

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 September 1998.

GA/Schafer onsite staff at LLNL, LANL, and SNL fabricated, machined, assembled and characterized more than 200 targets of various kinds for experiments on Nova, Omega, Trident, and Z. We fabricated, characterized, and delivered about 250 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.

SNL's recent Z experiment successes have resulted in the scheduling of ICF capsule implosion experiments for fall of this year. We have just fabricated the first of the fuel capsules planned for these experiments. SNL experimenter, Joel Lash, requested a variety of capsules, some of pure CH and others of CH doped with 3.0 atom % germanium. The requested capsules had an inner diameter of 1600 μm and a wall thickness of 30 μm . What made these capsules challenging to fabricate was the fill gas requirements requested by Lash, 0.1 atm of a diagnostic gas containing sulfur, and 15 to 18 atm of hydrogen or deuterium. Sulfur-containing gases consist of very large molecules and thus do not permeate easily. Hydrogen and deuterium on the other hand, readily permeate through a polymer capsule.

Abbas Nikroo and Dave Steinman at GA, led a team that fabricated the capsules using the standard decomposable mandrel technique. A poly alpha-methylstyrene (PAMS) bead was overcoated with glow discharge polymer (GDP) coating and then pyrolyzed to remove the PAMS mandrel, leaving a hollow GDP shell behind. We used SF_6 as the diagnostic gas due to its generally inert and non-toxic nature. We found we could permeate this gas into the bare GDP shell, without damaging the shell, using a fill temperature of 200°C. At this temperature, 1600 \times 30 μm GDP shells had an SF_6 fill half-life of about 4 hours, while at room temperature they had a half-life of over two weeks. Thus, we filled the shells at 200°C to over 90% of the final fill pressure (0.1 atm) in a day.

To hold hydrogen or deuterium in the capsule, we coated the now SF_6 -filled shells with polyvinyl alcohol (PVA), a plastic having very low permeability compared to other polymers. Figure 1 below shows how this was done. We picked up the shell with a vacuum chuck and immersed about two-thirds of the shell in a solution of ~5% PVA in water. We withdrew the shell and inverted it so that the PVA solution would more uniformly cover the shell while it dried under a fiber optic light source. Next we transferred the shell to a second vacuum chuck that held it by the PVA-coated side and repeated the process of coating and drying the rest of the shell. The PVA layer averaged about 2.5 μm in thickness. We found the capsule fill half-life for hydrogen or deuterium at room temperature to be on the order of 10 days, providing enough time to mount the capsule and shoot with a nearly full gas load.

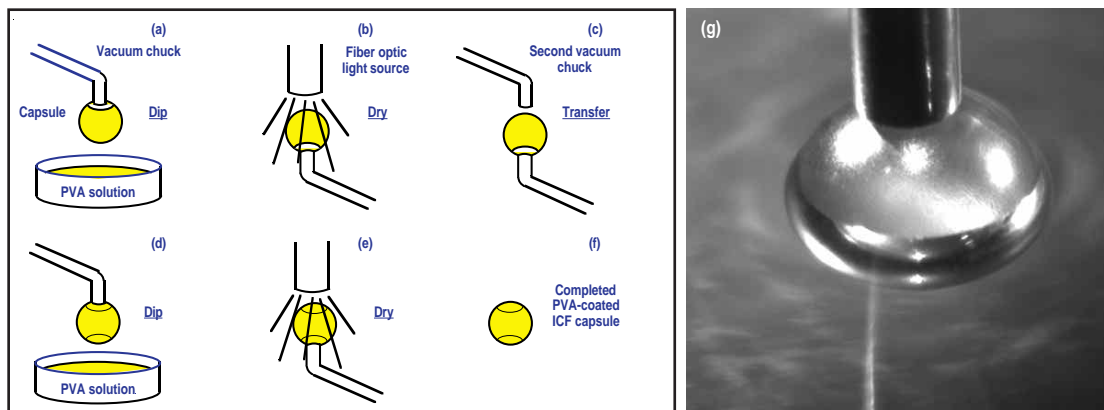


Fig. 1: The PVA coating process for SNL ICF implosion capsules. (g) Photograph of a 1.6 mm SNL fuel capsule being dipped into the PVA solution.

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