17th IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Systems and Infrastructures to Implement Sustainable Space Development and Settlement - Technologies (2B)

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NASA'S IN-SPACE MANUFACTURING PROJECT: UPDATE ON MANUFACTURING TECHNOLOGIES AND MATERIALS TO ENABLE MORE SUSTAINABLE AND SAFER EXPLORATION

Abstract

NASA's in-space manufacturing (ISM) project seeks to develop the materials, processes, and manufacturing technologies needed to provide an on-demand manufacturing capability for deep space exploration missions. The ability to manufacture and recycle some parts on demand rather than launch them from earth has the potential to reduce logistics requirements on long duration missions and enhance crew safety. With the launch of the first 3D printer (built and operated by Made in Space through a Small Business Innovative Research – SBIR – contract) to the International Space Station (ISS) in 2014, the ISM project demonstrated the feasibility of operating an on-demand manufacturing system in a microgravity environment. This paper will provide an update on recent advancements in ISM under three key technology areas: manufacturing, recycling, and development of a design database. ISM continues to pursue development of manufacturing technologies for space applications and use the ISS as a critical test bed to prove out these technologies before deploying them on next generation exploration systems. Activities under this

focus area include: characterization of materials manufactured using the Additive Manufacturing Facility (AMF), the second generation commercial 3D-printer on ISS, also owned and operated by Made in Space; development of prototype payloads for metal manufacturing through phase II SBIR contracts with Tethers Unlimited, Made in Space, and Ultra Tech Machinery; development of a rack-sized multimaterial fabrication laboratory capable of processing metals and providing inspection of manufactured parts through a Broad Agency Announcement (Techshot, Interlog, and Tethers Unlimited); an in-line sensing system for ISM platforms; and development of higher strength feedstocks for 3D polymer printers. In the area of recycling, the Tethers Unlimited ReFabricator payload (an integrated 3D printer and recycler for ULTEM 9085) launched to ISS in November 2018 and began operating in January 2019. This payload represents the first demonstration of on-orbit recycling; downmassed specimens will assess material degradation in the polymer over multiple recycling cycles to define limits on material re-use. Other work in the recycling area includes development of common use materials intended to be reused and recycled on space missions (Tethers Unlimited and Cornerstone Research Group) and a sterilization capability for multiple-use materials (ERASMUS from Tethers Unlimited). Concurrent with manufacturing technology and materials development work is creation of a design database, a curated list of parts that can be manufactured using the suite of in-space manufacturing capabilities.