§44. Investigation of Fast Electron Heating of Solid Cu Core Pertinent to Fast Ignition

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In Electron Fast ignition (FI), the energy of fast electrons generated by an ultra-intense, short-pulse interaction with a reentrant cone is deposited to the dense fuel of an imploded core, initiating ignition. For an efficient core heating, it is crucial to understand,

i) the effect of plasma surrounding the cone on energy coupling to the compressed fuel and
ii) the beam transport through cone tip into varying density compressed fuel. It is also important to understand as to
iii) how energy is deposited in the compressed core.

These issues are difficult to address in full scale integrated experiments. The objective of this experiment is to investigate the fast electron transport and heating using a solid Cu sphere (which mimics the compressed core) embedded in a foam target with a gold reentrant cone as a model experiment using surrogate core.

This study is to clarify the fast electron energy transport under an integrated experimental configuration relevant to fast ignition laser fusion. The experimental design has been based on our recent scientific achievements [1-9].As shown in Fig. 1 a foam plastic spherical shell (about 50 μm dia.) is prepared including a surrogate core of 35 μm dia. Cu sphere stucked on a Cu wire attached at the head of gold re-entrant cone. The foam shell may be replaced to a normal spherical shell. By observing Ka x rays from both Cu and Ti, we will obtain the information on spatially resolved image and x-ray spectral measurement. We will use a multi-channel electron spectrometer [3]. 9 beams of GEKKO XII laser system are used to irradiate the spherical shell. When an empty shell is used, LFEX ultra-intense laser pulse is injected into the re-entrant cone. The energy of the LFEX pulse will be 2 – 10 kJ with a 1- 10 psec pulse width. In our theoretical study [10], strong absorption of fast electrons is suggested based on the GMHD theory. This behavior is one of the most interesting focus points in this experiment. From the observation of Ka image and spectroscopy, we will estimate the fast electrons reaching the surrogate core.

Though we and staffs at ILE have tried to conduct this experiment within the fiscal year 2011, the shot time was not allocated unfortunately. It is appreciated if this unfortunate case is avoided especially in a frame of this international collaboration. UCSD has modified the Ka imaging device using their own budget in order to make this fit on the GXII experimental chamber. We have also completed the necessary modification using Grant-in-Aid for Scientific Research (Contract No.22246122).

Due to the several schedule shifts and finally the decision of no time allocation of the shots have involved some difficulties among the participating scientists from the abroad.

The details of the experiment have been discussed twice within the fiscal year making use of our participation to workshops.

We have been informed by ILE that our shots will be allocated in within 2013. The details of the experimental results will be included in the upcoming annual report.

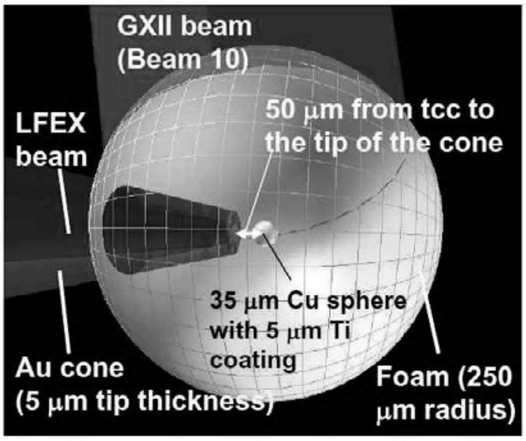

Fig. 1 A core sphere (35 μm Cu and 5 μm Ti coating) and Au cone embedded in foam. Other 8 GXII beams are not shown in the figure.

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