Laser action: Structuring, peening and microfabrication of laminates

Ashitkov S I[1], Khokhlov V A[2], Zhakhovsky V V[3,1], Petrov Yu V[2], Romashevskiy S A[1], Ignatov A I[3] and Inogamov N A[2,1,3,@]

[1] Joint Institute for High Temperatures of the Russian Academy of Sciences, Izhorskaya 13 Bldg 2, Moscow 125412, Russia
[2] Landau Institute for Theoretical Physics of the Russian Academy of Sciences, Akademika Semenova 1a, Chernogolovka, Moscow Region 142432, Russia
[3] Dukhov Research Institute of Automatics (VNIIA), Sushchevskaya 22, Moscow 127055, Russia

[@] nailinogamov@gmail.com

Knowledge of the physics of the effect of laser radiation on matter is important for many modern technologies.

Structuring. In the experiment two identical femtosecond laser pulses were used. They are separated in time by 200 microseconds. The first pulse creates a bubble. The bubble is filled with products of high temperature chemical decomposition of liquid. The microbubble has submicron or micron sizes. The second pulse undergoes diffraction scattering on a bubble. Thanks to diffraction, a bright ring (instead of Gaussian distribution) of illumination appears and is imprinted on the target.

Nanolaminates. The laser impact on laminates is fundamentally different from the impact on a homogeneous target. Echoes of reflections from contacts appear. During thermomechanical ablation of laminates, spalls within the layers alternate with spalls along the contacts between the layers.

Strengthening. We consider formation and propagation of laser shock waves (SW) generated by an ultrashort laser pulse. Our approach takes into account polymorphic phase transitions in the solid phase and geometric effects—the transition from a quasi-plane propagation regime to a three-dimensional (3D) SW. The fact is that the laser heating depth is small compared to the radius of the laser spot. Then the transition to the 3D regime occurs when the path traveled by the wave becomes of the order of the spot radius.