§42. Study on Stagnations of Plumes in Laser Fusion Liquid Wall Reactor Chamber

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A design of laser fusion reactor with a liquid wall, KOYO-fast, is reported in Refs. 1-3. Fig. 1 shows the simple outline of the first wall of KOYO-fast.

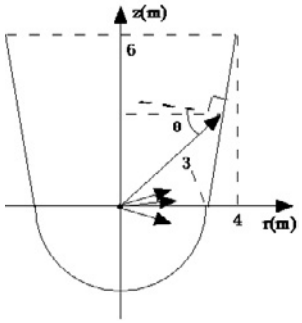

Fig. 1 The simple outline of the first wall of KOYO-fast.

To experimentally simulate the ablation process, laser irradiation is often used. We, however, found that ablation process by ions is quite different from that by lasers. The range of α particles in liquid Pb is about 10 μm. As the result, superficial liquid Pb evaporates as a high density, low temperature, plasma with low ionization rate. In this study, we have developed an integrated ablation simulation code DECORE (Design Code for Reactor) to clarify the ability of the chamber clearance.

Fig. 2 shows number density and velocity profiles of lead at the time a plume reaches to the center of the chamber. As shown in Fig. 2, ablated lead moves with velocities of roughly 40 km/s. To estimate number density and velocity is very important for analysis of collisions between plumes at the center of the chamber.

Fig. 3 shows diameters of clusters and condensation rate at the same time in Fig. 2. The regime x < 0.5m, clusters are created.

Collisions between plumes produced by ablation at the center of the liquid wall chamber are estimated. Collisions between plumes strongly affect a design of laser fusion reactor. Fig. 4 shows the time development of pressure distribution. Note that in Fig. 4, times from a collision starts are described. As shown in Fig. 4, at the time = 213 ms, near by the center of the chamber, pressure is roughly 10 Torr, and there is no aerosol at this time.

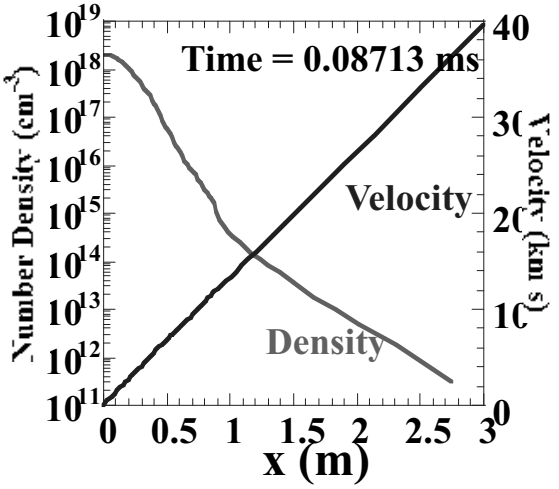

Fig. 2 Number density and velocity profiles of lead.

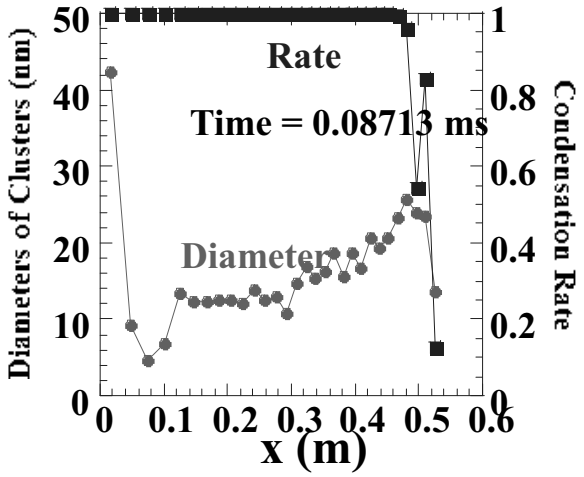

Fig. 3 Diameters of clusters and condensation rate.

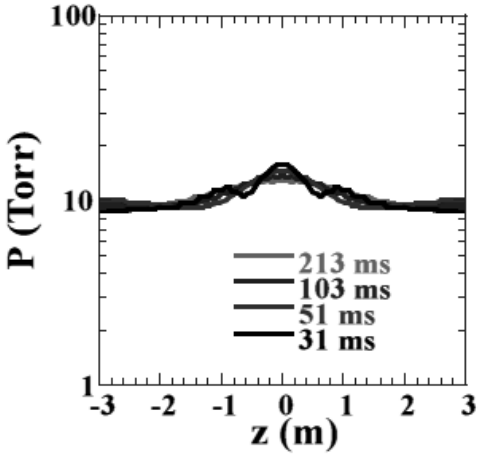

Fig. 4 Time development of pressure profiles.

[1] Y. Kozaki, Fusion Science and Technology **49** (2006) 542-552.
[2] Y. Kozaki et.al.; J. Plasma and Fusion Research **82** (2006) 817-837. (in Japanese)
[3] Y. Kozaki et.al.; J. Plasma and Fusion Research **83** (2007) 3-29. (in Japanese)