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SLM ADDITIVE MANUFACTURING AND SINTERING OF A LUNAR REGOLITH ANALOG

Abstract

These last years, a renewed interest has emerged from major space agencies for space human exploration, with a focus on the permanent presence on the moon. This new approach supposes the astronauts to be as autonomous as possible. There is a real need for ISRU (In Situ Resource Utilization) based technologies development fulfilling their different requirements such as oxygen or metallic alloys production from the regolith, or in situ manufacturing of objects, tools repairing of first necessity. Given its flexibility and potential, additive manufacturing is one of the most considered solutions for lunar regolith use of making objects at different scales, from millimetric high thermo-mechanic performance pieces to metric parts of habitat shielding walls [1, 2, 3]. Processing routes based on sintering of lunar regolith simulants is another important topics in the field of ISRU [4,5]. This communication will consider results linked to the activities of the ISRU taskforce in Toulouse [6,7,8,9]. A specific regolith analog, which is an unweathered lava flow located in the Pic d'Ysson (Massif Central, France) [10], available closeby, is systematically used for this purpose because its composition is close to the moon basaltic regolith from Mare areas. A specific methodology has been developed both for SLM (Selective Laser Melting) processing and for natural sintering processing. This is a step by step methodology which starts from 1D samples and moves progressively to 3D samples. Complementary experimental methods have been considered to characterize the high temperature behaviour of the analog (DTA, TMA, ...), the SLM printed and sintered samples (confocal microscopy, scanning electron microscopy, micro-indentation, compression tests). Relationships could be established between properties of the initial analog powder, process parameters, post SLM and sintering microstructures and mechanical properties. These results are paving the way to next steps with the objective of direct and non-direct additive manufacturing of small high performance parts.

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