HIGH-POWER LASER INTERACTIONS WITH LOW DENSITY POROUS MATERIALS AND THEIR APPLICATIONS

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Abstract. First part of the lecture will be devoted to an overview of low density solid porous materials that are used in high power laser interaction experiments. Low density porous targets have been used for smoothing laser beam intensity modulations and for studies of laser-plasma instabilities in long hot corona relevant for shock ignition of inertial confinement fusion. They are also efficient sources of soft X-ray emission, potentially suitable for applications. They have been also used in studies of high energy density matter and in laboratory astrophysics. Electron and ion acceleration by intense femtosecond laser pulses in nearly critical plasmas formed from porous materials have also been investigated. Additionally, low density foams have been utilized as a mold of cryogenic targets.

Second part of the lecture will describe this year's experiment carried out in PALS laboratory in Prague. Three types of low-density porous targets were irradiated by intense sub-nanosecond laser pulses on the 3rd and 1st harmonics of iodine laser at laser intensities in the range 10^{14} – 10^{15} W/cm^2: a) plastic TMPTA targets of average density 10 mg/cc doped with 8 weight percent of chlorine, b) 3D graphene targets of average density about 7 mg/cc and c) 3D printed regular porous targets of average density 8 mg/cc composed of plastic wires of radius 2.2 μm. We measured the speed of ionization wave propagation into the low-density porous matter via X-ray streak. Laser energy transformation into fast electrons was detected via time-integrated spatially resolved absolutely K-α emission from the copper foil placed at the target rear side. Chlorine emission spectra from chlorine doped TMPTA foams were used for measurement of electron and ion temperatures. Experimental results are compared with the results of fluid simulations using our novel sub-grid model of laser interaction with low density porous matter incorporated into PALE and FLASH hydrodynamic codes.

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