Investigation of impact of a double beam nanosecond laser exposure on a titanium target through a water layer

Isakov V V[1,@], Golubkin V S[1], Novikov I A[1], Shibaev S A[1] and Petrov M A[2]

[1] Central Institute of Aviation Motors, Aviamotornaya Street 2, Moscow 111116, Russia

[2] Moscow Polytechnic University, Avtozavodskaya 16, Moscow 115280, Russia

[@] vvisakov@ciam.ru

A technique has been developed for surface treatment by laser shock peening of a titanium alloy by simultaneously acting laser pulses (1064 nm and 532 nm) with a duration of 7.0 ns and a frequency of 10 Hz. A two-lamp laser of the SpitLight Compact 400 model has been applied. Using a polarization camera of the VCXG-50MP model, the evolution of a plasma torch was recorded in a full-frame format, with a pixel size of 3.45 x 3.45 m, under various laser exposure modes. The results of the experiments and their theoretical justification represents the synergetic approach for the used wavelengths' combination. A theoretical model of double pulse laser processing has been developed, taking into account the formation and evolution of the laser-initiated plasma as a function, affecting the characteristics and properties of hardened samples. In the studied laser-plasma interaction "fast" and "slow" variables were determined. It makes possible, to calculate pressure of laser plasma on a titanium target. The laser shock hardening zones were studied by X-ray diffraction analysis, layer by layer determining the deformation of the crystal lattice. In addition, surface residual stresses were studied by the polarization method with an additional level of polarization in angle (AOP), degree (DOLP) and their combinations (ADOLP) as well. The obtained data set was interpreted by the digital image correction (DIC) method. Based on the results, the purposed double beam laser shock peening method can be effectively applied for surface hardening of titanium samples.