Overview of High Density Carbon Capsules for Weekly Layered NIF Target Builds

N.G. Rice,¹ C. Kong,¹ E.L. Alfonso,¹ W. Sweet,¹ J.W. Crippen,¹ F.H. Elsner,¹ T. Bunn,³ and J. Biener²

¹General Atomics, P.O. Box 85608, San Diego, California 92186-5608
²Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California 94550
³Akima Infrastructure Services, LLC, P.O. Box 808, Livermore, California 94550

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NIF set the goal of fielding at least one ice-layer target per week

One ice-layer per week requires a reliable and flexible target supply

*Thanks to Becky Butlin & Chris Choate
HDC capsules for NIF cryo-targets require multi-month lead times

2017 HDC CFTA Process Flow

Start → 6 weeks → 12 weeks → 18 weeks → 21 weeks → 25 Weeks

- SI Mandrel
- Coating
- Polish
- Drill
- Leach
- Met
- CFIA
- Target Assy & Met
- Vendor
- Diamond Materials
- GA
- Capsule Selection
- LLNL

Campaign leaders do not want to wait ~6 months between experiments
• Goal is to reduce time-to-market
Improvements on rate-limiting steps can reduce overall processing time

- *Mandrel Acquisition – 6 weeks
- Coating/Polishing – 6 weeks, governed by physics of the process
- *Leaching – 6 weeks (for 5 μm drill hole)
- *CFTA – 2 weeks
Optimization in HDC capsule processing has reduced time-to-market by ~10 weeks and enhanced process reproducibility.

2017

Si Mandrel → Vendor → Diamond Materials → Coating → Drilling → Leaching → Metallizing → CFTA → Target Assy & Met.

2019

Coating → Polish → Drilling → Leaching → Metallizing → CFTA → Target Assy & Met.

~25 weeks

Capsule Selection

~15 weeks
Standardizing mandrel sizes and prepositioning at Diamond Materials reduces lead time by ~6 weeks.

Specifying capsule inner diameter ranges allows bulk acquisition of mandrels increasing flexibility and lowering time & cost within a size range.
Implementing pressure leaching process* on average reduces 5 μm drill hole leach time by 80%!

Manipulating the reaction generated gas bubble improves fluid exchange and reduces etch time

*Details in Casey Kong’s presentation
Pressure leaching provides feasibility of further improvements such as 2 μm fill tubes*

Further improvements underway to increase repeatability of small hole laser drilling

*Details in Jay Crippen’s presentation
Implementing universal parts streamlines fill tube assemblies*

Newer target design allows flexible location of joint as long as it’s outside the hohlraum

Glue joint matches diagnostic band

Glue joint no longer on diagnostic band

Build cycle can begin before capsule selection
CFTA assembly becomes limiting step following capsule processing rate improvement.

Capsule can be group processed into “bins” ready to be assembled into CFTAs.
Implementing universal parts streamlines fill tube assemblies*

- Historical target design required the CFTA to be glued to the diagnostic band at the fill tube-polymicro joint.
- Standardized fill tubes eliminate a sequential build step and allow prefabrication.

\[ 3.991 \text{ mm} \]

\[ \begin{align*}
\text{Capsule} & \quad \text{Fill Tube} & \quad \text{Polymicro Tube} & \quad \text{VCR} \\
\text{Glue Joint} & \quad \text{Glue joint matches diagnostic band} & \quad \text{Diagnostic Band} & \quad \text{Not to scale}
\end{align*} \]