

MAGNETIC PROPERTIES EVALUATION OF 316L STAINLESS STEEL PRODUCED BY ADDITIVE MANUFACTURING FOR BIOMEDICAL USE

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Introduction and objective: The modern additive manufacturing (AM) techniques represent the current state of the art of industry 4.0. Advanced selective laser melting techniques allow the production of parts with the most varied sizes, shapes and complex geometries, which would be difficult to obtain previously with casting, joining, machining, among others. In addition to saving material, they are automated, do not generate wear to the tooling and little waste. The durability of surgical instruments, implants, and prostheses with this type of manufacturing can be considered greater than that using conventional methods with cutting tools [1]. Austenitic stainless steels have been widely used for the manufacture of implants due to their good mechanical and electrochemical properties and their relative low cost. The present work evaluated the variation of some laser beam conditions, regarding the magnetic susceptibility in AISI 316L stainless steel samples produced by additive manufacturing (AM).

Methodology: The magnetic susceptibility of AISI 316L stainless steel was measured on samples produced by selective laser melting (SLM), in the dimensions: (12 x 35 x 3) [mm], layer thickness: 30 [μm], power: 53, 73, 93, 132 [W] and scanning speed: 800, 900, 1000, 1100 [mm/s]; seeking to meet requirements of: adequate surface finish, i.e. low roughness, high density (with low porosity index), according to the standard for metallic materials obtained by additive manufacturing (ASTM F3122-14).

Results and discussion: This occur because there is a microstructural transformation of the austenitic steel surface from the temperature increase generated by the laser beam energy. As the austenitic phase is paramagnetic, but the altered phase is ferromagnetic, a magnetic method was used to identify this transformation. The amount of altered material is tiny, and so the magnetic method must be extremely sensitive. To this end, a device like a susceptibility balance was set up. The use of an analytical balance allowed the measurement of this transformation with acceptable uncertainties.

Conclusions: The powder metallurgy production process using selective laser melting induced the formation of magnetic phases on the surfaces of the evaluated samples, resulting in small but significant changes in the magnetic susceptibility values.

References

[1] Yan, C.; Hao, L.; Hussein, A.; Young, P. Ti-6Al-4V triply periodic minimal surface structures for bone implants fabricated via selective laser melting. *J. Mech. Behav. Biomed. Mater*, 51, 61–73, 2015.

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