THE INFLUENCE OF POROSITY IN THE AUSTENITIC STEEL SAMPLES MANUFACTURED BY LASER 3D PRINTING ON THE PROCESS OF DYNAMIC STRAIN AGEING *

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The dynamic strain aging (DSA) effect is associated with the dislocation mobility, which appears in increasing of the ductility of the material with increasing of the strain rate in defined temperature-velocity range [1]. Increasing in the strain rate usually decreases the mechanical properties of the materials. Interest in a manufacturing of digital metal products by additive technologies is very high because of its difference in physical and mechanical properties. For example, in contrast to traditional austenitic steels, in which an increase in the deformation rate leads to an increase in strength and a decrease in ductility, in the same austenitic steels, but manufactured by laser 3D printing, it leads to an increase in both strength and ductility [2]. To date, it has been scientifically proven that all metal 3D products require a thermo-mechanical post-processing of the surface. In this regard, the problem is urgent to establish the temperature and speed ranges of external influences for their subsequent elimination or including in technological modes of processing metal 3D products.

The report presents the investigation of the process of strain rate deformation in porous samples of medical grade 316L steel manufactured by laser powder-bed fusion (L-PBF). The L-PBF steel samples with density of 92% are studied. Dynamic strain ageing (DSA) effect, which appears in increasing of the ductility of the material with increasing of the strain rate, in the studied porous L-PBF samples was found. It was shown that the initial porosity of the L-PBF sample affect the nature of its fracture under strain rate deformation (Fig.1).

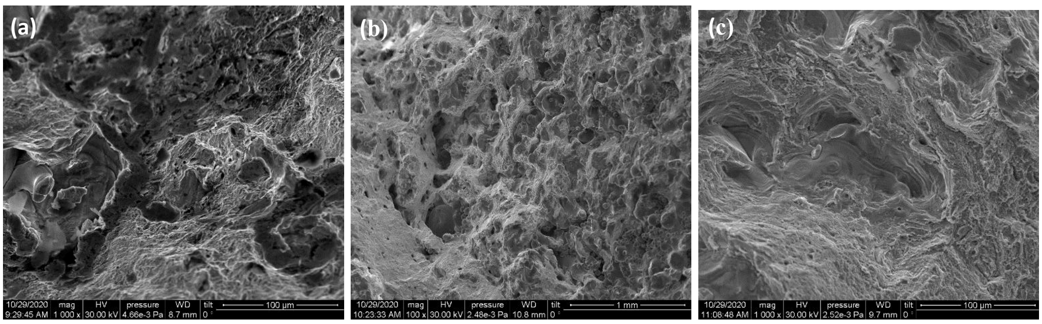

Fig.1. The fracture zone in the samples after deformation at different strain rates, SEM images:

(a) 3x10^{-4} s^{-1}; (b) 1x10^{-3} s^{-1}; (c) 8x10 $^{-3}$ s^{-1}

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