Heat Treatment of Inconel Selective Laser Melted Parts: Microstructure Evolution

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Abstract. The needing for high performances components with tailored properties is one of the major driving forces that push the research in manufacturing. The integrated manufacturing, seen as the coupling of different processes to obtain complex parts with the desired properties, is gaining a lot of interest in this context. In the meantime additive manufacturing technologies are also attaining a lot of interest due to their potentiality to produce complex shaped components starting from powders of the desired materials. Combining additive manufacturing with other technologies would strongly improve the capability to produce high performances components with tailored properties. In this scenario can be contextualized the present work. Aiming to produce Inconel components with tailored mechanical properties, a proper heat treatment have to be designed and developed. It is well known that the properties of the Inconel are ruled by the different phases that can be formed due to the complex chemical composition of this material. For instance is proved that the phases γ' and γ'' lead to an improving of the mechanical properties, on the other hand the Laves phases and δ phase would lead to a decay of the strength of the material, so the heat treatment has to be carefully designed. The printed parts have a different microstructure with respect to the conventional cast or wought components, so a dedicated heat treatment must be developed. In this paper the effect of several heat treatments, made varying the treatment temperature and time, on the Inconel printed parts was studied. The results obtained proved the effectiveness of the treatment, if the conditions are properly set, in producing the typical microstructure of the cast Inconel 718 that is the starting point for the conventional heat treatments.