Foam Shell Characterization Status

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Laser IFE meeting

NRL

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GENERAL ATOMICS

FY01 Foam Characterization Workscope

- **Develop and demonstrate foam shell characterization methods which meet NRL specifications**
  - **Diameter and sphericity (4 ± 0.2mm, 1% of radius)**
  - **Wall thickness (289 ± 20 μm)**
  - **Nonconcentricity (W_{max}- W_{min} = 1% of average wall)**
  - **Areal density variation (<0.3%)**

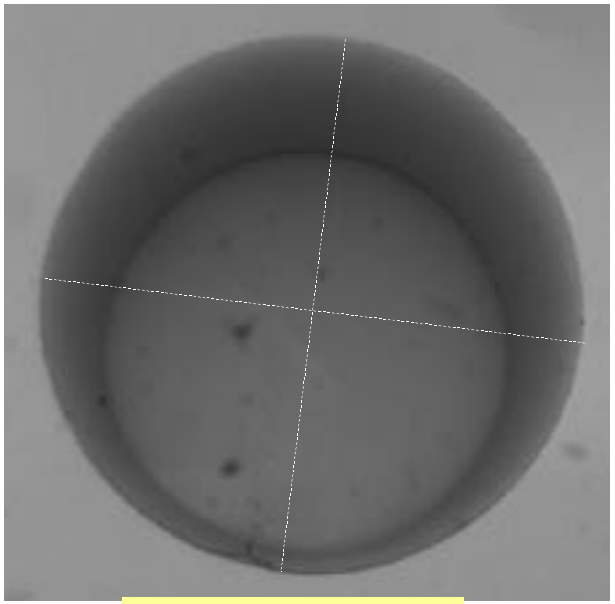
- **Support DVB foam shell process development**

Many techniques used for ICF targets may be adaptable to IFE target characterization

GENERAL ATOMICS

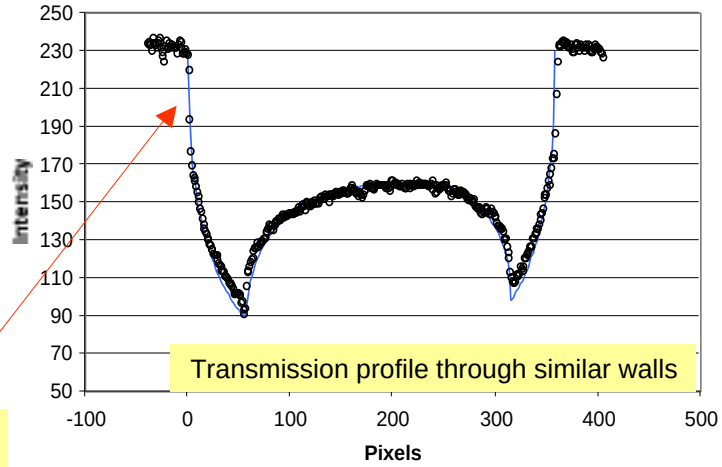
Shadowgraphy as a Direct Method for Determining Many of the Properties of Interest

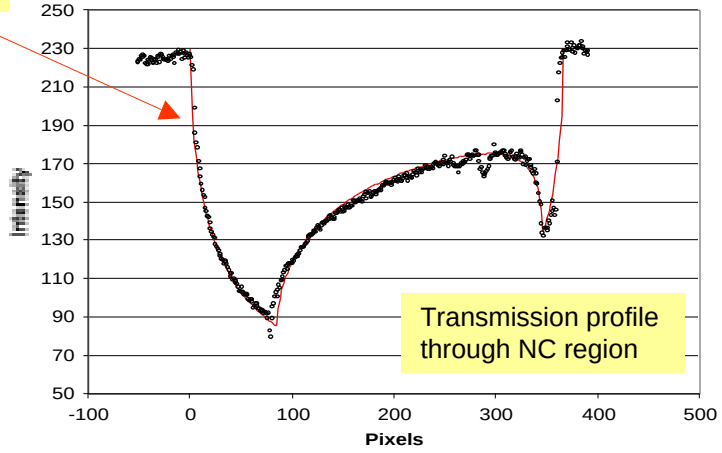
- **Shadowgraphy can be used for diameter and sphericity**
- **Initial tests indicate that wall thickness and concentricity might also be determined by shadowgraphy**



TMPT Foam Capsule

Points are data. Lines are model.

