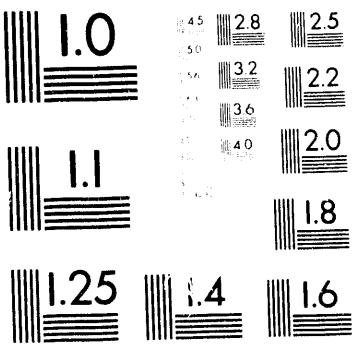
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LITHIUM THERMAL TARGETS SHOT ON PBFA II

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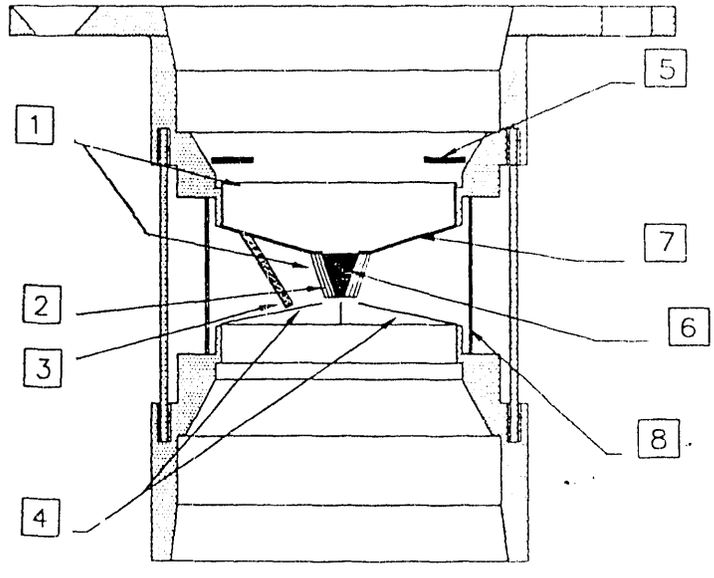
ABSTRACT

Recent lithium ion beam experiments on PBFAII have required intricate targets to measure beam performance and to study target physics issues. Because of the stopping power difference between lithium ions and protons, these targets have presented significantly increased challenges for material preparation and handling compared to previous proton shots. The greatest challenges included complex shaped gold hohlraums, CH foams of densities ranging from 3 to 6 mg/cm3 and vacuum seals covering large areas with a thickness under 1um. Details regarding assembly and characterization of lithium thermal targets will be described in this poster.

Poster Session of the Ninth Target Fabrication Specialists' Meeting, July 5-8, 1993, Naval Post Graduate School, Monterey, California.

The Lithium Thermal Targets are composed of 8 main components:

1. 15 um Parylene-D hourglass (for support)
2. 1um Parylene-D center cone window
3. 2um Ti on Al strip for beam characterization
4. Current return wires (3 Al; 1 Ti)
5. Brass X-ray Block
6. Low-density TPX foam
7. 4um gold foam retainer
8. Mylar vacuum seal



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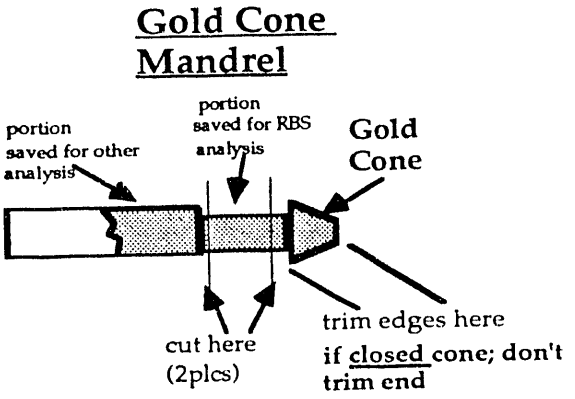
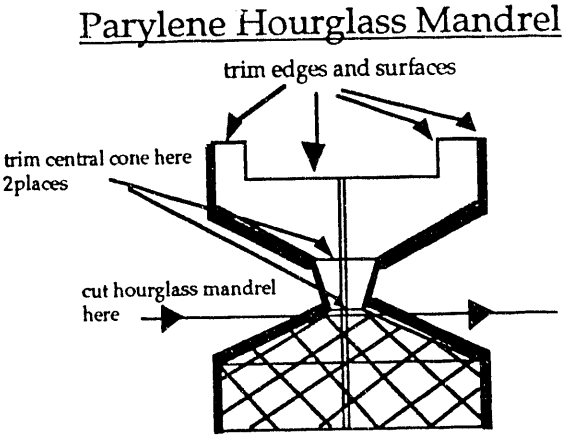
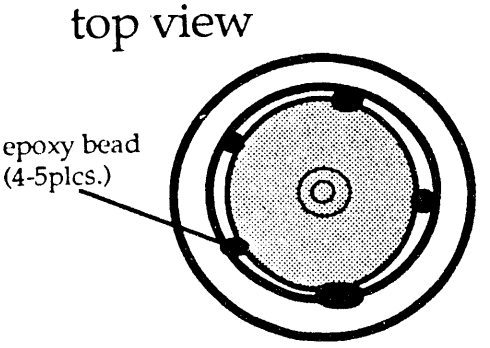
Mandrels were machined from extruded Lucite and coated with gold or parylene. The edges were trimmed (see illustrations) and the mandrels extracted in acetone. Parts were rinsed in clean acetone and installed into the brass target body in the following order.





