BOOK OF ABSTRACTS
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distances from the irradiated CH target ($< 50\ \mu$m), the generated proton pulses are very short (< 20 fs), and the proton beam intensities and the proton current densities reach extremely high values, $> 10^{21}$ W/cm^2 and $> 10^{12}$ A/cm^2, respectively, which are much higher than those attainable in conventional accelerators. Such proton beams can open the door for new areas of research in nuclear physics and high energy-density physics as well as can also prove useful for applications in materials research e.g. as a tool for high-resolution proton radiography.

Keywords: laser-driven ion acceleration, proton beams, laser plasma

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Expansion of laser-ablated carbon plume to ambient argon

Tomasz Moscicki, Jacek Hoffman, Zygmunt Szymanski

Institute of Fundamental Technological Research PAS Pawinskiego 5B, 02-106 Warsaw

tmosc@ippt.pan.pl

ABSTRACT

Pulsed laser vaporization is a well-established method of synthesizing nanostructures. The synthesis of single wall carbon nanotubes (SWCNT) needs fairly high temperature and density over some milliseconds. These conditions appear during the laser ablation of graphite in an ambient gas. Then the confinement of the plume takes place and an external shock wave in the ambient gas is formed. Next, when the plasma cools down during expansion carbon and catalyst metal atoms condense into larger structures along a steep temperature gradient.

The aim of this paper is to gain better understanding into the dynamics of the plume and conditions that ultimately lead to SWCNT production. A hydrodynamic model that describes both the target heating, and formation of the plasma and its expansion, consists of equations of conservation of mass, momentum and energy and is solved in axial symmetry with the use of the Ansys-Fluent software package. It is assumed that the plume expands to ambient argon at a pressure of 6x10^4 Pa and temperature 1000 ^{o}C. The Nd:YAG laser is operating at a wavelength of 1064 nm with a pulse energy of 300 mJ and 10 ns pulse duration. The laser beam has top-hat profile and intensity of 0.66 GWcm^{-2} and is normal to the surface of graphite target. The results show that the maximum plasma temperature of 27000 K is reached 23 ns from the beginning of the laser pulse and decreases to 9000 K after 1000 ns. The results are in fair agreement with the experimental findings.

Keywords: laser ablation, plasma plume
