB cycle material, along with characterization using SEM. Al-Cu and pure Al model alloys for the project has been acquired. Basic imaging on test material using the x-ray cabinet has been performed.	
Estimated Start Date: Fall 2021	**Estimated Knowledge Transfer Date**: Fall 2023

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.**