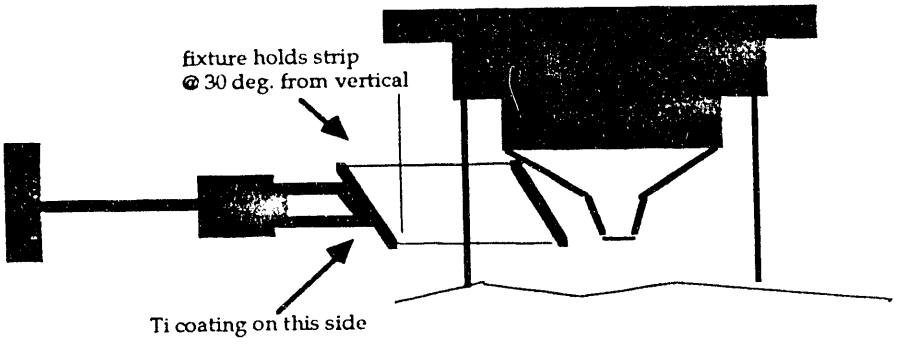
1. The parylene hourglass was secured to the top half of the target with 5 minute epoxy.



2. The bottom half of the target body was secured to the top half; spacers were used to insure proper heights.

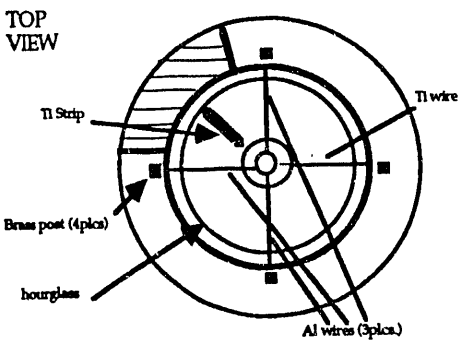
3. The target body was placed into an acetone bath and the gold cone (suspended in acetone) was floated gently into the hourglass. Excess acetone was carefully removed from the target assembly.

4. The titanuim strip was lined up to the proper orientation using a micro-manipulator and attached to the target assembly with 5 minute epoxy applied to the backside of the strip.

