I/UCRC Executive Summary - Project Synopsis	**Date**: April 3, 2018

Center/Site: CANFSA

TRACKING NO.: 17 Development of Advanced Nickel-Titanium-Hafnium Alloys for Tribology Applications	**Phone:** (614)313-3371	**E-mail :** seanmills@mines.edu

Center/Site Director: Dr. Michael Kaufman	**Type:** Continuing
Project Leader: Sean Mills	**Proposed Budget**: $240,000

Project Description: This project is designed to elucidate the effect of hafnium ternary alloying on the physical metallurgy and bearing element performance of superelastic Ni-Ti alloys. The overall benefits to hafnium alloying are in controlling the transformation kinetics which can reduce the residual stresses while retaining high strengths and hardnesses of quenched binary Ni-Ti alloys.

Experimental plan: This multimodal study will include rolling contact fatigue characterization, residual stress and hardness calculation and time/temperature/transformation study of NiTiHf alloy. Alloy optimization will be achieved by varying nickel and hafnium contents between 1-8at.%.

Related work elsewhere: NASA Glenn Research Center, NiTiHf alloy development for shape memory actuation and superelastic applications.

How this project is different: Higher nickel content alloy study optimizes the content and processing to increase the compressive/torsional toughness of the material. The alloy can be optimized specifically for tooling and wear-limited applications.

Milestones for the current proposed year: Nanoscale microstructure characterization of NiTiHf alloys. Continued rolling contact fatigue experimentation.

Deliverables for the current proposed year: Review paper of NiTi alloys for tribology applications. Acta Mat paper on NiTiHf alloy microstructure development for tribology.

How the project may be transformative and/or benefit society: Optimize alloys for rotary bearings in the International Space Station. Space-age applications can have a long-term impact on many other industries.

Research areas of expertise needed for project success: Fatigue and fracture, phase transformations, strengthening mechanisms, failure analysis.

Potential Member Company Benefits: Greater understanding of the NiTiHf system. This type of study may impact the method used in studying other alloy systems.

Progress to Date: Rolling contact fatigue experimentation, microstructure characterization, failure analysis, understanding phase transformations.

Estimated Start Date: Fall 2015	**Estimated Knowledge Transfer Date**: Summer 2019