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Acceleration of high charged Au ions from interaction between an extremely intense laser and an ultra-thin Au foil suspended on a large-area suspended graphene target

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In laser ion acceleration, a number of researches have been done to increase energy of accelerated ions for applications, e.g. cancer treatment. However, protons exceeding 100 MeV, required for cancer treatment, have not yet been observed. It is considered to be necessary to decrease target thickness to increase accelerated ion energy. However, laser pre-pulse generates pre-plasma from interactions with the target before main pulse arrival. This process prevents efficient energy conversions to ions and thinner targets are affected by it seriously.

We have succeeded to produce a suitable target for laser ion acceleration, large-area suspended graphene (LSG) target [1]. LSG is single to multiple-layered graphene sheets on a hole with diameter of hundreds of micrometers. Graphene is a well-known material as the strongest and thinnest material in the world. Furthermore, because of such features, LSG can mount very thin foils made of various kinds of material as laser driven ion sources.

We suspended Au foils with a few nanometer thickness on LSGs. We irradiated it with an ultra-high intense laser, J-KAREN-P [2, 3]. We used a Thomson parabola spectrometer (TPS) to diagnose distribution functions of accelerated ions. X-ray spectra generated by the interactions of the laser and plasma were obtained by crystal spectrometers. We have observed accelerations of highly charged Au ions with TPS. We investigate the process of ionization and acceleration of such high charged ions with particle-in-cell (PIC) simulations.

References

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