

The Relationship between the Parameters of Laser 3D Printing of Titanium Alloy and Its Strength Properties

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Abstract : A methodology for calculating and modeling technological modes of laser 3D printing of Ti6Al4V powder alloy samples has been developed. ProXDPM320 3D printer was used. The technological model that takes into account the multifactorial influence of modes and conditions of additive cultivation on characteristics and strength properties of titanium samples has been created. Process control parameters and an order parameter, to which the others are subordinate, were established. Using the iterative method, the optimal technological parameters for the additive growth of cylindrical samples were calculated. The calculations were combined with data obtained during virtual 3D printing in the Altair Inspire software environment. The samples were subjected to short-term tensile strength tests at normal temperature on a servo-hydraulic machine "LFV-100". As a result, deformation diagrams were constructed, and mechanical characteristics such as proportionality limit, conditional yield strength, tensile strength, elastic modulus, relative elongation, and stress at break were obtained. Comparison of these characteristics with those for the industrial alloy Ti6Al4V showed acceptable agreement. Some of the synthesized samples were subjected to laser shock treatment to increase fatigue strength. The results obtained were used to validate the mathematical model of 3D printing of titanium alloys.

Keywords : additive technology, titanium alloy, numerical simulation, strength tests

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