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 July 1999.

GA/Schafer onsite staff at LLNL, LANL, and SNL fabricated, machined, assembled and characterized more than 150 targets of various kinds for experiments on Omega, Trident, and Z. We fabricated, characterized, and delivered almost 460 targets and target components, including micromachined hohlraums, witness plates and foams, plastic and glass microballoon capsules, and flat foil targets of various materials and configurations to LANL, LLNL, NRL, SNL and UR/LLE for experiments on Nike, Omega, Trident and Z.

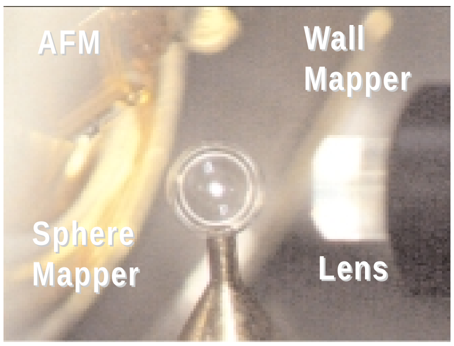

Fig. 1. Closeup of the combination sphere-mapper/wall mapper. An atomic force microscope for surface profiling is visible on the left. The wallmapper focussing lens is visible on the right.

The compression of targets can be limited by imperfections in their sphericity; any fluctuations in the outside and inside surface, and in the wall thickness are Rayleigh-Taylor unstable. Until now, only the outside surface defects have been measurable and have been analyzed. Recently, Steve Haan has developed guidelines for outer and inner surface and wall thickness fluctuations for modes up to eight, and there is a need to measure these fluctuations.

Rich Stephens at GA has developed an optical wall mapper which measures the shell wall thickness using the interference oscillations in light reflected from the outside and inside. White light is focussed from an optical fiber onto the surface of a shell. Light is reflected from both the outside and inside surfaces, back through the same lens to an adjacent fiber. The collected light is analyzed by a spectrometer. Interference between the light reflected from the two surfaces causes oscillations in the wavelength dependence of the reflections. With knowledge of the index of refraction of the shell material, the wall thickness can be calculated with a resolution of about 20 nm averaged over a spot about 130 microns across (for a 2 mm dia shell; it is smaller for smaller shells).

This device has been mounted on our Atomic Force Microscope (AFM) Spheremapper (Fig. 1) so that surface profiles and wall thickness measurements can be made along the same paths and subtracted to give inner wall surface profiles. Because of the size of the light spot — about 130 microns on a 2 mm shell — we can measure up to about mode 20. Along three mutually orthogonal paths (labeled 1, 2, and 3). The profiles and wall thicknesses for that shell are shown for three mutually orthogonal paths in Fig. 2(a) and Fig. 2(b), and the calculated inner profile in Fig. 2(c). The average outside, inside, and wall power spectra are shown in Fig. 2(d).

The data came from a bare poly-α-methylstyrene (PAMS) shell. It shows that the structure in the surface profile represents folding in the wall – not dents, because the wall thickness varies only very slowly.

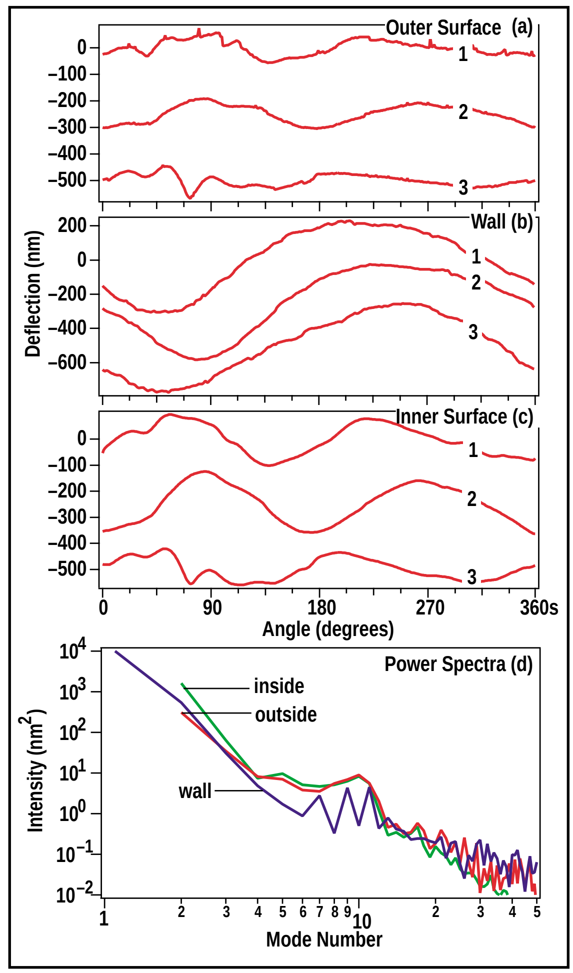

Fig. 2. Outer profile wall thickness and (calculated) inner profile for three orthogonal paths around a bare PAMS shell and the average power spectrum for each of these data sets.

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