## §8. Study of IR Heating Technique with Cone Guide Temperature Control for Fuel Layering of FIREX Cryogenic Targets

Iwamoto, A., Sakagami, H.,
Iwano, K., Norimatsu, T., Nakai, M., Fujioka, S., Shiraga, H., Azechi, H. (ILE, Osaka Univ.)

i) Introduction

FIREX targets have been developed under two layering strategies: foam shell and cone guide laser heating methods.[1,2] To date proofs of their principles have been done. Then a new method employing Infrared (IR) heating is studied. IR heating itself has already been applied to implosion experiments on OMEGA in USA.[3] Our research is the modification of the IR technique to FIREX targets. The difficulty is to realize the temperature condition with spherical symmetry in the FIREX target shell because of the attached cone guide. The cone guide temperature control is a possible solution. We design and assemble a dedicated IR heating system.

ii) Designs of the IR heating and cone guide temperature control system

The idea of uniform fuel layering is shown in Fig. 1. This is based on the layering technique of the central ignition target for OMEGA experiments. When the IR irradiation is uniform onto the target shell, solid $H_2$ is sublimated from thicker parts and re-solidified to thinner parts because a thicker layer becomes higher temperature than a thinner. The temperature difference causes the driving force of the redistribution of solid $H_2$.

The configuration of the IR system is shown in Fig. 2. An integrating sphere is applied to uniformly irradiate a FIREX target with IR rays. Its wave length is 2219 nm, which is the same as that of the absorption peak of solid $H_2$.[4] The IR ray comes from a IR laser with ~3 mW through feedthroughs and optical fibres. A target must be located in the centre of the integrating sphere. On the other hand, the cone guide temperature is controlled by a heater glued on the cone to realize the temperature condition with spherical symmetry in the target shell.

The sphere is put in the dedicated cooling system.[5] The Gifford-McMahon (GM) cryocooler, RDK-415D (Sumitomo Heavy Industries, Ltd.) is used to cool it. The sphere can be cooled down at ~10 K. Therefore solidification experiments are possible.

iii) Experiment

A cool-down of the IR heating system was conducted. Then IR irradiation to the integrating sphere was tested. After the IR irradiation, the temeprature of the integration sphere was rised slightly. We have confirmed the validity of IR heating system at the cryogenic environment.

1) Iwamoto, A., et al., *J. Phys.: Conf. Ser.* **244** (2010) 032039.
2) Iwamoto, A., et al., *Nucl. Fusion* **53** (2013) 083009.
3) Stoeckl, C., et al., *Phys. Plasmas* **9** (2002), 2195.
4) Gush, H. P., et al., *Can. J. Phys* **38** (1960), 176.
5) Iwamoto, A., et al., *Fusion Eng. Des.* **81** (2006), 1647.

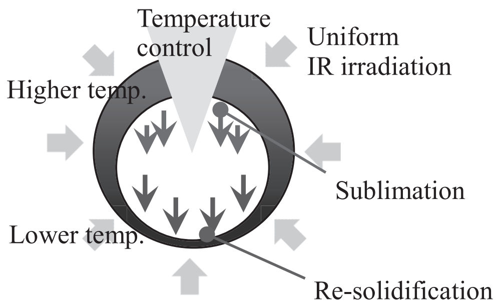


Fig. 1 Idea of uniform layering based on the central ignition target layering.

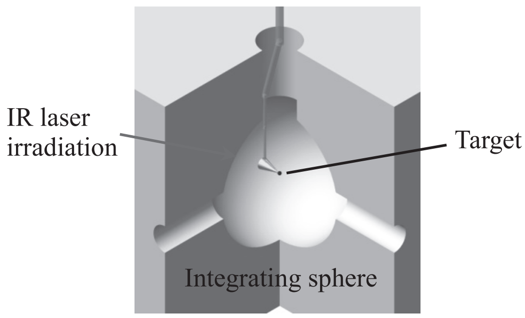


Fig. 2 Schematic of IR irradiation system. It is consist of an integrating sphere and an IR laser with ~ 3mW.