The approaches to increase of deposited energy density in condensed matter under irradiation by tightly focused femtosecond pulses

Annotation

In this work the approaches to increase of deposited energy density in condensed matter under irradiation by tightly focused femtosecond pulses are considered. The tandem two-color (620 and 1240 nm) excitation of fused silica allows for deposited energy density increase up to 12.9 kJ/cm^3. It was shown that tuning wavelength of the heating IR pulse to 1760 nm leads to a decrease of deposited energy density to 5.5 kJ/cm^3, which is associated with the decrease in the plasma formation threshold. Increasing the duration of the tightly focused laser pulse by introducing a negative chirp, the impact of two-photon absorption and plasma defocusing in the pre-focal region was significantly decreased. With this approach the maximum fluence of 0.13 J/cm^2 was reached in bulk silicon, which was enough to create micromodifications of material by tightly focused (NA = 0.85) 520-fs 900-nJ laser pulses centered at1.24 μm in multipulse regime (5 pulses, 10 Hz) and without solid-immersion.