3D printing of lunar bases using moondust

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Citation: GOULAS, A., 2014. 3D printing of lunar bases using moondust. Poster presented at Wolfson School Research Conference, 11 June 2014.

Additional Information:

- Winner of the first prize for the best poster, at the Wolfson School Conference 2014.

Metadata Record: https://dspace.lboro.ac.uk/2134/17491

Version: Published

Publisher: Loughborough University

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INTRODUCTION
An investigation into using Selective Laser Melting (SLM), a modern powder-bed fusion category Additive Manufacturing/3D printing process, in order to fabricate structures out of non-traditional multi-component ceramic materials such as lunar regolith (moondust). The overall aim of this research is to investigate the feasibility/suitability of the SLM method for on-site (on the moon) manufacturing of various structures, parts/replacements for future space applications.

INITIAL RESULTS
• Identification of transition phase from sintering to complete melting between material particles.
• Successful fabrication of test parts and more complex geometries [Figure 4].
• Material Hardness identified as 1200-2000 HV
• Intense thermal stresses during cool-down phase, leading to curling and part deformation.
• Fabricated test parts formed porosities [30%]

FUTURE WORK
• Refining the process to allow manufacturing of highly complex 3D structures/moon-bases.
• Further simulation of manufacturing in lunar environment conditions (vacuum, dry and cold atmosphere).

METHOD
A laser source is used to provide thermal energy and selectively fuse regions of a powder bed containing the regolith material and manufacture complex structures on a layer-by-layer strategy [Figures 2,3].

Figure 1 - European Space Agency, (2014) Building a lunar base with 3D printing.
Figure 4 – Physical size and SEM micrographs of actual fabricated parts via SLM