INVESTIGATION OF THE EFFECT OF LASER RADIATION PARAMETERS ON THE STRUCTURE AND MECHANICAL PROPERTIES OF PARTS OBTAINED BY THE SLM TECHNOLOGY FROM A TITANIUM ALLOY

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Today 3D-printing is a fast developing technology that produces three-dimensional objects directly from digital models through additive process, typically by precipitation and "cured in place" successive layers of polymers, ceramics or metals. Unlike traditional production processes associated with subtraction, for example, a cutting process or shaping techniques, such as stamping, bending and molding, AT connects the material layers to create a final product. Originally, this technology was conceived as a method for producing prototypes, but currently additive manufacturing has improved to the extent that they are increasingly used to obtain the finished product. Therefore there are high demands on the quality of the synthesized material to details grown [1].

Selective laser melting technology (SLM) is a fast growing technology that allows to produce metal parts in a short time. Interest in the technology is growing from year to year. At the moment, there are several well known works devoted to the study of physical and mechanical properties and structure of the samples obtained by the SLM. For example, in works [2-3] studies on the impact of the mode selective laser melting refractory metal powder on the structure of the material are presented.

Despite the fact that the SLM technology has advanced considerably in recent years, its use is still limited due to the appearance of defects in synthesized parts, for example, such as hollows and cracks [4]. Also there are questions to the mechanical characteristics of the parts made by the SLM technology [5]. As is well known, the mechanical characteristics of the material obtained by the technologies of selective laser melting differ from the mechanical characteristics of the same material obtained by the traditional technologies.

The quality of the material obtained by the SLM technology is influenced by a large number of parameters, such as the laser emission power, scanning speed, diameter of the laser spot, the thickness of a sintered layer, structure, the properties of the material used, and many others [2]. The study of the influence of the SLM technology on the mechanism of structure formation and mechanical characteristics of the synthesized material is, therefore, of considerable interest.

Titanium alloys are widely used for manufacture of parts in aerospace, medical, automobile, chemical and other fields of industry [6, 7]. The main advantages of titanium alloys in comparison with structural steels are high unit strength in relation to material density, good rust resistance and high mechanical characteristics at influence of high temperatures.

VT-6 alloy (analogue ASTM Grade 5 titanium, Ti-6Al-4V) relates to titanium deformable α+β to alloys. High durability such alloys is achieved through use of a heat treatment. Ultimate strength of material about 885 MPas at rather high plasticity δ=10 … 13%. With an increase ultimate strength of material up to 1100 MPas leads to receiving enough low values of plasticity, an order δ=4 … 6%. It is the main reason for the fact that BT6 alloy is in most cases used in not strengthened state.

VT6 alloy besides the β-stabilizer contains aluminum which is mainly dissolved in a α-phase and strengthens it.

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