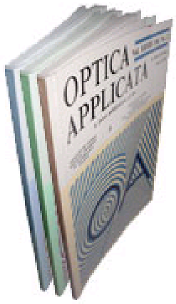

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High power laser interaction with single and double layer targets

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Keywords

laser produced plasma, three-frame interferometry, macroparticle, single and double targets, crater, shock wave, laser energy absorption

Abstract

Results of extended complementary experimental and computer simulation studies of craters formation produced by high power lasers in single and double layer targets are presented. The experimental investigation was carried out using the PALS (Prague Asterix Laser System) facility working with two different laser beam wavelengths: ●$_1$ = 1.315 μm and ●$_3$ = 0.438 μm. Two types of targets made of Al were used: single massive targets and double targets consisting of foils or disks (6 and 11 μm thick for both cases) placed in front of the massive target at distances of 200 and 500 μm. The targets were illuminated by laser energies E_L = 130, 240 and 390 J always focused with diameter of 250 μm. In all experiments performed the laser pulse duration was equal to 400 ps. The 3-frame interferometry was employed to investigate the plasma dynamics by means of the electron density distribution time development, as well as the disks and foil fragments velocity measurements. Dimensions and shapes of craters were obtained by crater replica technology and microscopy measurement. Experimental results were complemented by analytical theory and computer simulations to help their interpretation. This way the values of laser energy absorption coefficient, ablation loading efficiency and efficiency of energy transfer, as well as 2-D shock wave generation at the laser-driven macroparticle impact, were obtained from measured craters parameters for both wavelengths of laser radiation. Computer simulations allowed us to obtain an energy absorption balance of incident laser energy for both wavelengths employed.

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