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Laser ablation of metals: Analysis of surface-heating and plume-expansion experiments

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Abstract

The thermal effects produced by laser pulses (6 or 18 ns) absorbed by a solid target have been investigated experimentally and theoretically. The energy which is absorbed serves to raise the temperature of the surface. The regimes to be considered are described by the heat-diffusion equation under conditions of what we term `normal vaporization'. Numerical solutions of the heat-diffusion equation lead to the temperature profiles produced within the target. The aim of this work is to present the results on heat flow in terms of the surface temperature and the velocity at which the surface recedes. Experimental data on the recession velocity and of the crater depth in relation to the thermophysical parameters of the metals Al, Cu, Nb, W, and Zn, are reported. The effect of the surface heating has also been examined in terms of the velocities of the plumes emitted from the targets. It is concluded that vaporization from the laser-heated targets is not the only relevant process but that one or both of laser-plume interaction

and phase explosion may play a role in determining particle energies.

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