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Systems and Infrastructures to Implement Sustainable Space Development and Settlement - Technologies
(2B)

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ORBITAL, LUNAR AND PLANETARY INFRASTRUCTURE FOR METAL PROCESSING:
ENABLING THE INDUSTRIAL REVOLUTION IN SPACE

Abstract

Industrial revolutions in the past have been driven by in situ resource utilization, in particular metals. In orbit, metal from defunct spacecrafts could be the first space-derived, in situ resource available. On the lunar or planetary surfaces, metal is one of the waste products when extracting other resources, such as water and oxygen from regolith. Processing metal into a useful form opens up the possibility to reuse it for in-space manufacturing. However, very few companies are researching effective ways to produce intermediate metal feedstock for in-space manufacturing from in-space resources.

This work summarizes the findings of the authors in two consecutive NASA SBIR projects building metal processing capabilities for space. A metal processing system for micro gravity has been developed, called the Modular Space Foundry (MSF), that melts aluminum feedstock using electromagnetic induction and forms the molten metal through continuous casting. The resulting product of this melting process is an aluminum rod which can be used as feedstock for construction or as solid metal propellant for metal based electric propulsion systems (such as vacuum arc thrusters). The system has been recently demonstrated on a parabolic flight and is now being advanced to fly on a demonstration mission on the ISS in 2024.

In-space metal processing is a critical link in the emerging cislunar industrial value chain. Advancing this Modular Space Foundry technology will enable the industrial space economy to reach its full potential and lead to a sustainable human presence beyond Earth.