§13. The Repetitive Ice-pellet Injector for Applications to a Laser Oscillation in TPD-II

Namba, S. (Dept. Energy Eng. & Sci., Nagoya Univ.)

Nomura, I. , Sato, K.

Oda, T. (Dept. Applied Phys. & Chem. Fac. Eng., Hiroshima Univ.)

Studies for population inversions of atoms in plasma have been performed in the TPD-II device, by using high density helium plasmas in contact with neutral gases(H_2, He, N_2, Ne). At this stage, however, no sufficient gain of population inversions, which lead to a laser action, has been obtained. In order to get enough gain, electron temperatures has to be cooled down more rapidly. We tried to shoot iced pellet into a plasma instead of neutral gases. In research on the refueling of fusion oriented plasmas, various ice-pellet injectors have been developed. One of these, which is the droplet method of injector used for an internal target of the Cooler-Ring[1], has a promising potential for our purpose, that is, the intense temperature cooling.

Our apparatus which is expected to produce about 0.25mm hydrogen pellet is shown in Fig.1. The production procedure of the spherical ice-pellet is as following:

(1) H_2 gas with high purity is precooled to 77K by a closed-cycle He gas two-stage cryogenic refrigerator(①1st. cooling stage; cooling power 35W at 77K).

(2) This cooled gas is further cooled to 14K (② 2nd. cooling stage; cooling power 12W at 20K)

(3) Gases of H_2 are liquefied at the triple point. The temperature is controlled by feedback systems with a Si diode and a heater. Pressures are controlled by an absolute pressure controller coupled with control valves.

(4) Liquid droplets are produced by vibrating the nozzle(inner diameter 0.165mm pyrex glass) with a piezo electric transducer in the droplet formation chamber ③(controlled by pressure control valves).

(5) At last, a liquid droplet freezes by the free expansion into the vacuum region④. The vacuum chamber has to be pumped by large turbo molecular pumps(1500l/s and 500l/s) to exhaust the evaporated H_2 gas because the pressure has to be kept under near free expansions.

At present, we are starting an operation of injector, and collecting basic characteristics of an ice-pellet by this injector.

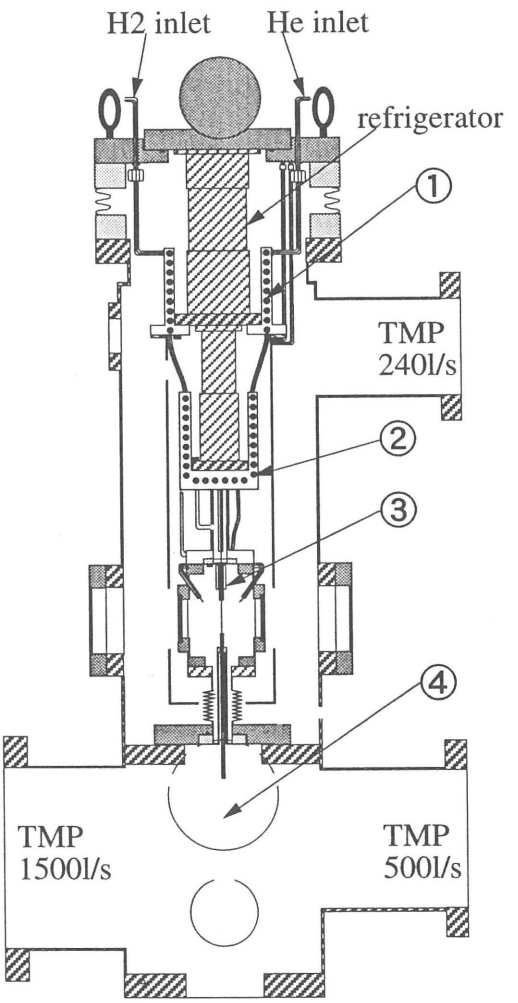

Fig.1 Schematic diagram of Ice-pellet injector.

References

1) B. Trostell, A Design Report, Uppsala University, Sweden(1990).