Three Dimensional Printing Capabilities Used by Target Fabrication at the Laboratory for Laser Energetics

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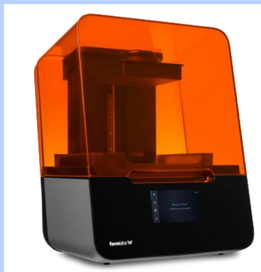
Millimeter-Scale Printer – Formlabs

Form 3

- Total build volume: 14.5 × 14.5 × 19.3 cm
- Layer thickness: 25 μm to 300 μm
- Resolution: 50 μm
- Resin: liquid photopolymer

Clear resin is most commonly used by Target Fabrication at LLE



Micron-Scale Printer—Boston Micro Fabrication

microArch® S230

- Total build volume: 50 x 50 x 50 mm
- Layer thickness: 5 μm to 20 μm
- Resolution: 2 μm
- Resin: photosensitive resin (HTL Yellow Resin)

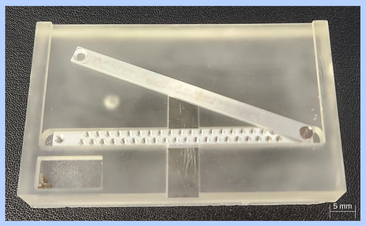
Submicron-Scale Printer—Nanoscribe

Photonic Professional GT2+

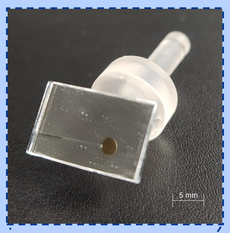
- Total build volume: 100 x 100 x 800 mm^3
- Layer thickness: 0.3μm to 5.0μm
- Resolution: 400 nm to 1000 nm
- Resin: acrylate

IP-Dip2 is most commonly used by Target Fabrication at LLE

Fixtures, Jigs and Tools

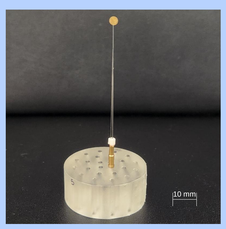


This fixture secures storage eggcrates containing capsules decreasing the possibility of loss or damage



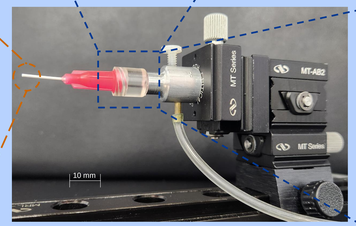
A mirror attachment with a 45° angle creates an accurate edge on view during assembly

A fixture holds a strainer to allow printed parts to be removed from their substrates and soaked in isopropyl alcohol in a controlled manner



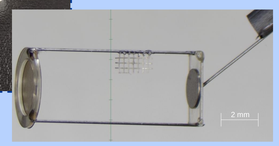
Blocks are printed to hold individual or multiple target assemblies and can be sized accordingly to fit specific storage needs

The fixture is 4 mm total in length with a 100-μm-thick wall, and a 1.6-mm-long, 100-μm-diameter vacuum channel fits inside the bore of a vacuum chuck

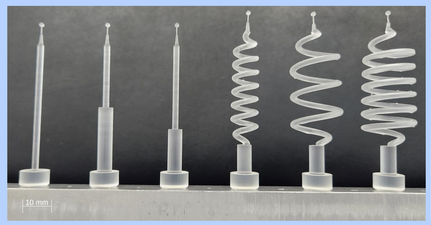


A lure lock adapter was printed to attach a vacuum chuck to a micromanipulator, which allows vacuum control while making fine movements

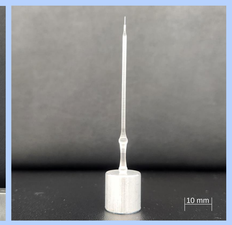
MagCShockPAR-J-24A
A jig was designed to aid in assembly of precisely aligned targets



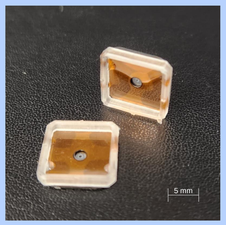
Production Ready Products



StalkEMP-EP-24A
Target stalks are printed to cut down on assembly time and can be designed for electromagnetic pulse reduction

