Diploma thesis abstract

«Dynamics of laser-induced phase transitions at mechanically confined metal surface»

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A theoretical and experimental study of near-critical states of metals (with temperatures ~ 1 eV and pressures ~ 10 kbar) and dynamics of first-order phase transitions during nanosecond laser irradiation at moderate intensities (up to 10^8 W/cm^2) of confined metal surface is presented.

Experimental setup for simultaneous measurements of pressure, temperature and reflectivity of metal surface with nanosecond time resolution was assembled. The dynamics of laser-induced phase transitions in lead and mercury under stress confinement conditions was studied.

For lead target the dynamics of pressure and reflectivity of metal surface was obtained. At low laser energy densities the pressure at the surface duplicates the laser time profile. For greater energy densities the pressure signal was wide, that was caused by melting. A non-linear change of acoustic signals – shock wave formation during propagation in immersion liquid (water) was observed. The peak pressure obtained in the experiments was about 5 kbar. The considerable decrease of reflectivity was observed - by a factor of ~ 5 compared to normal conditions.

The dynamics of pressure and temperature change in near-critical region at the mercury surface in the confined conditions was studied. The curves of the process of laser heating in P-T coordinates were obtained. The peak level of obtained temperatures and pressures was 2500 K and 6.5 kbar correspondingly.