POST-PROCESSING OF AM-SLM AlSi10Mg SPECIMENS: MECHANICAL PROPERTIES AND FRACTURE BEHAVIOUR

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ABSTRACT

In this paper, the mechanical properties and fracture behavior of additive manufactured AlSi10Mg specimens were investigated. The samples were manufactured by the powder-bed process known as Selective Laser Melting and underwent machining afterwards. Nine samples were tested in the as-built condition, as well as after stress relief heat treatment at two temperatures (573K and 813K); six samples were tested after Hot Isostatic Pressing (HIP) treatments at two temperatures (600K and 800K) under a 100MPa Isostatic pressure. The results were analyzed and revealed that the post-processing treatments had a profound effect on the overall mechanical properties. HIP treatments show a trend of an inverse relation, the increase in HIP temperature leads to a decrease in tensile strength. Another phenomenon observed after the HIP treatment was the elimination of porosity and the significant increase in the elongation values. The results of this preliminary research demonstrated, for the first time in literature, the possibility of controlling the mechanical properties of AlSi10Mg AM-SLM material by the HIP process.

KEYWORDS: additive manufacturing, AlSi10Mg, hot isostatic pressing, mechanical properties, fracture behaviour.

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REFERENCES

[1] **Krishnan M., Atzeni E., Canali R., Calignano F., Manfredi D., Ambrosio E. P., Iuliano L.**, *On the effect of process parameters on properties of AlSi10Mg parts produced by DMLS*, Rapid Prototyping Journal, 20, 2014, pp. 449 – 458.
[2] **Read N., Wang W., Essa K., Attallah M. M.**, *Selective laser melting of AlSi10Mg alloy: Process optimization and mechanical properties development*, Mater. Des., 65, 2015, pp. 417–424.
[3] **Thijs L., Kempen K., Kruth J. P., Humbeeck J. V.**, *Fine-structured aluminium products with controllable texture by selective laser melting of pre-alloyed AlSi10Mg powder*, Acta Mater., 61, 2013, pp. 1809-1819.
[4] **Brandl E., Heckenberger U., Holzinger V., Buchbinder D.**, *Additive manufactured AlSi10Mg samples using Selective Laser Melting (SLM): Microstructure, high cycle fatigue and fracture behavior*, Mater. Des., 34, 2012, pp. 159-169.
[5] **Rosenthal I., Stern A., Frage N.**, *Microstructure and mechanical properties of AlSi10Mg parts produced by the laser beam additive manufacturing (AM) technology*, Metallog. Microstruct. Anal., 3, 2014, pp. 448-453.
[6] **Rosenthal I., Sharon R., Shwartzman Z. and Stern A.**, *Hatching Strategy: 3D Visualization Model for Powder Bed Based Additive Manufacturing with Focused Beams*, The Annals of Dunarea de Jos University of Galati. Fascicle XII, Welding Equipment and Technology, 2014, pp. 13-18.
[7] **Buchbinder D., Meiners W., Wissenbach K., Poprawe R.**, *Selective laser melting of aluminum die-cast alloy—Correlations between process parameters*, solidification conditions, and resulting mechanical properties, Journal of Laser Applications, 27, 2015, pp. 1-6.
[8] **Buchbinder D., Meiners W., Pirch N., Wissenbach K., Schrage J.**, *Investigation on reducing distortion by preheating during manufacture of aluminum components using selective laser melting*, Top of FormJ. Laser Appl., 26, 2014, pp. 1-10.
[9] **Rosenthal I., Nahmany M., Stern A., Frage N.**, *Structure and Mechanical Properties of AlSi10Mg Fabricated by Selective Laser Melting Additive Manufacturing (SLM-AM)*, Advanced Materials Research, 1111, 2015, pp. 62-66.
[10] *******, *EOS AlSi10Mg material data sheet*, EOS GmbH electro optical systems, 2011, pp. 1-5.
[11] **Kempen K., Thijs L., Humbeeck J.V., Kruth J.P.**, *Mechanical Properties of AlSi10Mg produced by Selective Laser Melting*, Phys. Proc., 39, 2012, pp. 439-446.