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The book consists of the abstracts of plenary, oral and poster contributions to the XXX International Conference on Interaction of Intense Energy Fluxes with Matter (March 1–6, 2015, Elbrus, Kabardino-Balkaria, Russia). The reports deal with the contemporary investigations in the field of physics of extreme states of matter. The following topics are covered: interaction of intense laser, x-ray and microwave radiation, powerful ion and electron beams with matter; techniques of intense energy fluxes generation; experimental methods of diagnostics of ultrafast processes; shock waves, detonation and combustion physics; equations of state and constitutive equations for matter at high pressures and temperatures; low-temperature plasma physics; physical issues of power engineering and technology projects.

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CONTENTS

CHAPTER 1. POWER INTERACTION WITH MATTER

1. Sokolowski-Tinten et al., PRL 81, 224 (1998); Inogamov et al., JETP Lett. 69, 310 (1999).

THIN 10–100 nm FILM IN CONTACT WITH SUBSTRATE: DYNAMICS AFTER FEMTOSECOND IRRADIATION

Khokhlov V.A., [*1] ***Inogamov N.A.,*** [1] ***Zhakhovsky V.V.,*** [2] ***Shepelev V.V.,*** [3] ***Ilnitsky D.K.*** [2]

[1] *ITP RAS, Chernogolovka,* [2] *VNIIA, Moscow,*
[3] *ICAD RAS, Moscow, Russia*

**khokhlov@landau.ac.ru*

Ultrashort laser pulse may induce the interesting combinations of thermal and hydrodynamic phenomena including foaming and freezing of molten metals and semiconductors [1], formation of chaotic surface nanostructures and mesoporous layers [1], and superelastic shocks [2]. Appearance of negative pressures within the frontal surface layer heated by a laser has a key importance for understanding of frontal nucleation, foaming, and spallation often called ablation (mass removal) in laser community. Release and movement of spallation shell allows understanding the puzzle of Newton rings [3]. Disruption of a free-standing plane film quickly heated by a laser is the simplest model of laser spallation [4], in which the sharp spallation (ablation) threshold F_a determines dynamics of the free-standing film. Problem of significant importance is: how this picture will change if the film is deposited onto substrate? This problem is solved in the report. It is found that now there are two thresholds $F_s < F_a$ and three regimes of motion, comp. with the freestanding film. For $0 < F < F_s$ the film oscillates remaining on substrate. Oscillations decay in time due to emission of acoustic waves into substrate. For $F_s < F < F_a$ the film breaks away from substrate because negative pressure propagating with acoustic waves arrives to a film-substrate contact and overcomes the cohesion strength of the contact. In the third regime $F_a < F$ there is inner disruption of the film happened before a moment when negative pressure separates metal and dielectric substrate at the contact. Support from RFBR 13-08-01095 and RAS program "Substance at high energy densities" is acknowledged.

1. Ashitkov et al., JETP Lett. 95, 176 (2012); Inogamov et al., J. Phys.: Conf. Ser. 510, 012041(2014); Wu et al., Appl. Phys. A 114, 11 (2014).
2. Zhakhovskii et al., JETP Lett. 92, 521 (2010); Ashitkov et al., ibid 92, 516 (2010).
3. Sokolowski-Tinten et al., PRL 81, 224 (1998); Inogamov et al., JETP Lett.

69, 310 (1999).
4. Zhakhovskii et al., JETP Lett. 71, 167 (2000); Anisimov et al., ibid 77, 606 (2003); Appl. Surf. Sci. 253, 6390 (2007); Upadhyay et al., Phys. Rev. B 78, 045437 (2008); Demaske et al., ibid 82, 064113 (2010); Leguay et al., PRL 111, 245004 (2013).

IMPLEMENTATION OF NUCLEATION MODEL INTO HYDROCODE FOR SIMULATION OF LASER ABLATION

Povarnitsyn M.E.,* Fokin V.B., Levashov P.R., Khishchenko K.V.

JIHT RAS, Moscow, Russia

**povar@ihed.ras.ru*

We present a hydrodynamic model for simulation of laser–matter interaction. The model describes laser energy absorption, hydrodynamic motion of material, two-temperature effects, electron–phonon coupling and electron thermal conductivity. One of the basic mechanisms of femtosecond laser ablation is mechanical fragmentation. To properly take into account the nucleation in metastable liquid phase we implement into the hydrocode a nucleation model that takes account of formation of bubbles of critical size and their subsequent growth. During simulation thermodynamic parameters in metastable and stable phases are known from a multiphase equation of state. Results of modeling are in a good agreement with molecular dynamic simulation and experimental findings.

CONTINUAL ATOMISTIC SIMULATION OF METAL TARGETS IRRADIATED BY FEMTOSECOND DOUBLE-PULSES

Fokin V.B.,* Povarnitsyn M.E., Levashov P.R.

JIHT RAS, Moscow, Russia

**Vladimir.Fokin@phystech.edu*

In this work, we study the mechanisms responsible for the dynamics of femtosecond double-pulse laser ablation of metals. In several experiments it was previously shown that the crater depth in double pulse irradiation monotonically drops when the delay between pulses increases. This decrease of the crater depth starts from the delay of several picoseconds and for delays longer than the time of electron–ion relaxation the crater depth can be even smaller than that produced by only a single pulse. To de-