ICF Target Support Highlights

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General Atomics, with our partner Schafer Corporation, serves as the ICF Target Support Contractor, providing target development and fabrication and target system engineering development to support the ICF program at five ICF Labs — LLNL, LANL, NRL, SNL, and UR/LLE. This informal newsletter contains highlights of that support for April 1998.

GA/Schafer onsite staff at LLNL, LANL, and SNL fabricated, machined, assembled and characterized more than 140 targets of various kinds for experiments on Nova, Omega, Trident and Z. We fabricated, characterized and delivered more than 400 targets and target components, including micromachined hohlraums, witness plates and foams to LLNL, LANL and SNL for shots on Nova, Omega, and Z, plastic and glass microballoon capsules to LLNL, LANL and UR/LLE for shots on Nova and Omega, and flat foil targets of various materials and configurations to NRL and UR/LLE for experiments on Nike and Omega.

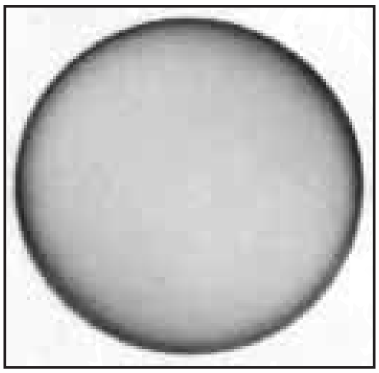

Fig. 1: Optical image of a 1740 µm glass shell made by the re-blowing technique. The starting mandrel was 1200 µm in diameter.

Currently, cryogenic DT layering experiments for the NIF are performed on plastic shells with attached fill tubes. While this technique has provided a great deal of information on the layering process, the fill tubes invariably introduce undesired perturbations in the measurements. Therefore, it is highly desirable to perform these experiments using shells that are capable of holding the desired DT pressure without the necessity of a fill tube. Traditionally, glass shells have proven to be excellent for this purpose, because of their high strength and low permeability to DT at room temperature. Glass shells are made using a drop tower technique which is currently incapable of making good quality shells greater than 1500 µm in diameter. However, for the NIF, large glass shells, that are close to 2 mm in diameter are needed.

Abbas Nikroo has developed a new technique that enables us to produce good quality glass shells up to 2 mm in diameter. Smaller (less than 1500 µm in diameter) glass shells made using the traditional drop tower technique are first filled with helium. They are then redropped through a short tower which has an approximately one foot hot zone heated to 950 °C. The glass shell softens at that temperature and the internal gas pressure blows the shell larger. Because the heated zone is short, the enlarged glass shell exits the hot zone and hardens before the helium can permeate out of the shell. The fill pressures depend on the amount of enlargement needed. The enlargement appears to be proportional to the cube root of the fill pressure extrapolated to 950 °C.

The requirements for the starting glass shells are stringent. In particular, these shells must be thick walled and have very good wall concentricity. The thick walls are required because as the shells expand, they also become thinner. The increased aspect ratio leads to buckling of many of the enlarged shells if the starting shells are too thin. In addition, starting shells with non-uniform walls will enlarge asymmetrically leading to oblate enlarged shells which cannot be used for layering experiments. With the current starting shells available the final shells are 1500-2000 µm in diameter and 2-3 µm thick. These shells are very fragile because of their very high aspect ratio. We are currently pursuing several ways of strengthening these shells to render them suitable for the layering experiments which will require pressures greater than 100 atmospheres.

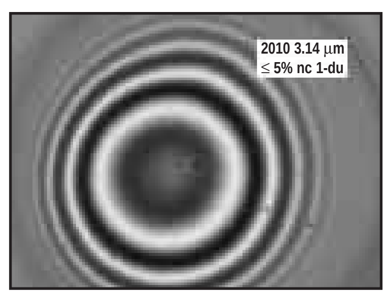

Fig. 2: Interferometric image of a 2002 µm glass shell. Many re-blown shells have smooth fringe patterns.

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