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MD study of femtosecond laser spallation of aluminum and gold
VASILY ZHAKHOVSKY, University of South Florida, NAIL INOGAMOV, KATSUNOBU NISHIHARA, Institute of Laser Engineering, Japan — The ultrashort laser-matter interaction with femtosecond laser pulse (fsLP) and moderate incident fluence is important for fundamental physics of fast processes, warm dense matter physics as well as for a wide range of industrial applications. Fast heating of target material by fsLP results in formation of thermo-mechanically stressed zone of 10-100 nm thick with pressure 10-50 GPa. Its unloading may cause frontal cavitation and ablation of subsurface layer at a crater depth of 50 nm for aluminum and 100 nm for gold as our MD simulations and experiments indicate. The ablation thresholds of Al and Au obtained in simulations with the use of our new EAM potentials agree with experimental data as well. The compression wave propagating deep into material hits the rear side of a target with formation of a rarefaction wave. The last may produce cracks and spallation on rear side. MD simulations of spallation of Al and Au films induced by fsLP show that the used EAM potentials (Mishin et. al. and our new ones) predict the different spallation thresholds while the shock wave profiles are similar. Simulated spall strength of Al is 7.4 GPa, that is noticeably less than 10 GPa obtained from acoustic approximation with the use of velocity pullback on velocity profile of free rear surface.

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