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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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CHAPTER 1. POWER INTERACTION WITH MATTER

and ultrafast processes dynamics.

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1. Vicario C., Ovchinnikov A. V., Ashitkov S. I., Agranat M. B., Fortov V. E., Hauri C. P. Generation of 0.9-mJ THz pulses in DSTMS pumped by a Cr:Mg_2SiO_4 laser // Optics Letters. 2014. V. 39. N. 23. P. 6632–6635.

MODELING OF PUMP-PROBE EXPERIMENTS WITH Ti:SAPP PUMP AND X-RAY PROBE

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Faenov A.Ya., [3] ***Shepelev V.V.,*** [4] ***Ilnitsky D.K.,*** [2] ***Hasegawa N.,*** [5]
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Fifteen years ago observation and explanation of Newton rings [1] clearly manifests that ablation by an ultrashort pulse resulting in release of a spallation shell is qualitatively different from the gas-plasma flow ablation produced by a nanosecond pulse. Fast pumping of energy into material by an ultrashort pulse generates a state with pressure as high as in a detonation wave in high explosives. Strong shortening of pulse duration transfers a long pulse gas-plasma rarefaction wave to a rarefaction wave in condensed media where cohesive resistance to stretching plays a decisive role. All this is said to emphasize that the fast ablation is unique. Observations [1] have been made in a pump-probe scheme with an optical pump, wavelength $\lambda_{opt} \sim 1000$ nm. First rings appears when the spallation shell with velocity ~0.5 nm/ps passes a distance larger than one half-wavelength ~500 nm. Thus, observation of rings begins at ~1000 ps after pump. In contrast, the new observation technique with soft X-ray probe $\lambda_X = 13.9$ nm allows to begin observations 1–1.5 orders of magnitude earlier. In the report the hydrodynamics and molecular dynamics simulations and their comparisons with X-probe experimental data are presented. We see how an internal ruptures appear and reflections from them begin to interfere. This sheds light onto dynamical effects accompanying cavitation and internal fragmentation of material. Support from Russian Science Foundation 14-19-01599 is acknowledged.

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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

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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.

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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.