I/UCRC Executive Summary - Project Synopsis	**Date**: April 2022
Center/Site: CANFSA/Colorado School of Mines	
Tracking No.:57: Aluminum for H_2 Service	**E-mail :** afreund@mines.edu
	Phone : (805) 231 - 6036
Center/Site Director: CANFSA/S. Mathaudhu/K. Clarke/A. Clarke	**Type: (Continuing)**
Project Leader: Adam Freund	**Proposed Budget**: $240,000 CANFSA and Leveraged
Project Description: Hydrogen embrittlement afflicts aluminum, reducing mechanical properties and part lifetime. A fundamental understanding of this phenomenon is not completely understood and gaining greater insight into its workings can help to enhance resistance and improve capabilities.	
Experimental plan: Cast and wrought aluminum will be compared before hydrogen charging has been performed to create a baseline. This will be accomplished through mechanical testing (consisting of slow strain rate and cyclic fatigue testing) and microstructural characterization (consisting of EBSD, EDS, SEM, and XRD). Samples will then be subjected to hydrogen charging of various lengths of time to elicit hydrogen embrittlement effects. Samples will then be tested to explore the effects of embrittlement.	
Related work elsewhere: Previous studies have investigated hydrogen embrittlement pathways, both through experimentation and simulation, to isolate the primary embrittlement pathways. Further research has been conducted to ascertain the effects of aging on hydrogen susceptibility as well as the role of hydrogen embrittlement on fatigue.	
How this project is different: Few studies have examined the effects of hydrogen embrittlement on nearly pure aluminum in as-cast and plastically deformed material. This extends to severely plastically deformed aluminum to investigate the fundamental effects of embrittlement due to hydrogen and the pathways it takes when dislocation density is incredibly high.	
Milestones for the current proposed year: Further literature review; Optimize hydrogen charging method, cyclic fatigue and slow strain rate testing apparatuses; Start baseline experiments of wrought and cast aluminum.	
Deliverables for the current proposed year: Microstructural characterization and mechanical testing of baseline samples; Investigation of hydrogen embrittlement effects as a function of charging time and amplitude on both wrought and cast samples.	
How the project may be transformative and/or benefit society: Increased knowledge of hydrogen embrittlement of aluminum alloys can improve hydrogen susceptibility and mechanical properties, ultimately increase part lifetime and capabilities.	
Research areas of expertise needed for project success: Access to a hydrogen charging apparatus, load frame, cyclic fatigue tester, SEM, EBSD, EDS, XRD, and thermal desorption spectroscopy via HNO analyzer.	
Potential Member Company Benefits: Enhanced understanding of hydrogen embrittlement in the scope of wrought and cast aluminum alloys.	
Progress to Date: Gaps in knowledge base concerning aluminum alloys and hydrogen embrittlement have been identified. An experimental setup has been chosen and detailed that will allow for hydrogen charging and mechanical testing. Microstructural characterization techniques have been selected and sample alloys have been chosen and sourced.	
Estimated Start Date: Fall 2021	**Estimated Knowledge Transfer Date**: Spring 2025

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.**