§3. Development of Cryogenic Foam Target with Guide Cone for FIREX-I

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In FIREX-I (Fast Ignition Realization Experiment) project, heating of a compressed-DT plasma to an ignition temperature is the final goal of the project. Laser technologies to provide 10 kJ in a few pico-second and target fabrication technologies are the critical path toward the goal. Figure 1 shows the cryogenic foam target for FIREX-I that consists of a solid DT layer supported by a low density foam layer, a gas barrier, a guide cone, and the fuel feeder pipe. Fabrication of low density, low atomic number foam and control of the fuel amount is the critical path because the foam is an impurity for fusion plasma and the fuel amount directly influences the implosion timing.

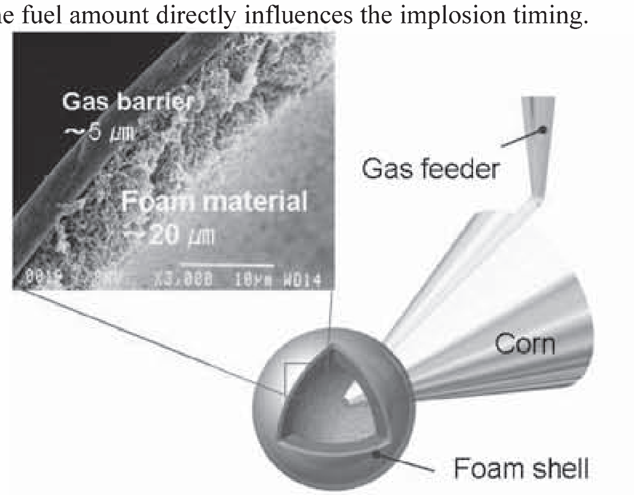


Fig. Cryogenic foam target with guide cone for FIREX-I

In 2005, the foam shell was developed at ILE under collaborative work with General Atomics, USA and the cryogenic experiment was carried out at NIFS.

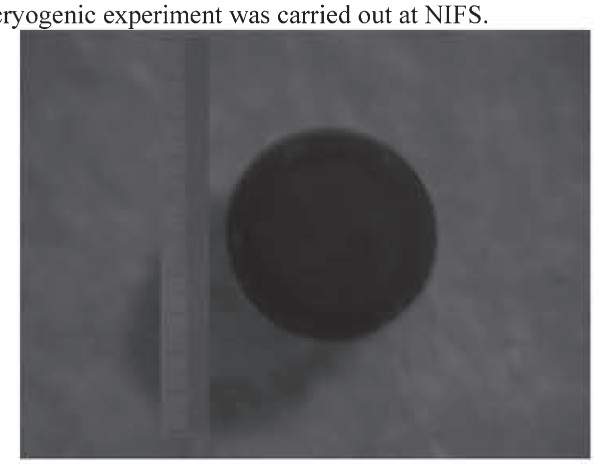


Fig. 2 Resorcinol-phloroglucinolcarboxylic acid /formaldehyde shell. Diameter 650 μm, the wall thickness 50 μm

Figure 2 shows a Resorcinol-phloroglucinolcarboxylic acid /formaldehyde shell whose material was newly developed at ILE this year. The thickness uniformity was much better than conventional RF foam and the control of thickness is more flexible because of the higher viscosity.

Current thickness uniformity was +/- 5% that should be reduced to +/- 2% and the density was 100mg/cc. We are now testing a new material to make foam shells with lower density.

At NIFS, control of fuel loading to the RF foam shell was examined in this year. Figure shows the first result for liquid hydrogen fill through the gas feeder pipe. Figure 3 shows experimental setup for interference observation of the foam shell.

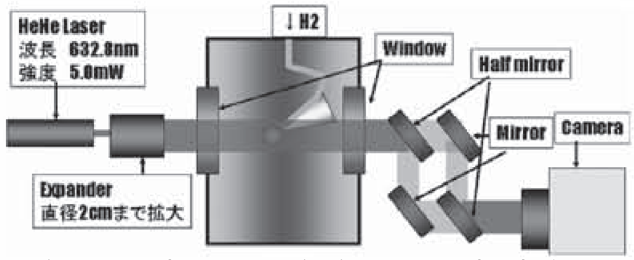
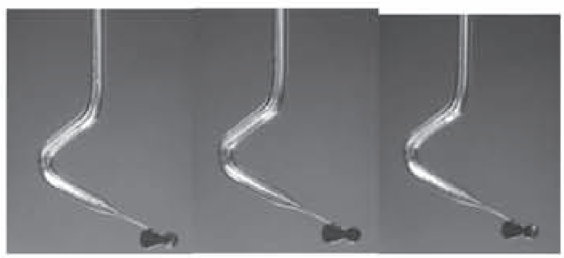


Fig. 3 Interference monitoring system for fuel control experiment.



(a) (b) (c)

Fig. 4 Dry foam (a) and partially filled foam (b) and fully filled with liquid hydrogen (c), respectively.

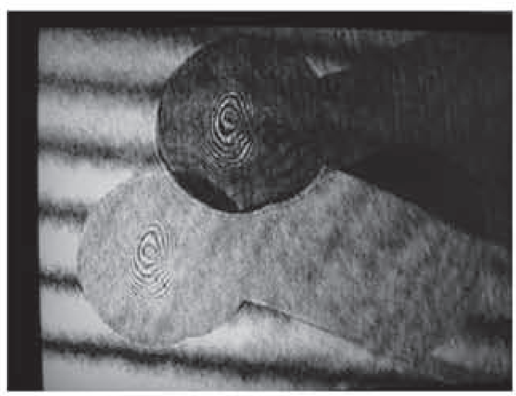


Fig. 5 Interference pattern of foam shell filled with liquid hydrogen, indicating uniform distribution of liquid hydrogen.

The foam shell became dark when it is partially filled with liquid hydrogen as shown in Fig. 4. We are considering that the reason can be attributed to the increase of scattering in the foam.