THE ELECTRON MICROSCOPIC STUDY OF L-PBF TITANIUM SAMPLES AFTER CYCLIC DEFORMATION ON BENDING[¯]

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Titanium alloys are well-known biomaterial, which is the most commonly used in the manufacturing of medical implants and instruments [1]. Today, the main investigations of the medical materials associate with surface treatments, protective covers, the development of new alloys, and new manufacturing. The metal implants in site the human body undergo the specific type of the deformation, which can include the compression, tension, bend. The additive manufacturing (AM) is a perspective way for personal medicine. Because of that, the fatigue properties of the metal implants manufactures by 3D printing are in the scope of world scientific studies. The fatigue fractures in an additive manufactured metal implant are found depended on the defects and were initiated by multiple surface defects rather than internal porosity [2]. However, it was found that the as-build L-PBF Ti-6Al-4V alloy samples had the non-equilibria martensitic structure, which could also effect on the fatigue life of the AM titanium implants. The phase transitions in titanium alpha-beta alloys include formation as equilibrium, as non-equilibrium or metastable phases.

The report presents the electron microscopic results of the study of the as-build L-PBF Ti-6Al-4V alloy samples after cyclic deformation on bending. The main purpose of the study is valuation of degree of the structure degradation in L-PBF Ti-6Al04V alloy samples after fatigue test. The deformation test was done with test machine TIRA test 2750 at room temperature and σ=700 МПа, the number cycles before fracture was N=25227. Structure studies were done with the Tecnai G2-30 Twin transmission electron microscope and JSM 6490 scanning electron microscope equipped with an Oxford Inca system for energy dispersive and wave microanalysis. Figure 1 presents the microstructure of fracture zone in the studied L-PBF sample. The deformed technological pore with unmelted powder particles inside (Fig.1a) and the twinning martensite the may be observed in Figure 1b. The pore influences on the deformation process and phase transition in L-PBF Ti-6Al-4V alloy during cyclic deformation are discussed.

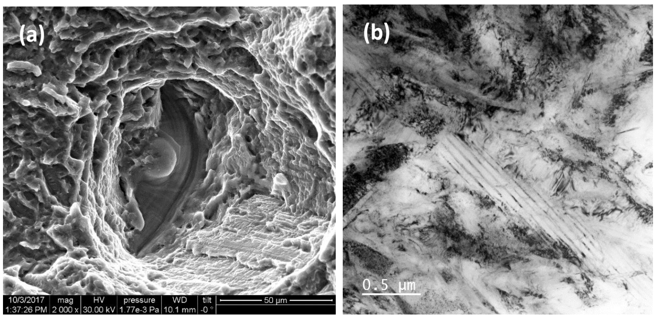

Fig.1. Fracture zone in the L-PBF Ti-6Al-4V sample after fatigue test: (a) SEM image; (b) TEM image

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