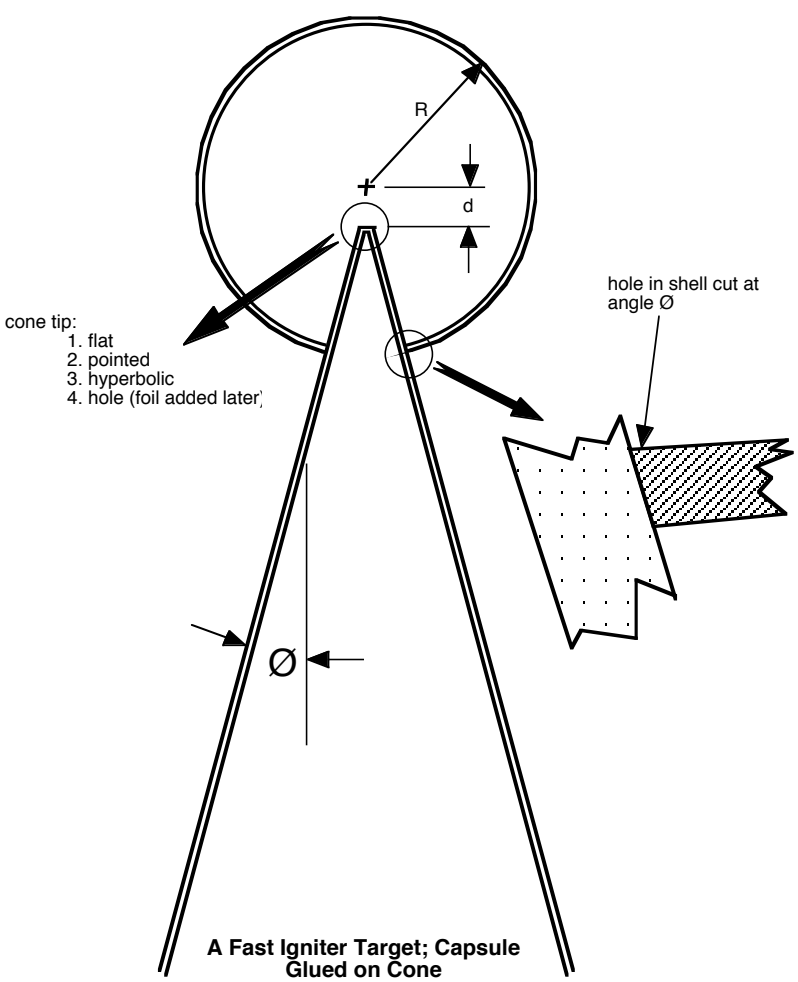
Fabrication of Fast Ignition Targets

- **Requires collaboration between three centers at GA**
  - Center for Target Component Fabrication and Fabrication Development
    - Jim Kaae, Joe Smith, Jason Wall, Clyde Shearer
  - Center for Polymer and Coating Development
    - Abbas Nikroo, Erwin Castillo, Don Czechowicz, Barry McQuillan
  - Center for inertial Fusion Capsule Production
    - Dave Steinman, Dale Hill, Steve Grant, Annette Greenwood

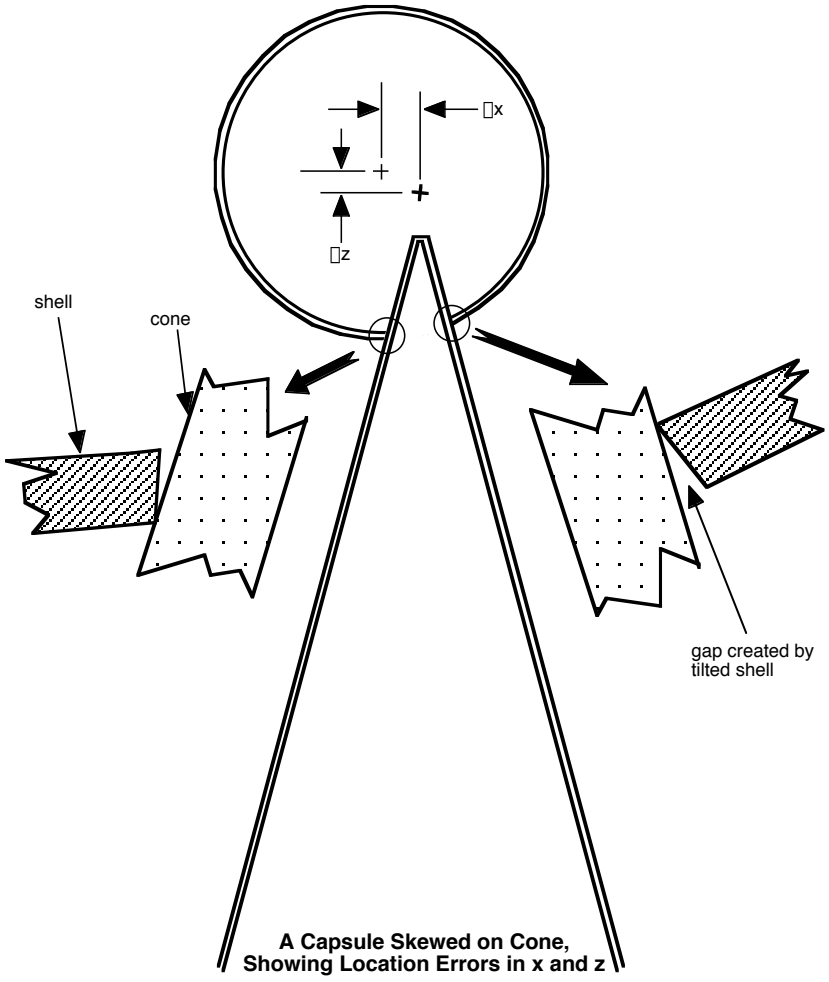
The Two Parts of the Targets are Fabricated Simultaneously

