OPTICAL CHARACTERISTICS OF ALUMINUM WITH THE HOT ELECTRONS AND THE KINETICS OF MELTING UNDER THE ACTION OF ULTRASHORT LASER PULSE.

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The absorption of the ultra-short laser pulse irradiation for a short time transforms the metal to the new state which exists only in the laboratory. In this state because of the strong electron excitations the change of the elastic modules (as in the case of a gold target) and variation of optical characteristics can be observed. It is important that at the initial stage these changes take place at the practically unchanged crystal lattice, corresponding to the undisturbed cold metal. In our work we do the theoretical consideration and experimental investigation of the optical properties of solid aluminum with the hot electrons arising under the action of femtosecond laser pulse and consider the kinetics of melting of aluminum under these conditions. Two-temperature hydrodynamics code and molecular-dynamics simulation are used in numerical calculations. Experiments are made on the chromium-forsterite terawatt femtosecond laser system by the use of pump-probe scheme. As a result of the theoretical consideration and experiments the contribution of electron-electron collisions into the dielectric permittivity ϵ of aluminum with hot electrons at the moderate fluences F_{inc} of the order of $1\un{J/cm}^2.$ is estimated.

We investigate the melting process under the influence of hot electrons. At these and higher fluences aluminum in the skin layer melts more earlier than the equalization of temperatures between electrons T_e and ions T_i keeps place. Hence the phase transformation but not the temperature equalization limits the time of life of the exited two-temperature aluminum crystal. At this stage liquid phase is produced by the non-equilibrium bulk melting when the crystal is overheated above the melting temperature.