

§40. New Target Material Development for Modified FIREX-I

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New materials are required for target fabrications. Recently, new design of FIREX-I was released [1] as shown in Figure 1. Rayleigh-Taylor (RT) instability is one of the most challenging obstacles for achieving the goal of laser-fusion. In this decade, much effort has been exerted to suppress this instability. Fujioka et al. [2] suppressed this instability through stabilization of the RT instability by multi-ablation in a self-radiation target (SMART), which uses a ‘self-radiation target’ consisting a plastic capsule and a high-atomic-number dopant material. X-ray radiation emitted from high-atomic-number materials generates a new ablation front, and because of the longer density scale length, the multi-ablation structure homogenizes the plasmas, therefore, suppressing RT instability.

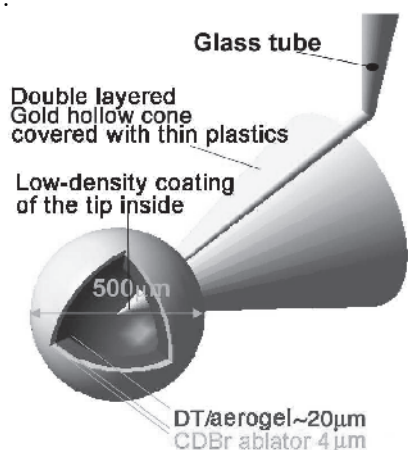


Figure 1. Schematic view of the cryogenic DT target with a plastic aerogel shell.

The high quality deuterated hydrocarbon target has been prepared by a density matched emulsion technique with use of deuterated polystyrene which was obtained from polymerization of deuterated styrene monomer. Doping of brominated compound induced a dissolution of halogenated hydrocarbon into water, and the use of brominated polymer cost high, then we have chosen a bromination of the deuterated polystyrene. The optimized synthesis method was slightly different from the previous report [2], for example, the solvent of the bromination. The weight ratio of Br in the obtained polymer was 3.5~8.5 % depending on the condition. Trace amounts of nitrogen was observed, maybe due to initiator of the polymerization. The sum of the concentration of C, H, N, and Br was 100+1%. According to their characterization bromine atom was not introduced to the aromatic ring but to the beta position as shown in Figure 2.

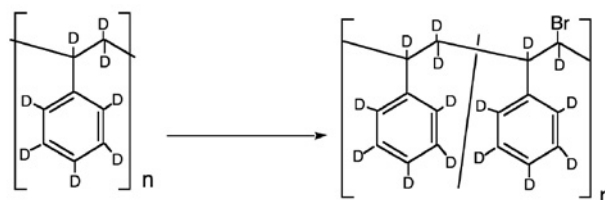


Figure 2. Scheme of the bromination to deuterated polystyrene.

The required concentration of bromine is 3.3 wt%, then it was mixed with non-brominated deuterated polystyrene in order to adjust the bromine content. The capsules were obtained using a modified density-matched emulsion technique. The mixture was dissolved into fluorobenzene and 1,3-difluorobenzene mixture whose specific gravity was 1.050. The obtained capsule was transparent without vacuoles. When the bromination was done using not distilled CH_2Br_2 , capsules had a vacuoles maybe due to very small amount introduction of hydroxyl group on the polystyrene.

For the fundamental studies of the multi-photon absorption, Tokyo tech group prepared optically high quality and thick film of brominated styrene, and supplied for the ILE experiment [3]

- 1) K.Nagai et al., “ Fabrication of aerogel capsule bromine-doped capsule, and modified gold cone in modified target for Fast Ignition Realization Experiment (FIREX) Project” *Nuclear Fusion*, **49**, 950028(9pp)(2009)
- 2) S.Fujioka et al., “Suppression of Rayleigh-Taylor instability due to self-radiation in multi-ablation target” *Phys. Rev. Lett.* **92**, 195001(2004)
- 3) K.Watanabe et al., “ Two-Photon Absorption in Styrene-Derivative Inertial-Confinement Fusion Target Materials” *IFSA2011.France*