Effect of processing parameters on microstructure and properties of CuSn10P1 alloy fabricated by SLM

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Abstract:

The interest in Cu-Sn alloys is associated with excellent flexibility, wear and corrosion resistance, and high mechanical strength. CuSn10P1 alloy has the widest applications among Cu-Sn alloys and is widely used in the shaft sleeve, bearing, gears, valves, etc. The properties of this alloy are strongly depended to the manufacturing process. Usage of the traditional casting causes the intergranular segregation and crystallization of primary α-Cu phase in a coarse mesh dendritic structure. This, in turn, manifest itself in poor properties, limiting its uses in industry. According to that new manufacturing methods should be used to improve the properties of this alloy.

In this work, CuSn10P1 alloy was successfully produced using selective laser melting (SLM). The powder size was between 20-63 μm and its humidity during the process was lower than 5%. The four printing strategies were selected to investigate the impact of printing parameters on the microstructure and mechanical properties of the prints. The optimal processing conditions were chosen on the basis of optimization of laser power and scanning speed. The different process parameters result in the changes of the microstructure, especially porosity and the presence of microcracks. On the basis of the analysis of wavelength-dispersive X-ray spectroscopy, it was confirmed, that all chemical elements are evenly distributed after selective laser melting. The segregation of tin and copper can be also observed, however only under remelting of the same layer.

Key words:

Additive manufacturing, 3D printing, Cu-Sn alloys, selective laser melting