Femtosecond diagnostics of plasma created by laser irradiation of solid targets

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In this work we present a numerical simulation of experiments on irradiation of solid-density aluminum and silver targets by femtosecond laser pulses. The pulse (wavelength 1.24 nm, duration 110 fs) was directed at angle of 45° to the surface of the target. A probe pulse with the second harmonic wavelength 620 nm was radiated normally to the target after different delays since the beginning of the primary pulse. The registered interference pattern was processed by means of a special algorithm on the basis of the Fourier transform giving information both on the absolute value and phase of the reflection coefficient. Thus obtained experimental data were interpreted with the help of numerical simulation on the basis of the developed model of interaction of intense laser pulses with solid targets. The model takes into account the laser energy absorption and reflection, electron-ion temperature relaxation, ionization, recombination, heat conductivity and plasma expansion. A wide-range two-temperature equation of state, describing nonequilibrium heating of target from solid state to hot plasma, is used for determination of thermodynamic properties of heated matter. It is shown that for aluminum ionization process doesn’t play a significant role under experimental conditions, while for silver contribution of ionization is crucial. Different approaches to consider ionization in numerical modeling are discussed. In addition, a contribution of *d*-electrons into thermodynamic and transport properties of silver is investigated. The described above model allows one to achieve good agreement with experimental data and gives information about transport properties and absorption ability of non-ideal plasma of solid-state density.