COMPOSITE ALLOY FORMATION BY LASER METAL 3D PRINTING

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17-4 PH stainless steel is one of the most commonly used materials in the SLM process Fig. 1 due to its mechanical properties and corrosion resistance. Despite these advantages, the alloy has a rough surface and is known for its brittleness. Ceramic materials are not suitable for direct laser sintering, but are increasingly being used as a fastening material for a metal matrix. The search for metal-ceramic composite mixtures with thermal conductivity, low expansion coefficient and strength is becoming one of the most important research directions in the field of high technology.

17-4 PH metal material and metal-ceramic composite mixture of which 94% of the mass consists of 17-4 PH powder and the remaining 6% - SiC ceramic particles are used for the study Fig.2. During the experiment, an EOS M280 laser printing machine is used to form 3D objects. During all printing processes, the powder layer thickness of 40 μm is maintained, as well as the hatching distance of 100 μm and the laser power, which reaches 164 W. The laser scanning speed is changed, obtaining different energy densities, which are selected as 61, 67 and 73 J/mm^3. The obtained samples were analysed by using SEM EDS, optical profilometer, as well as performing density, strength and hardness measurements.

It was found that the surface of the composite alloy has a more uniform surface, the roughness is reduced by 30% and ranges from 8 to 16 μm, and of the 17-4 PH material from 12 to 26 μm depending on the energy density. The mechanical property measurement results showed that the strength limit of the composite material dropped by 20% and reached 766 MPa, while for the 17-4 PH material it was 988 MPa. The hardness of the 17-4 PH + 6% SiC mixture decreased by 8% to 92 HRB, while for the metal alloy it reached 98 HRB. However, the results of the relative elongation showed that value of relative elongation for the composite mixture is 8.5% higher than 17-4 PH.

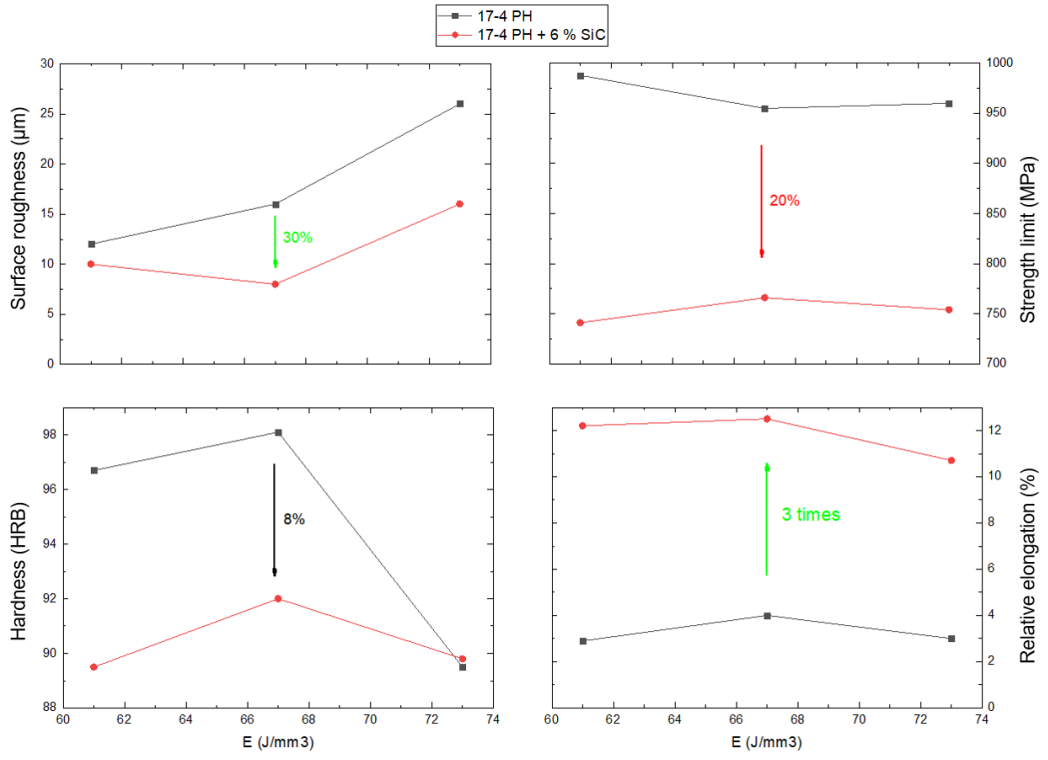

Fig. 1. Comparison of properties of SLS printed samples from 17-4 PH and 17-4 PH + % SiC mixture