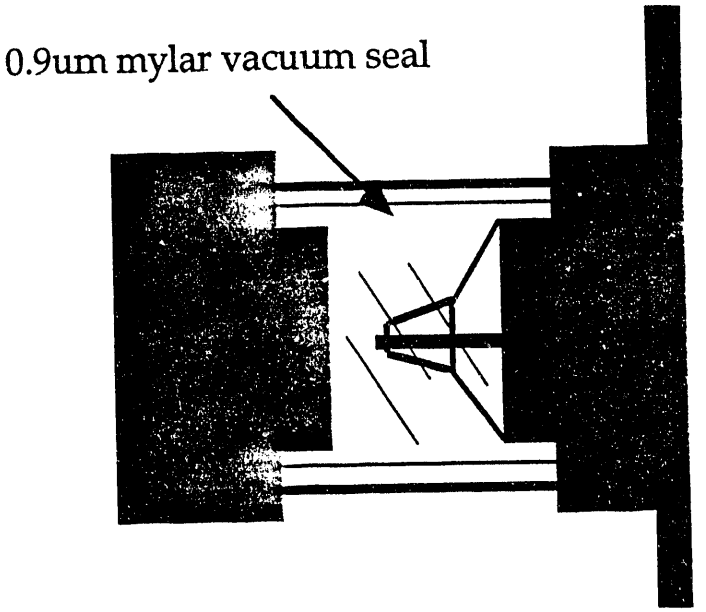


5. Four current return wires (3-.25mm Aluminum; 1-.25mm Titanium) were secured to the lower half of the target body with 5 minute epoxy.

Current Return Wire Locations



6. The .9um Mylar vacuum seal was wrapped around the inner ledge of the target body and secured around the circumference and at the seam with a small bead of Polysulfide sealant (PR-1201-Q). The target assembly was placed in an oven at 60 °C for 18 to 24 hours to cure the sealant.



7. The TPX foam (still containing the durene/naphthalene solvent) was loaded into the hourglass. The 4um gold foam retainer was placed over the foam to prevent air currents from shifting it. The target assembly was then placed into a freeze-drier for several hours to sublime the solvent from the foam.

8. After the foam was freeze-dried, the gold foam retainer was secured with 5 minute epoxy, The X-ray beam block was then installed and secured with 5 minute epoxy.

9. Before each target was delivered, radiographs were taken, comparator measurements were performed, and numerous photographs were taken to document alignments, concentricity and overall appearance.

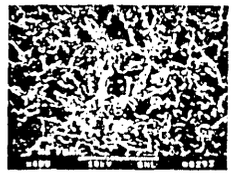
Rutherford backscattering techniques as well as profilometer measurements were performed on samples of the gold coatings to verify thicknesses. Scanning Electron Microscopy was also used to analyze the titanium coatings and the TPX foams. Samples of RBS, profilometer, and SEM analysis results are shown below:

Lithium/Thermal ICF Shot Series 1992-1993 Target Data

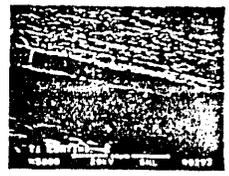
Preshot #	Target #	Date	Parylene Thickness (microns)	Gold Cone Thickness (Microns) RBS	Gold Cone Thickness (Microns) W. Slide	Gold Cone Thickness (Microns) Nominal	Foam Density (mg/cc) Nominal	Foam Density (mg/cc) Measured	Ti Strips (microns) W. Slide	Ti Strips (microns) Wt./Area	Concentricity Au Cone (mm) Axial	Concentricity Au Cone (mm) Lateral
2015	LT1092.6	2/19/93	1.2 m	1.0254	1.032	1.0	6	4.753	1.898	2.816		0.2990/.321
2016	LT1092.7	2/25/93	1.1 m	0.4636	0.514	0.5	6	4.753	2.028	1.863		0.2870/.325
2017	LT1092.8	3/3/93	1.3 s	1.0339	1.055	1.0	3	2.378	1.898	2.218		0.2720/.127
2018	LT1092.5	3/8/93	1.2 m	1.0280	0.991	1.0	3	2.378	1.898	2.816	0.2930/.327	
2019	LT1092.10	3/12/93	1.6 m	0.4833	- -	- -	- -	- -	1.898	2.246		0.1250/.406
2020	LT1092.11	4/1/93	1.3 m	1.0068	0.972	1.0	6	4.753	1.898	1.944		0.1190/.255
2021	LT1092.13	4/7/93	1.2 s	0.5085	N/A	0.5	6	4.753	1.898	2.204	0.1016/.117	
2022	LT1092.1	4/9/93	1.3 s	1.0678	1.055	1.0	6	4.753	2.028	1.790	0.1840/.340	
2023	LT1092.2	4/14/93	1.3 s	1.0483	1.030	1.0	3	2.378	2.028	1.971	0.1650/.405	
2024	LT1092.18	4/16/93	0.97 s	1.0614	0.989	1.0	3	2.378	1.898	2.412	0.1440/.329	