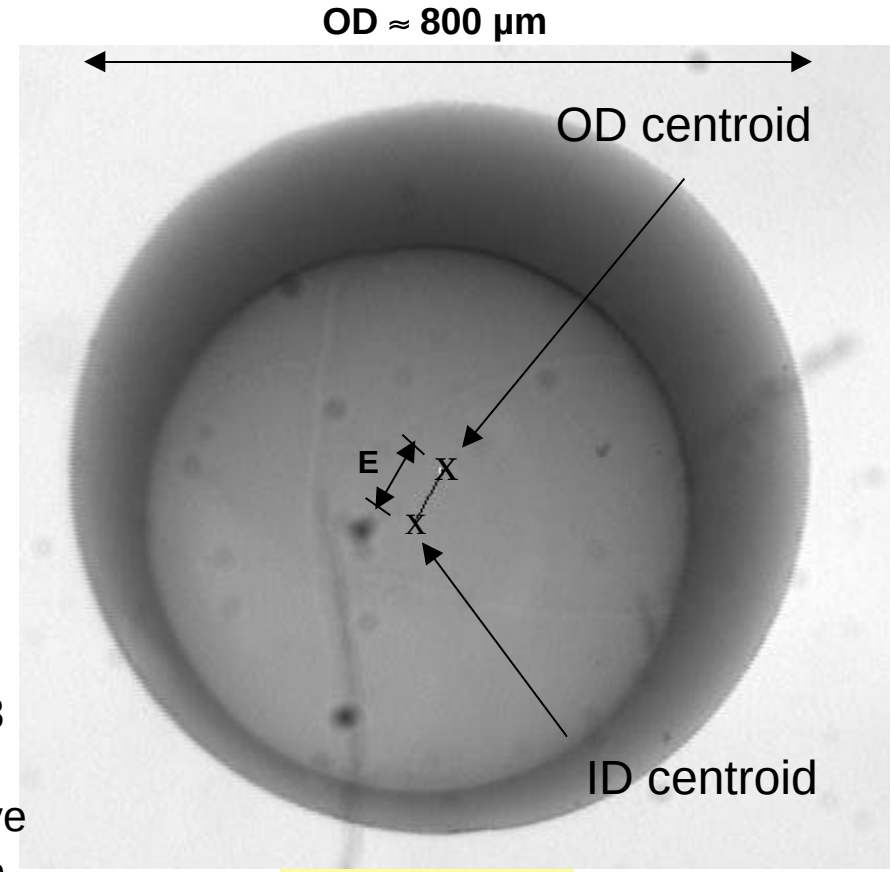




GENERAL ATOMICS

Shadowgraphy – Centroid location

- **Shadowgraphy software can find edges and determine centroids for internal and external elipses**
- **Current NRL spec would require ∆centroids < 1.5 micron – can we measure that accurately by shadowgraphy?**



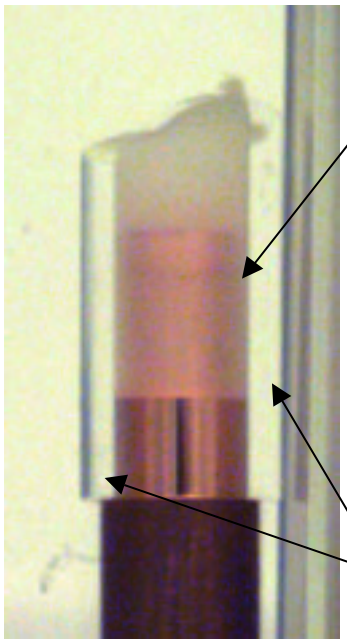
TMPT foam shell

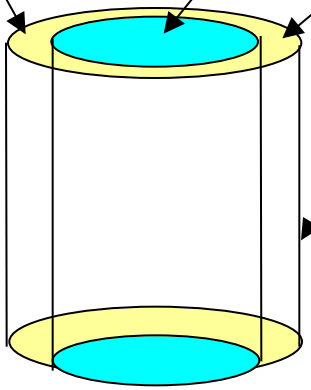
E = 67 µm
NC=E/w
Avg w = 98
NC= 68%
NC by curve fitting=60%

