Production of low-density targets for laser driven ion acceleration

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The performances of laser-driven ion acceleration [1] can be enhanced controlling laser-matter interaction through the design of suitably engineered targets. In this work we report on the production and testing of low-density targets to be adopted in novel laser driven ion-acceleration experiments exploring enhanced acceleration regimes.

As a possible way to enhance the maximum energy of laser-accelerated ions in the Target Normal Sheath Acceleration (TNSA) scheme, multi-layered targets having a near-critical density layer on the directly illuminated surface have been recently numerically investigated [2]. Low-density carbon foams can also be exploited in other acceleration schemes, like Hole-Boring Radiation Pressure Acceleration and Collisionless Shock Acceleration. Because of their extremely low density (few mg/cm^3 for laser wavelengths around 1 μm) and the possible request of good adhesion to the solid surface, the production and characterization of these targets is not straightforward.

In this frame, we report on the production of low density carbon foams by Pulsed Laser Deposition with thickness in the range 5-150 μm and densities down to 3-5 mg/cm^3. Foams were characterized through Scanning Electron Microscopy and Raman Spectroscopy [3] and their density was evaluated exploiting Energy Dispersive X-ray Spectroscopy. In particular, both nearly freestanding foams and multi-layered targets composed by a thin Al solid foil (0.7-12 μm) and a near-critical density carbon foam layer directly grown of its surface have been produced.

Laser-ion acceleration experiments employing multi-layered targets have been carried on at the UHI100 system, at CEA Saclay, within the frame of Laserlab EU program. For relatively low laser intensities (10^{16}-10^{17}W/cm^2), a systematic enhancement of the maximum ion energy has been observed in presence of the foam layer, allowing to reach the MeV range. More generally, the results of a parametric analysis of a wide number of target-laser interaction conditions will be presented.

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[3] A. Zani *et al.*, Carbon, **56** 358 (2013)