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Advancements in Materials Applications, Additive Manufacturing, and Rapid Prototyping Manufacturing and Rapid Prototyping (8)

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GATEWAY EARTH ISRU: MANUFACTURING MECHANICAL MODULES ON THE MOON

Abstract

The Seventh Step in the Gateway Earth's deep space access architecture (Vidmar and Webber, 2017) is in-situ resource utilisation (ISRU) at lunar and planetary destinations within our Solar System. This is to enable easier mission return as well as uplift of material or manufacture of required (spare) parts and components which can be made out of local minerals. Doing so would enable Gateway Earth to reduce required supply of raw material from the Earth and thus keep to a lower energy budget for its resupply missions. A number of research projects have reported on the viability of use of lunar regolith for additive manufacturing. It has been shown that using powder bed fusion (PBF) techniques, rigid material can be produced, though so far this was limited to simply examining fixing regolith to avoid dust scattering (Ginés-Palomares et al., 2023) or developing very basic solid geometry (Popovich et al., 2020; Goulas, Harris and Friel, 2016). Some mechanical testing and surface analysis has also been carried out, demonstrating structural viability of manufactured objects (Goulas et al. 2019). Following advances in laser processing of ceramic material for earth-based applications (e.g., Gopal et al., 2023), we explore the possibility of ISRU manufacturing functional mechanical components using the lunar regolith. We document the viability of 3D printing basic modules and testing their functional integrity as well as assessing their viability as useful mechanical components. Based on our preliminary results, we discuss options for future targeted work on optimising the process and functional characteristics of both the material as well as the manufactured parts.