Collaboration Between Material Scientist and Engineers Created a Manufacturing Process Using Casting and Encapsulating Techniques Combined with Diamond Turning to Fabricate Thin-walled Aerogel End Caps on Laser Hohlraum Targets

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Lawrence Livermore National Laboratory (LLNL) manufactures laser targets for physics experiments on large laser systems such as the National Ignition Facility (NIF) and the Omega Laser in Rochester, NY. These targets are complex precision systems that require novel materials, engineering and manufacturing processes. A recent hohlraum development experiment required low density, 100 mg/cc, tantala, Ta2O5, aerogel hohlraums with 140 mm end caps that could not be manufactured or structurally supported once they were created. To fabricate these targets a stainless steel mold was first fabricated and the low density aerogel was cast in place. This provided structural support and a fixturing point for manufacturing other features in the target. A second version of this target required a high density tantala foam at 4.0 g/cc, which required both a different material processing technique and a second manufacturing plan. Since this material preparation procedure involves pressing of powders at high pressure and temperatures (30 ksi, 1100°C), the casting technique for the low density aerogel could not be used. For this design the manufacturing process first created a cylindrical foam piece and then encapsulated it in an epoxy mold to provide the structural integrity for manufacturing and structural support of the end caps. To create these targets required a combined effort between material scientists and engineers to create designs that could be both manufactured and survive as freestanding targets. The typical, and the new hohlraum target designs and manufacturing processes will be shown. The formulation of the materials and casting techniques will be discussed. The manufacturing processes and the fabrication results of building these targets will be shown.

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