Microdroplet Plasma Heating Under Irradiation by an Intense Ultrashort Laser Pulse

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The use of microstructured targets in interaction with intense ultrashort femtosecond laser pulses is considered to be a uniquely convenient approach for the development of a compact, versatile pulsed source of secondary radiation. Innovative nano- and micro-sized targets, including sub-microwire array target, droplet (cluster) media, make it possible to effectively absorb laser energy, generate high energy electrons, X-rays, DD microfusion neutrons, etc [1–5].

In this study, we establish the matching condition for laser-micro-droplet parameters, which maximize the yield of hot electrons of the required energy upon irradiation of an ensemble of submicron-sized clusters by the ultrashort relativistically intense laser pulse. We geometrically optimize micro-droplet target parameters to increase the absorption of laser light and energy (temperature) and the number of hot electrons. In the optimum regime considered, a well pronounced stochastic wandering of electrons in the Coulomb fields of clusters is observed. Stochastic heating is clearly illustrated by the first time found a plateau in the energy distribution of hot electrons with super-ponderomotive energy, which contains a significant part of accelerated particles and the total kinetic energy of accelerated electrons. The generation of a large number of hot electrons, in turn, leads to the generation of a significant number of fast ions from the expanded clusters, for example, deuterons, and, accordingly, thermonuclear neutrons from DD reactions. The design of the laser target under consideration has the potential for use as a compact laser source of neutrons and X-rays.

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