Notes
(1) (2) (3) (4)
1 Parylene thickness "m" denotes thickness determined by mass measurement; "s" denotes thickness determined by stylus measurement of a witness slide. Parylene "D" is used; its formula is $(C_8H_8Cl_2)_n$
2 Foam density determined by weight/volume measurement of foam billet
3 Ti strip coating thickness determined by area/weight measurement vs. density
4 Concentricity: the first of the two numbers refers to the large cone truncation, while the second refers to the small cone truncation

3mg/cc TPX Foam



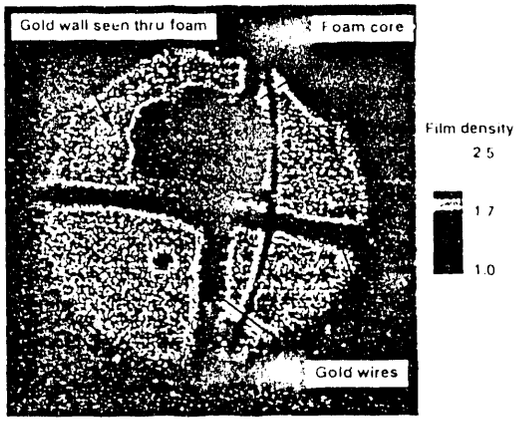
Side View of Titanium-coated Beam Characterization Strip



Some examples of the data obtained from this most recent series of experiments are illustrated below:

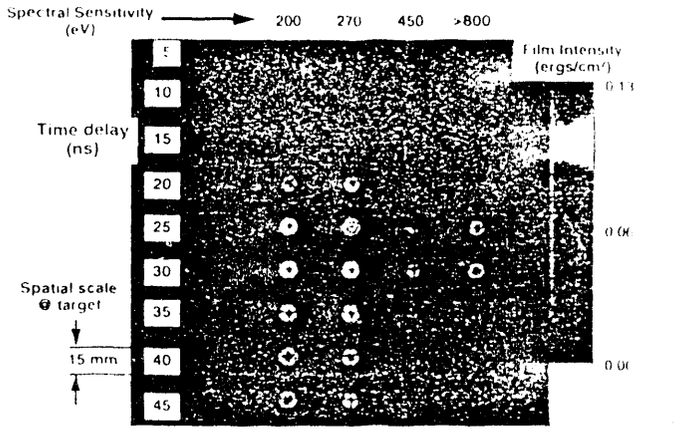
Lithium hohlraum

The soft x-ray image of thermal source target indicates the foam is optically thin



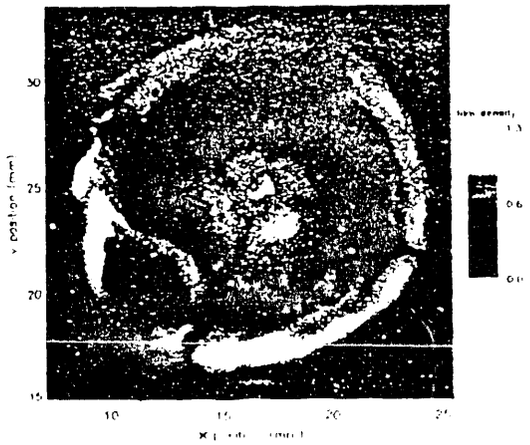
Lithium hohlraum

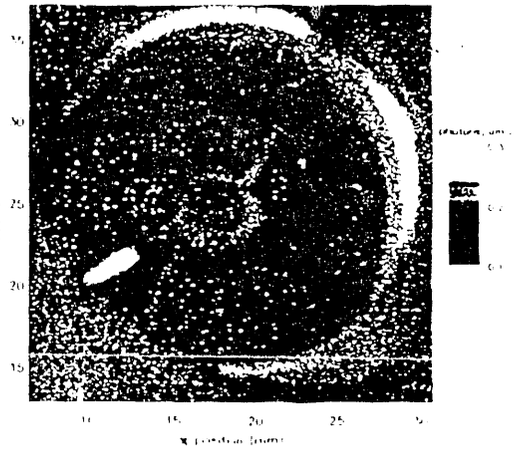
A time resolved image of the source shows the optically thin foam tamps the gold wall



Hard X-Ray Images of Open and Closed Cones Containing Optically Thin Foams

Shot 5975 Cam3 Filt1
Neutral Density mylar, Chem Foam





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