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Generation of nonthermal ion beams from layered targets irradiated by an ultraintense laser pulse

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Target normal sheath acceleration (TNSA) is one of the typical acceleration mechanisms when a foil target with thickness of a few micrometers is used. Usually protons having a Maxwellian energy distribution with a cut-off have been generated. However, on experimental observation, an ion enhanced double-layer target (IEDL) shows powerful to generate ions having a non-Maxwellian energy distribution [1]. We presented the density difference could lead these results between the layer materials of target by using an EPOCH simulation code [2]. And for the intense and monoenergetic ion beam generation, an ion layer embedded foil (ILEF) target has been proposed at KAERI to utilize a bulk electrostatic (ES) field [3]. The IEDL and ILEF target have a layered structure consisting of a metal foil and a CH-rich layer such as polymethyl methacrylate (PMMA, $C_5O_2H_8$) and carbon. To demonstrate the performance of the ILEF target, a cleaning laser is used to pre-ablate the contamination layer on the rear surface just before a main laser shot. Because the ions on the contamination layer are accelerated by a sheath field, which could disturb the ions accelerated from the CH-rich layers. The cleaning laser reached on the target rear surface about 100 ns earlier than the main laser pulse. Figure 1 (a) shows the experimental schematics and TPS images from an ILEF target without(up) and with(down) cleaning laser. Proton and carbon ions with an interesting non-Maxwellian energy distribution were generated. Figure 1 (b) and (c) show the non-thermal energy spectra of C^{6+} ions obtained from the IEDL and ILEF target respectively.

We will present such experimental results and simulation studies with IEDL and ILEF targets performed at KAERI and CoReLS, IBS respectively.

References

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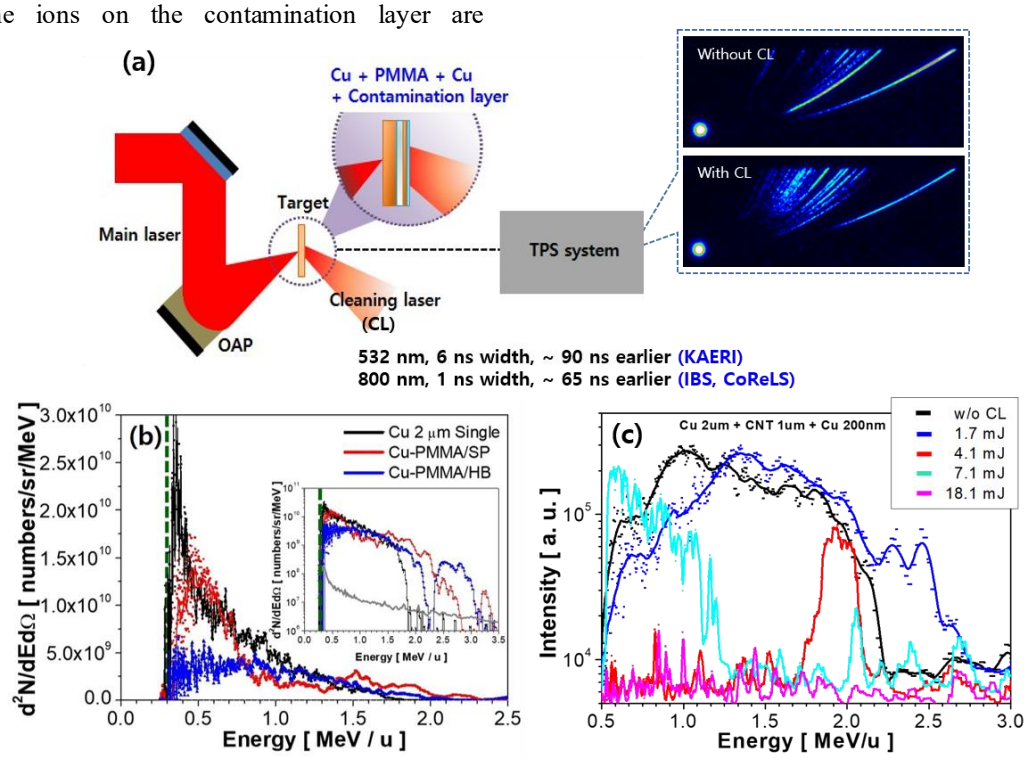

Figure 1. (a) Experimental schematics for ILEF target with cleaning laser to reduce the effect of ES field by contamination layer. (b) Non-thermal energy spectra of C^{6+} ions obtained from IEDL targets. (c) Non-thermal energy spectra of C^{6+} ions obtained from ILEF target with variable cleaning laser.