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LUNAR REGOLITH MELTING ANALYSIS UNDER DIFFERENT WORKING ATMOSPHERES

Abstract

Utilizing resources in situ (ISRU) stands out as a crucial strategy for fostering sustainability in lunar exploration, with the goal of minimizing dependence on resources from Earth. The ISRU approach supports on-site manufacturing using different technologies, ranging from making relatively small objects such as spare parts to mega-scale objects such as habitats and roads. To enable these purposes, various manufacturing technologies, such as Additive Manufacturing (AM), have been introduced. Using AM, different shaping methods, including lasers and solar light heat, have been tested to demonstrate the feasibility of lunar fabrication via regolith melting. To comprehend and optimize these AM methods for lunar application, a comprehensive analysis of lunar regolith simulant under lunar conditions is essential. However, reported regolith analyses have predominantly focused on melting under ambient or inert gas atmospheres. Therefore, this study concentrates on analyzing the melting behavior of the EAC-1 simulant under vacuum conditions and compares it to conditions under an argon gas and ambient atmospheres. Various simulants, including EAC-1, JSC, and LHS, have been studied by Differential Thermal Analysis (DTA). The glass transition (Tg), melting and crystallization peaks of each simulant under different atmospheres are identified. Furthermore, the DTA results are compared with published results of different simulants' melting behavior analyzed using the Hot Stage Microscopy (HSM) method and aligned with experimentally derived and calculated viscosity fix points.