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.

References