MICROSTRUCTURE AND PROPERTIES OF TI-6.5AL-3.5MO-1.5ZR-0.3SI PARTS PRODUCED BY ELECTRON BEAM MELTING

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Nowadays additive manufacturing (AM) are being actively implemented in many industries. The advantages of AM such as a high rate of production and the possibility of creating unique product geometry over traditional manufacturing methods of metal products are undeniable. The use of additive manufacturing allows creating a new generation of materials with a unique set of properties. One of the most actual methods of creating three-dimensional products is the method of "electron beam melting" - EBM [1-2]. This method has the following advantages: high possible resolution in the horizontal plane, high performance, this method does not require subsequent heat treatment to achieve high strength. The wide range of various defects, anisotropic structures and etc. are formed during the process of products synthesis from titanium alloys with the help of additive technologies due to the high cooling rate of the material. The formation of the structural-phase state of the samples occurs as the result of powder melting to the temperature of 1900 °C and subsequent rapid cooling to a the temperature of ~ 700 °C followed by cooling to the room temperature. Structure and properties of manufactured alloy parts depend on many factors, such as powder composition, part thickness, beam current, beam speed, scanning strategy (including line offset), energy input, etc. Thus, the regularities of structure formation and evolution depending on the additive manufacturing parameters have a great practical importance. The aim of this work is to study the influence of manufacturing conditions on the evolution of the structural-phase state and the change in the mechanical properties of samples prepared by electron beam melting from Ti-6.5Al-3.5Mo-1.5Zr-0.3Si powder. The samples have been manufactured on an experimental unit developed and manufactured at the R&D Laboratory for Modern Production Technologies in the National Research Tomsk Polytechnic University. To study the beam current effects on the build parts, samples were fabricated at different beam current (3-6 mA). The hatching direction was rotated by 90° between each layer. The investigations were carried out using X-ray diffractometer, optical and scanning electron microscopy, the method of measuring microhardness and Young's modulus. The patterns of structure and properties change of samples made by electron beam melting from Ti-6.5Al-3.5Mo-1.5Zr-0.3Si powder have been established, depending on the manufacturing conditions.

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