

COMPARATIVE ANALYSIS OF THE STRUCTURE AND INTERNAL STRESS IN Ti-6Al-4V ALLOYS MANUFACTURED BY 3D PRINTING AND PROCESSING WITH SCREW EXTRUSION¹

*N.V.KAZANTSEVA**, *I.EZHOV**, *N.I.VINOGRADOVA**, *A.S.FEFELOV***, *MERKUSHEV A.***, *ILYINIKH M.***, *A.E.VOLKOV****

** Institute of Metal Physics, 620990, Ekaterinburg, Russia, kazantseva-11@mail.ru*

*** Regional Engineering Center of laser and additive technology, 620078, 61, Komsomolskaya Str., Ekaterinburg, Russia*

****Scientific and Production Company Ruteni Ltd., 620075, 85/212, Mamina Sibiraka Str., Ekaterinburg, Russia*

One of the main tasks of modern developments in the production of titanium alloys is the expansion of the spectrum of metal properties using various processing methods. It is known that metals subjected to strong deformations can acquire completely new properties, most of which can be of practical interest. For example, it may combine high plasticity with great strength. The method of reverse and comprehensive extrusion with the use of screw extrusion includes several stages of ingot processing [1]. Figure 1 shows one of the stages.

Additive technology is a novel surface engineering technique, which allows us to obtain Ti-6Al-4V alloys with high density (about 99.9%) as cast materials [2].

In this report, we present the comparative study of the Ti-6Al-4V alloys manufactured by 3D printing and processing with screw extrusion. Horizontal Ti-6Al-4V samples were produced by the EOSINT M280 machines (EOS GmbH) equipped with an Ytterbium fiber laser operating at 1075 nm wavelength (IPG Photonics Corp.). We examined the industrial Ti-6Al-4V samples after the first twisting and after pressing the twisted sample into a round washer.

According to structural studies, the deformed alloy retains a two-phase state. After the first twisting in the sample, a change in the intensity of X-ray diffraction lines indicating the presence of the texture is revealed. The grain size in the sample after pressing decreases by about half compared to the sample after pressing.

It is known that 3D printing of the titanium alloys produces the samples with non-equilibrium structure with high level of internal stresses. TEM studies of 3D samples showed the martensitic structure without any β precipitations.

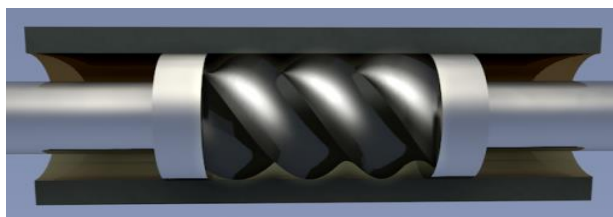


Fig. 1. Fig.1. Pressing a twisted blank into a washer

Estimation of residual internal stresses in the studied samples and comparison with obtained data on influence of severe plastic deformation by screw extrusion is provided.

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