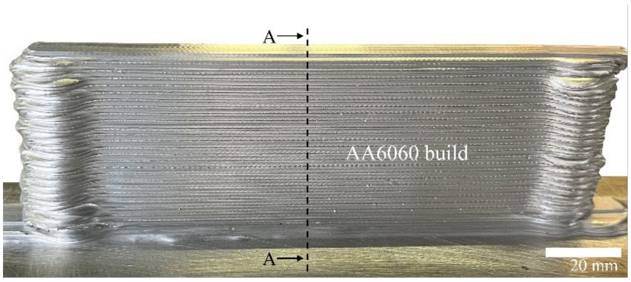
Solid-state additive manufacturing of high-strength aluminium alloys:

towards understanding of microstructural changes employing a thermomechanical simulator

Additive Manufacturing (AM) of high strength aluminium alloys by fusion based approaches is often limited by the occurrence of solidification related defects. Solid based approaches form an attractive alternative where the temperature during deposition remains below the melting point. The in house developed Friction Screw Extrusion Additive Manufacturing (FSEAM) process is a very promising approach to fabricate aluminium and magnesium parts with much higher resolution and part complexity than state-of-art solid state approaches. First results have been very interesting (Fig. 1), but better understanding of the deposition process is required to optimize the process and exploit all potential benefits.



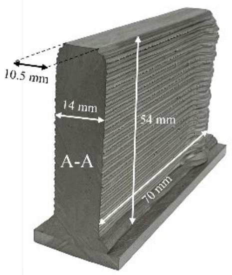


Fig. 1. Example of a FSEAM build fabricated from AA6060 (Al-Mg-Si alloy) at 500 mm/min.

After the fabrication process, the strength of the build is reduced as compared to the feedstock material. The process temperature is high enough to dissolve the precipitates that provide the strength of the material. The complicated thermal history due to the layer by layer deposition process determines the properties in the as-printed state. Typically, a non-uniform distribution of the strength over the fabricated part is observed.

In this research project the influence of the process conditions on the strength evolution during FSEAM and additional post manufacturing heat treatments will be investigated. Based on the measured temperature history the feedstock material will be exposed to various temperature profiles to study the influence on the strengthening precipitates. Here, the Gleeble thermomechanical simulator will be employed that provides high heating and cooling rates for large-scale samples, followed by detailed microstructural analysis with the many devices available within our laboratories.

The new insights available should enable a further optimization of the FSEAM process. Would you like more information on this fascinating assignment? Please contact:

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