

Surface modification by nanosecond duration laser as the way of enhancement Very High Cycle Fatigue resistance of metal alloys

Balakhnin A.N.^{1,®}, Bannikov M.V.¹, Oborin V.A.¹ and Naimark O.B.¹

¹ Institute of Continuous Media Mechanics of the Ural Branch of the Russian Academy of Sciences, Academician Korolev Street 1, Perm, 614013, None

® balakhnin.a@icmm.ru

The surface of Ti-6Al-4V alloy samples was treated by an ytterbium nanosecond pulsed fiber laser manufactured by IPG Photonics, with an emission wavelength of 1064 nm. The irradiation parameters were as follows: pulse duration of 200 ns, pulse energy of 1 mJ, and a spot diameter of the laser beam focused on the surface of approximately 30 microns. Laser processing was conducted beneath a layer of water approximately 2 mm thick. The Very High Cycle tests were carried out on a Shimadzu USF-2000 ultrasonic fatigue machine at 20 kHz with air cooling.

The results obtained indicate the changing of thin subsurface structure. The method developed by the authors allowed to separate the influence of surface quality (roughness) and laser treatment on fatigue properties of Ti-6Al-4V alloy. The processing variant proposed by the authors demonstrates improvement of characteristics by 9-11 percent under conditions of Very High Cycle tests and is a promising method of increasing fatigue resources of aircraft engine building materials.

The work was carried out as part of a major scientific project funded by the Ministry of Science and Higher Education of the Russian Federation (Agreement No. 075-15-2024-535 dated 23 April 2024).