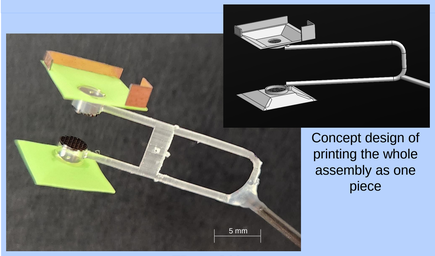


Multi-Terawatt laser



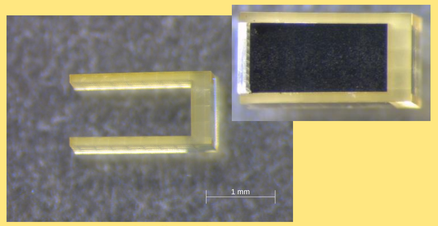
MgOLiqXRD-EP-24A
Part number Q-FA-C-338 is a support frame for powder x-ray diffraction image plates

CISImprint-23A
Part number Q-FA-C-498 are gold-coated cones with a 500 μm opening to seat a drilled capsule



TDyno-24A
A tuning fork fixture was used to create a set distance between two grids; fixtures like these simplify the assembly of multipart targets

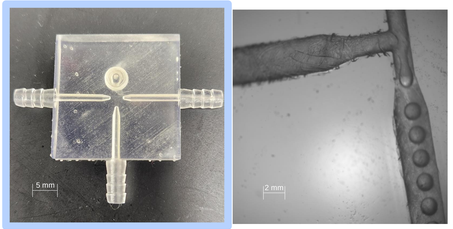
Concept design of printing the whole assembly as one piece



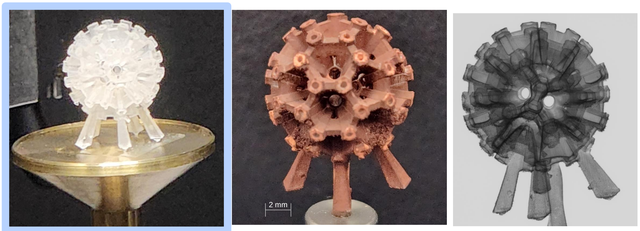
D2Radiography-19A
Printed housing along with Kapton windows and a modulated foil were used to encapsulate a foam block

A concept targe with an 850-μm OD capsule and an 8-μm wall, was printed for future use on OMEGA; a 50-μm drain hole was added to the print to allow for resin drainage

Parts Used for Research and Development

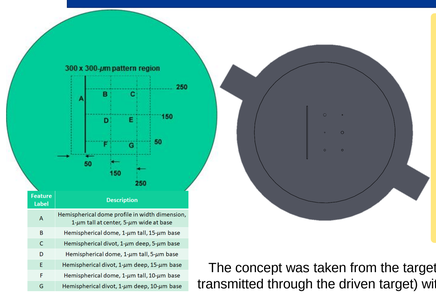


Printed on the Formlabs Form 3 printer; microfluidic channels were made to demonstrate successful emulsions of oil and water; in this example, oil flow is dispersed, and water flow is continuous though a 1.7 mm channel

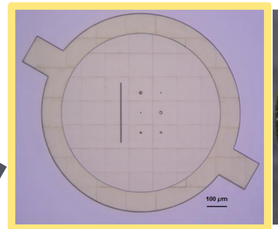


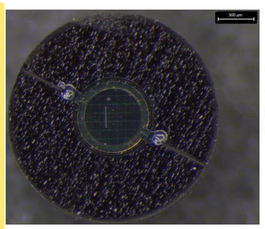
Printed on the Formlabs Form 3 printer; this 12-mm-sized replica of the OMEGA chamber was used to test electroless copper plating; the part was then imagined on the Bruker Skyscan221 XRM

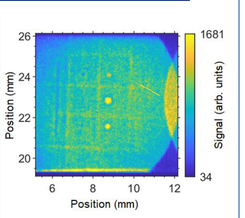
Full Target Life Cycle



Feature Label	Description
A	Hemispherical dome profile in width dimension, 1-µm tall at center, 5-µm wide at base
B	Hemispherical dome, 1-µm tall, 15-µm base
C	Hemispherical divot, 1-µm deep, 5-µm base
D	Hemispherical dome, 1-µm tall, 5-µm base
E	Hemispherical divot, 1-µm deep, 15-µm base
F	Hemispherical dome, 1-µm tall, 10-µm base
G	Hemispherical divot, 1-µm deep, 10-µm base







TargetDefects-24A
The concept was taken from the target request, designed in SolidWorks and then printed on the Nanoscribe Photonic Professional GT2+; the radiograph (x-rays transmitted through the driven target) with line feature on the left, domes in the center, and divots on the right. Increase signal corresponds to reduced areal density, and we use the modulation of the signal for comparison to calculations

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