VI Serbian-Belarusian Symp. on Phys. and Diagn. of Lab. &
Astrophys. Plasma, Belgrade, Serbia, 22 - 25 August 2006
eds. M. Ćuk, M.S. Dimitrijević, J. Purić, N. Milovanović
Publ. Astron. Obs. Belgrade No. 82 (2007), 35 *Invited lecture*

SELECTION OF SOLID PROPELLANT FOR LASER PLASMA ENGINE

N. A. Bosak[1], A. N. Chumakov[1], Yu. A. Stankevich[2]

[1]*Institute of Molecular and Atomic Physics of National Academy of Sciences of Belarus*
220072, Minsk, Belarus, e-mail: bosak@imaph.bas-net.by
[2]*Heat and Mass Transfer Institute of National Academy of Sciences of Belarus*

Abstract. Possibility of jet thrust creation at laser action on absorbing condensed mediums was revealed many years ago (G.A. Askaryan, 1962, A. Kantrowitz, 1972). But only now the idea of laser propulsion has chance of using for control of micro- and nano-satellites movement. Such satellite needs obtaining the strictly verified impulses for its orbits correction. One of the promising directions of solving this problem is creation of laser-plasma engine of ablative type with solid-state working substance (solid propellant). The important characteristic of laser engine is its working resource which depends on used solid propellant. This report is devoted to optimal selection of solid propellant based on experimental determination of specific mass-removal of various materials irradiated by pulsed laser in vacuum.

Dependences of specific mass removal on laser radiation power density were studied by experimental and numerical methods. The experimental results were obtained for number of metals (Al, Bi, brass), for graphite and composites (glass fibre and carbon fibre plastics, sol-gel glass SiO_2 containing 40 % of graphite particles) irradiated in vacuum ($P_0 = 2 \cdot 10^{-2}$ mm Hg) by Nd:YAG laser (1064 nm wavelength, ~20 ns and ~200 μs pulse duration, irradiance in the range of $1 - 2 \cdot 10^4$ MW/cm^2). The simulation results, which were obtained for Al and graphite samples, are compared to the experimental ones, for the range of power density $30 - 10^4$ MW/cm^2. It was found out that experimental dependences of specific mass removal on laser radiation power density are characterized by areas with dominance evaporative or explosive mechanism of target destruction. Obtained results showed mainly evaporative regime of graphite and brass destruction for laser irradiances 30-600 MW/cm^2 that comes with specific mass removal ensuring necessary resource for created laser plasma microengine.