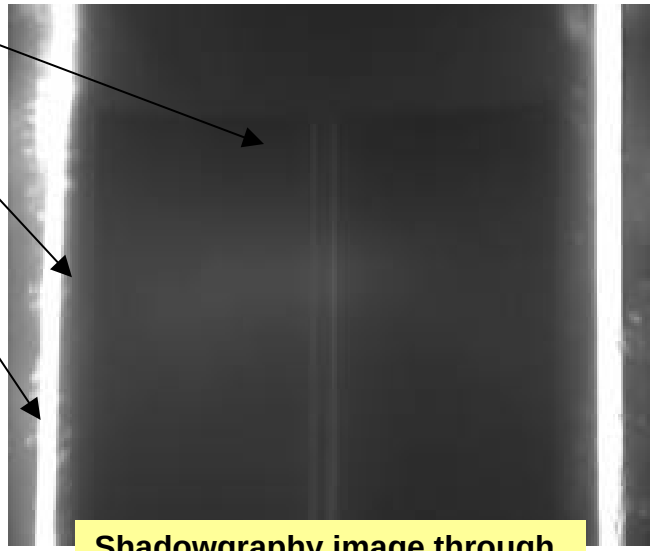
GENERAL ATOMICS

Annular Foams Can be Used to Determine Measurement Accuracy

- Annuli can be used as surrogates for developmental work until foam capsules are available
- Annuli allow us to determine the accuracy of measurements







Shadowgraphy image through copper filled annulus

GENERAL ATOMICS

Interferometry for Concentricity and Wall Thickness

- Interferometry is the standard process used for concentricity and wall thickness characterization of ICF targets
- We can obtain fringes through RF foam capsules – we will need to optimize the index mismatch (maximize index difference while minimizing scatter) for DVB foam and determine accuracy

-For known foam density → Fringe offset from center provides nonconcentricity value

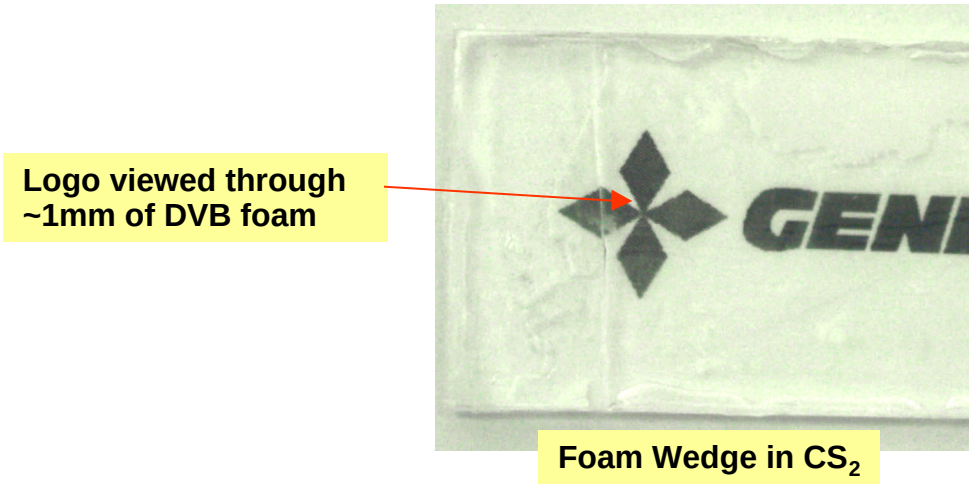
-If thickness is known by shadowgraphy, density can be determined → Wall thickness is determined by using interference pattern to locate interfaces

Fringes observed through an RF foam capsule

GENERAL ATOMICS

Foam Areal Density

- FTIR and UV-Vis spectrometry will be investigated for areal density measurements
- We will need to create a narrow beam width and will have to develop techniques for centering the beam on the foam capsule
- CS_2 can be used as an index matching fluid to minimize scatter and absorption interference
- Results will be compared with other, less harmful, and/or less expensive fluids (mineral oil, CCl_4, etc.) of different refractive indices



GENERAL ATOMICS

Issues and Future Work

- GA provided Schafer with molds from which foam annuli have been cast with fixed OD and ID (4 mm and 3.4 mm respectively). These will allow us to determine the accuracy of our characterization methods at the dimensions of interest with DVB
- For 4 mm capsules, we are working at the limit of our current microscopy equipment. To improve accuracy, we are examining alternative microscopes and CCD's
- We are exploring commercial systems which may be adapted for automation and scale-up of characterization tasks.