

(MAGMA) Molten Aluminum Generation for Manufacturing Additively

Colorado School of Mines

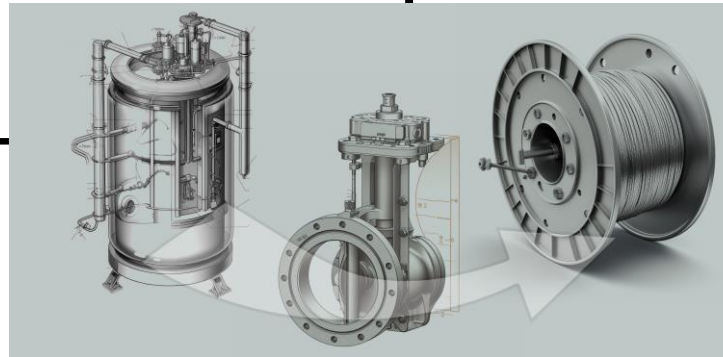
- Dr. Kevin Cannon – project lead
- Drs. Craig Brice (additive manufacturing), Chris Dreyer (tap system design), Zhenzhen Yu and Jihye Kim (metallurgy computational modeling), Geoff Brenneka (ceramics & materials compatibility)

Lunar Resources, Inc.

- Industry Partner led by Dr. Alex Ignatiev

Development Objectives

- Develop tap system and quench wheel to produce aluminum wire feedstock using Molten Regolith Electrolysis.
- Challenges: extreme temperatures, corrosion, repeated metal extraction.
- SOA is core MRE reactor tests in ambient conditions; we will advance to end-to-end aluminum wire production in vacuum.
- Starting TRL for tap system: 3 (concept modeled with small-scale demo).
 - End TRL: 6 (integrated tests in vacuum).



MAGMA will use MRE (left) with a novel tapping system (center) to repeatedly produce aluminum wire (right) as an AM feedstock.

Approach

- CSM designs and tests novel tapping system.
- Integrate with LR's MRE reactor and quench wheel; demonstrate end-to-end production of aluminum wire from regolith simulant.
- Wire evaluated as AM feedstock at CSM.
- V&V: chemistry, phase assemblage for all solid reactants and products. Aluminum wire: production rate, thickness, purity, microstructure, 3D map of defects (XCT).

Impact and Infusion

- Speeds transition from ilmenite-based techniques to highlands compositions for Artemis polar landings.
- Infusion into near-term CLPS demonstrations ultimately scaling to pilot plant operations.
- Other by-product resources: oxygen, iron silicide can be processed to steel and solar PV parts; green steel applications for Earth.