3D printing of lunar bases using moondust

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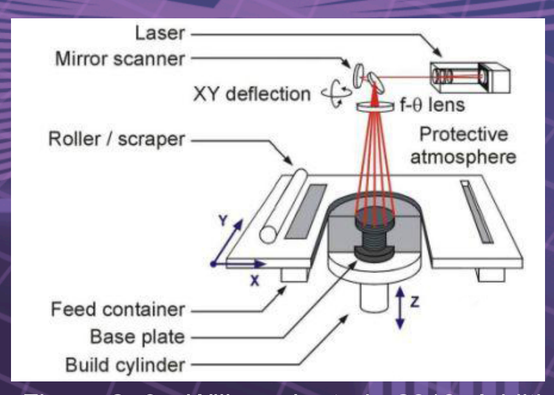
ADDITIVE MANUFACTURING RESEARCH GROUP

3D PRINTING OF LUNAR BASES USING MOONDUST

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.

Figure 1 - European Space Agency, (2014) Building a lunar base with 3D printing.



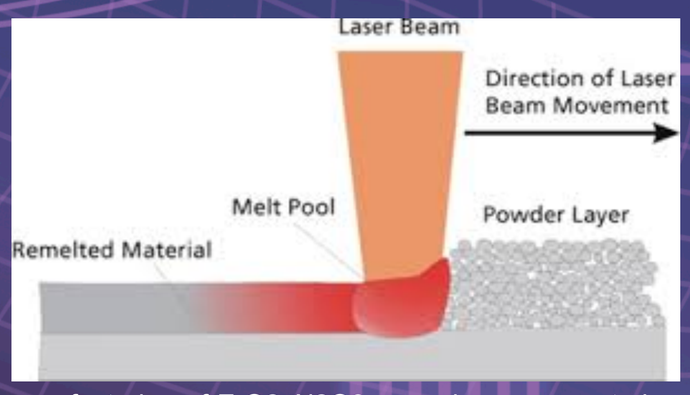


Figure 2, 3 - Wilkes, J. et al., 2013. Additive manufacturing of ZrO2-Al2O3 ceramic components by selective laser melting. Rapid Prototyping Journal, 19(1), pp.51–57.

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].

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%]

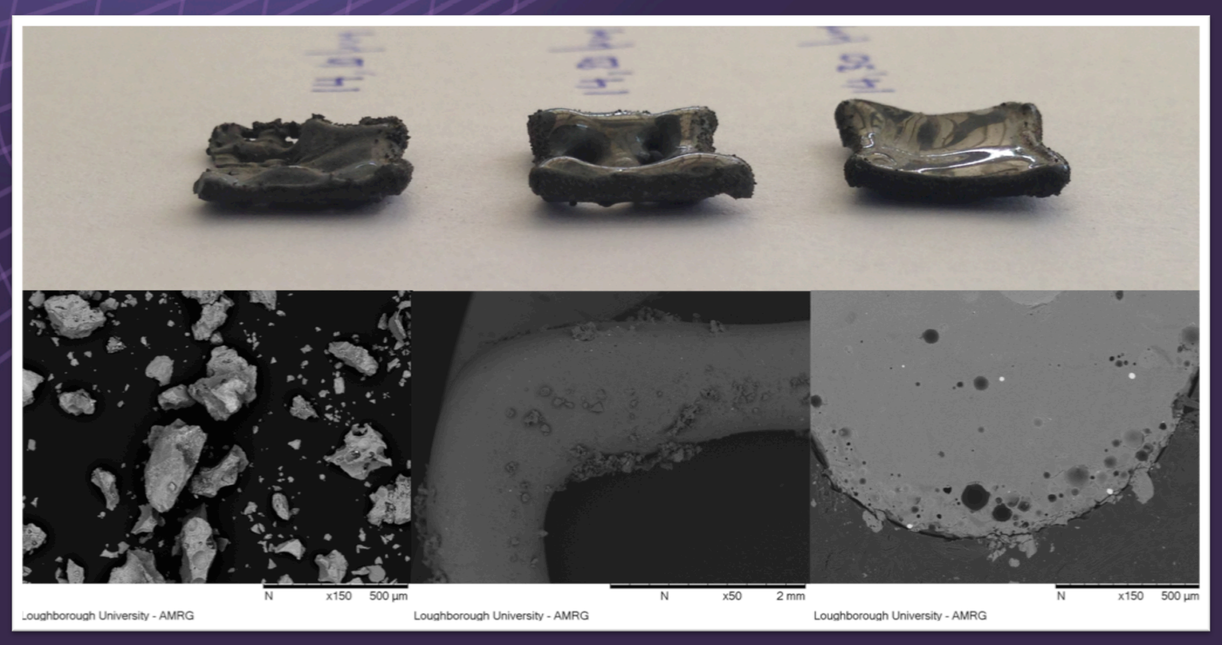


Figure 4 – Physical size and SEM micrographs of actual fabricated parts via SLM

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).

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