

Shape Memory Alloy Material Maturation (SMA)

Active Technology Project (2023 - 2027)



Project Description

The Shape Memory Alloy (SMA) project will evaluate, process, and refine 3 SMA materials that have the potential to provide the properties needed to enable various technologies for human exploration missions on the Moon and Mars. The work will focus on the development and identification of a new SMA alloy targeted at enabling compliant rover tires capable of the extreme demands (high loads, faster drive speeds, extreme cold temperatures and exceedingly long mission durations). The necessary work will include the development of key material testing capabilities that will enable material properties development from 40K – 400K for all properties needed to qualify space flight hardware (Tensile, Fatigue/Durability, etc.). The SMA wire properties will be input into a database and model, ultimately to disseminate material property design data (for 1 alloy only) as parameters for finite element modeling of a tire structure.

Specific tasks include:

- Task 1: Perform **Wire Process Evaluation** to optimize the process route for the three (3) pre-selected, proprietary SMA alloys. The optimization will be performed with Fort Wayne Metals, a proven metal wire supplier with the selected proprietary alloys.
- Task 2: Establish **40-400K Wire Characterization Rigs and Thermal Vacuum Chambers (TVACs)** to perform tensile and bend testing to iteratively evaluate the performance of the complex metal working/processing space.
- Task 3: Develop a **Wire Properties Database and Model** that converts raw mechanical property data into design data as parameters for finite element modeling of a tire structure. The database is used to identify appropriate alloy(s) and processing route(s) based on properties as function of temperature.
- Task 4: Perform **Form Process Evaluation** to assess the alloys' characteristics as used in complex shapes.

Potential applicability: LTV and PR

Anticipated Benefits

The end goal is to identify a material that has the potential to be commercially manufactured and purchased as Commercial Off-the-Shelf (COTS) hardware with well established properties. This will afford future hardware providers commercially available materials options, properties databases, and SMA modeling framework that can be leveraged to meet the challenging demands of designing hardware for numerous ARTEMIS programs on the Moon and future missions to Mars. The project will also establish key material testing capabilities that will enable material properties development from 40K – 400K for all properties needed to qualify space flight hardware (Tensile, Fatigue/Durability, Wear, etc.).



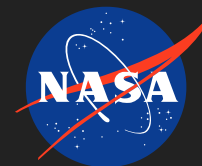
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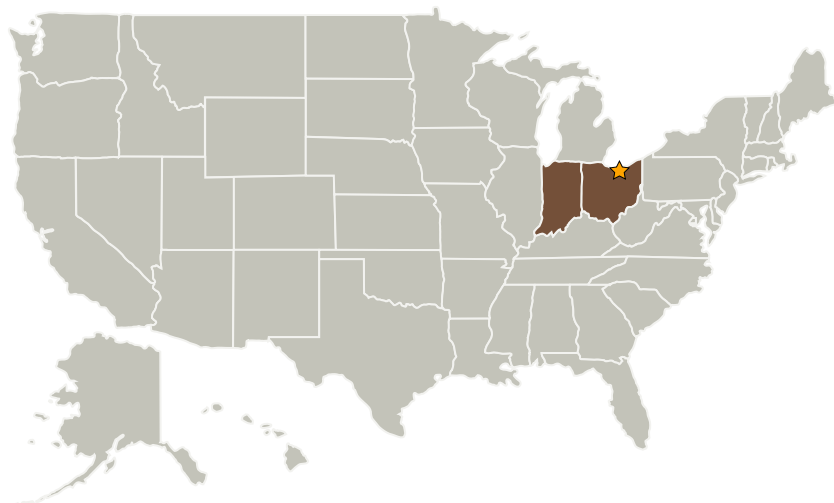
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
Fort Wayne Metals Research Products Corp	Supporting Organization	Industry	Fort Wayne, Indiana

Co-Funding Partners	Type	Location
xEVA and Human Surface Mobility	NASA Program	

Primary U.S. Work Locations	
Indiana	Ohio

Organizational Responsibility

Responsible Mission Directorate:

Exploration Systems Development Mission Directorate (ESDMD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

EVA and Human Surface Mobility

Project Management

Project Manager:

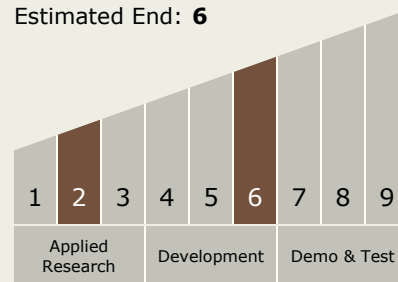
Andrea Marchica

Principal Investigator:

Santo Padula

Technology Maturity (TRL)

Start: **2**
Estimated End: **6**



Technology Areas

Primary:

Continued on following page.



Technology Areas (cont.)

- TX04 Robotic Systems
 - └ TX04.2 Mobility
 - └ TX04.2.4 Surface Mobility

Target Destinations

Mars, Moon and Cislunar

Views on TechPort

25 views