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Title: Tensile and toughness behaviour of SLM processed Al-Mg-Sc-Zr alloy

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Abstract:

Selective Laser Melting (SLM) offers the opportunity to create directly metallic parts with complex geometry. Lightweight design is of particular importance in aerospatial and automotive industries. 4xxx alloys are traditionally used in additive manufacturing for such applications, but with the drawback of having poor hardening behaviour. Hardenable 2xxx, 6xxx and 7xxx are more difficult to process by SLM due to their hot cracking tendency. Therefore, there is a need for developing high strength Aluminum alloys dedicated to additive manufacturing of lightweight structural parts. SLM processed Sc- and Zr- modified Al-Mg alloys provide significant advantages over the 4xxx alloys, thanks to nanometric precipitation of $Al_3(Sc,Zr)$ giving rise to very fine-grained and stable microstructure, as well as to solid-solution hardening. Tensile and toughness properties are studied according to three building directions on a heat-treated SLM processed Al-Mg-Sc-Zr alloy. Results show very high yield strength with low anisotropy, ductility linked to a mainly intergranular fracture path and the presence of process porosities and brittle inclusions. Toughness measurements show pop-ins. These could be linked to the dynamic strain ageing, porosities and/or the bimodal microstructure.