Beryllium Capsule Coating Development for NIF Targets*

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Be is the preferred ablator material for NIF ignition targets because of its low opacity for x-rays as well as its high density which provides high ablating mass. Be coatings on spherical surfaces were first developed at LLNL with continued development at General Atomics using magnetron sputtering. Due to the nature of directional coating, sputter-deposited Be exhibits extended columnar grains. Various morphologies of the coated films have been observed, including nodular growth, cone growth and twisted grain growth. Consistent columnar grain structure has been obtained on capsules up to 170 μm thick using an agitation method that includes both reducing coating rates and bouncing and rolling the spherical mandrels. The inner surface and outer surface roughness were studied by interferometry, atomic force microscopy spheremapping and radiography. The deformation of shells has been observed on CH mandrels after Be coating. Improved surface roughness from mode 3–10 has been observed on thicker CH mandrels. Coatings on Si mandrels exhibit even smoother finishes through these modes. Density measured by weighing and radiography suggests that the sputtered Be is 93%–95% of bulk density. This is consistent with the observations of voids and other defects by transmission electron microscopy, which showed 100–200 nm size voids in the film and striations inside the grains. Ultra small angle x-ray scattering measurements confirm the existence of pores of various sizes in the coatings. Possible reasons for the leakage of the D_2 gas sealed in the shells are through connected pores or other defects. Interrupting the columnar grain structure with thin B-doped amorphous Be layers resulted in improvements to fuel gas retention half life.

*This work was performed under the auspices of the U.S. Department of Energy by General Atomics under Contract DE-AC03-01SF22260, by the University of California Lawrence Livermore National Laboratory under Contract W-7405-ENG-48, and by Los Alamos National Laboratory under Contract W-7405-ENG-36.