§33. Preliminary Study of Chamber Engineering for Fast Ignition Laser Fusion Reactor

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One of the major problems in the technological feasibility of the inertial confinement fusion reactor is the chamber that should accept pulsed load of radiation, ion particles and debris and be pumped out in the repeated pulsed operation cycle of several Hz. Especially in a fast ignition scenario, lead (or lithium lead) cones attached to the target fuel pellets add specific material transfer issues such as deposition on the chamber wall, ablation, and formation of clusters that are suspected to affect the pumping characteristics (Fig.1). Ablated metal particles from the wall are suspected to form various sizes of clusters that fly slower and more difficult to evacuate. This collaborative research will investigate the basic behavior of the ablated particles from the surface simulating laser fusion chamber.

Experiments were carried out using the EUV database laser and the target chamber at ILE, Osaka Univ. Thomson parabola is used for ion energy and charge state measurements, the quadrupole mass spectrometer is for detection of polymer particle, and the charge collector is for ion current of ablated particle along the time.

In fiscal year 2005, we observed time variation curve of mass number 27, 54 with Al target shows almost same, which we thought the 54 amu particles are estimated to be dimer of Al.

In fiscal year 2006, we have been trying to observe same evidence with Pb target. Thomson parabola detected lead ions of 1 to 7 charges with high energy (Fig. 2). Figure 3 shows a photograph of a Pb secondary target after experiments, where particles from a primary plastic target bombed on.
To detect polymer of Pb using QMS, we have worked on expand of QMS range by decreasing RF frequency; figure 3 shows the prototype of it. Using Pb vapor made by electron beam impact, we have been trying to measure Pb and multiple of it to prepare for laser ablation experiment now.

In the fiscal year 2007, we plan to continue this development and investigate time variation of emitted particles synchronized to laser pulse and identify the source of them.

Acknowledgement

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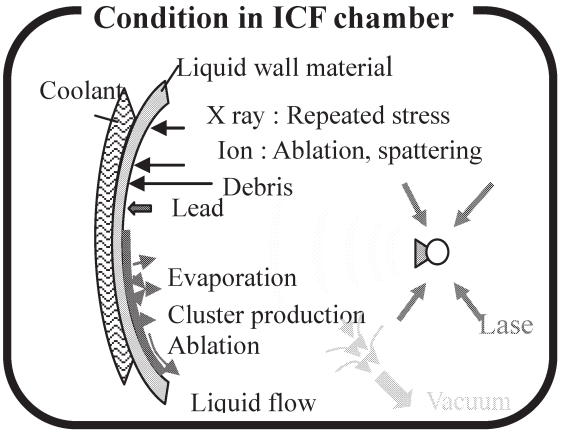

Fig. 1 Schematics of particle flow in ICF chamber

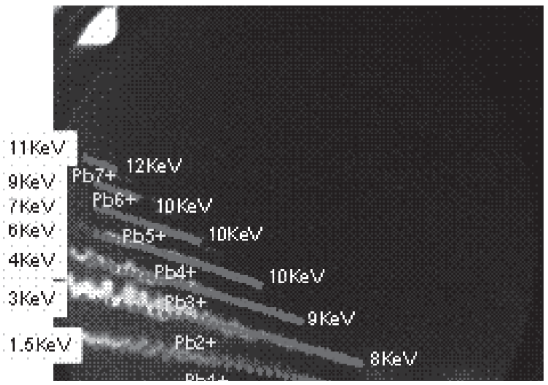

Fig.2 Tracks of ions observed by Thomson parabola.

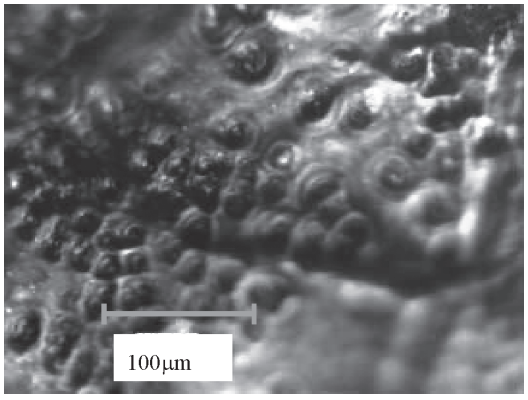

Fig.3 Surface of Pb target after experiments

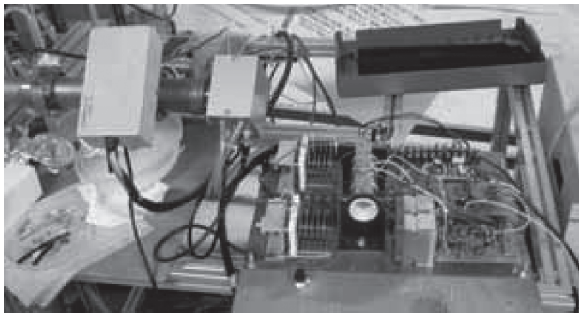

Fig.4 Prototype of wide-range QMS