GIGABAR SHOCK WITH FEMTOSECOND IRRADIATION OF NANOENGINEERED TARGETS

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We present a novel configuration for the generation of Gbar range shock pressures in bulk solid materials using multi-joule femtosecond lasers and targets with a layer nanostructured over-coating, properly designed to enhance energy absorption. The coating of nanostructures (nanowires) on the illuminated side of the target is the essential ingredient allowing a laser with modest (few Joules) energy to rapidly generate a hot and dense, several micrometer thick plasma with a large (multiGbar) internal pressure[1]. Rapid expansion of this layer acts as a piston, launching a strong, impulsive shock in the underlying target substrate (the bulk). Our model [2] clarifies the effect of nanostructure geometry on the distribution function of accelerated electrons and shows the dependence of shock breakout time vs laser absorbed energy and substrate target thickness.

A preliminary experimental campaign was carried out to investigate the role of nanostructures on fast electron generation and to characterize spatial and temporal evolution of rear-side optical emission in view of shock break-out measurements. Our data provide time-resolved measurements of rear-side emission, showing a strong emission localized on the laser axis, likely due to optical transition radiation from fast electrons and a following emission indicating bulk heating. An overview of current modelling along with recent experimental findings will be presented and discussed.

References

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