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# Pressure generation mechanisms in picosecond laser – metal interaction

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Studying the behavior of the recoil pressure generated in a metal under pulsed laser irradiation is necessary to clarify the possible manifestations of the critical parameters of a substance under nonequilibrium conditions. In [1], during MD modeling of picosecond laser ablation of aluminum against the background of a characteristic thermoacoustic pressure pulse, additional peaks were also observed during irradiation (peak1) and after its completion (peak2), associated with the movement of the melting front and subsurface cavitation, respectively. In the considered exposure mode, no noticeable effect of the subcritical evaporation process on the recoil pressure was observed.

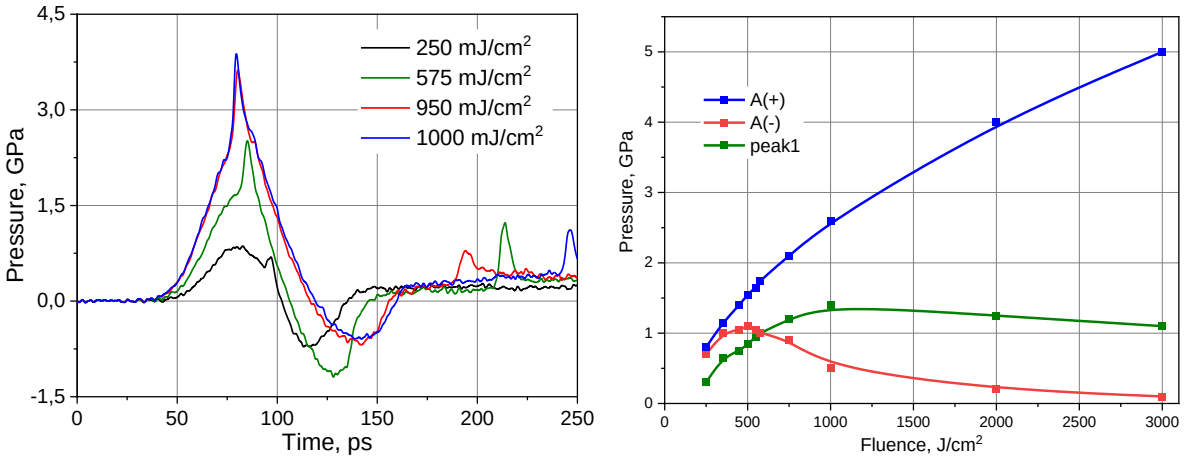


Fig.1: **(a)** Pressure curves with additional peaks (peak1 and delayed peak2). **(b)** Fluence dependencies of thermoacoustic positive (A(+)) and negative (A(-)) amplitudes together with peak1.

Fig.1(a) shows several pressure curves and the dependence of their amplitudes on the irradiation energy density. The difference in the behavior of positive and negative amplitudes (fig.1(b)) is due to the nonlinear effects of the thermoacoustic response, which is consistent with the continuum modeling performed in the present study. The role of the thermoacoustic mechanism in the formation of recoil pressure can also be significantly influenced by an increase in the radiation absorption length in the metal, which, apparently, was observed during nanosecond irradiation of mercury in [2], but has not yet been sufficiently studied.

[1] D.S. Ivanov and A.A. Samokhin, Pressure recoil behavior in picosecond laser metal interaction: MD simulation, Abstract book of International Conference on Advanced Laser Technologies (ALT), (2023).
[2] A.A. Samokhin, E.V. Shashkov, N.S. Vorobiev, A.E. Zubko, On acoustical registration of irradiated surface displacement during nanosecond laser-metal interaction and metal–nonmetal transition effect, Appl. Surf. Sci., 502, 144261, (2020).