Plasma expansion dynamics under interactions of femtosecond laser pulses with metal targets

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The results of investigation of hydrodynamic plasma expansion, formed on the surface of Fe target, irradiated by infrared high contrast femtosecond laser pulses with intensity ~10^{16} W/cm^2, are presented. Time-resolved interferometry technique was used to measure phase shift of the reflected probe wave. The experiments were carried out in a vacuum at pressure of order 10^{-3} mbar. 2D Fourier-transform technique was applied for processing the recorded interferograms. Plasma density scale length at the moment of pump pulse-target interaction is defined.

It is shown that at pump-probe delay $\Delta t_{delay} > 100$ fs complex reflectivity phase changes become considerable. But at $\Delta t_{delay} = 0$ (the pump pulse profile maximum coincides with probe pulse one) a critical density layer displacement is about only ~ 20 nm, which corresponds to ~ 0.016λ. The obtained results confirm the suppossion that under current experimental conditions vacuum heating mechanism of hot electrons generation could be a main one. In particulare, these hot (~10 KeV) electrons may produce characteritic X-ray radiation on metal targets.