- **Fabrication of Cones**
  - Fabricate copper mandrel
  - Coat mandrel with gold
  - Back machine gold coating to desired shape and thickness
  - Remove copper mandrel by acid etch
- **Fabrication of Shells**
  - Prepare PAMS mandrel
  - Coat mandrel with GDP (metal doped)
  - Bore hole in shell
  - Clean and pyrolyze
  - Measure shell OD, wall thickness, and hole diameter

Shell Positioning was Difficult with Initial Cone Design

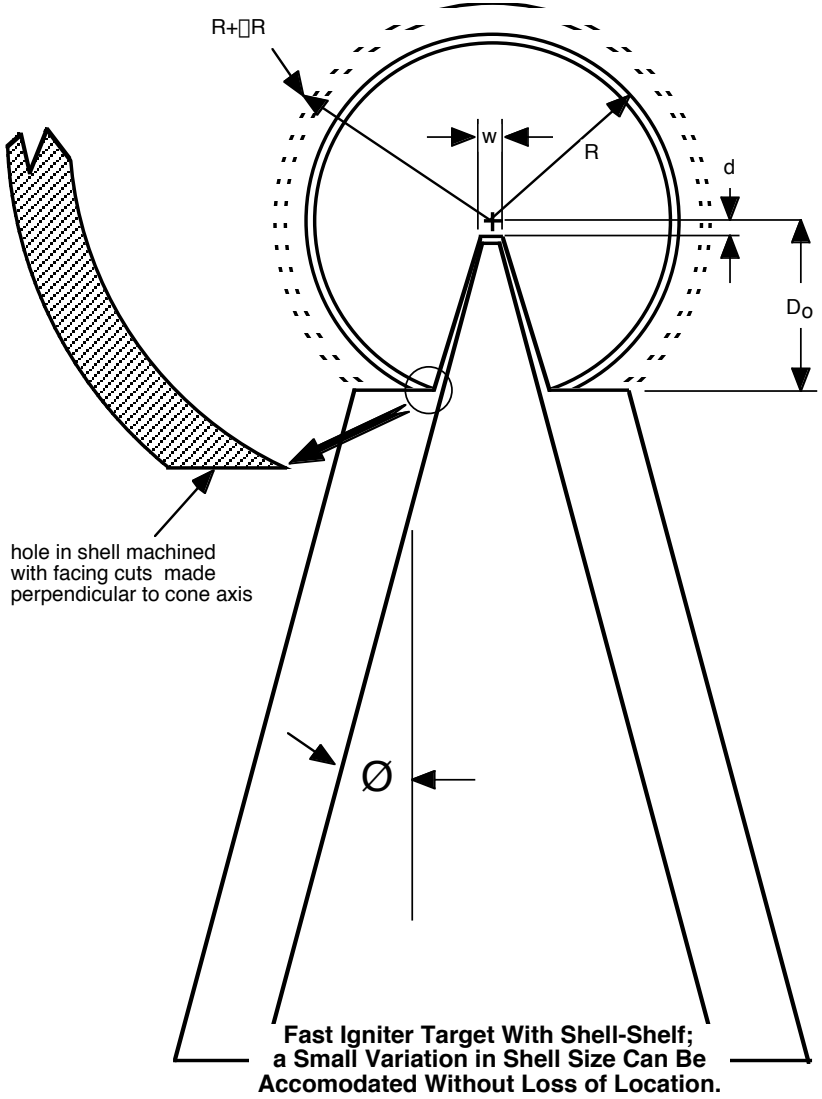


A Fast Igniter Target; Capsule Glued on Cone



A Capsule Skewed on Cone, Showing Location Errors in x and z

Diagram of Shell Mounted on Cone with Shelf



Fast Igniter Target With Shell-Shelf; a Small Variation in Shell Size Can Be Accomodated Without Loss of Location.

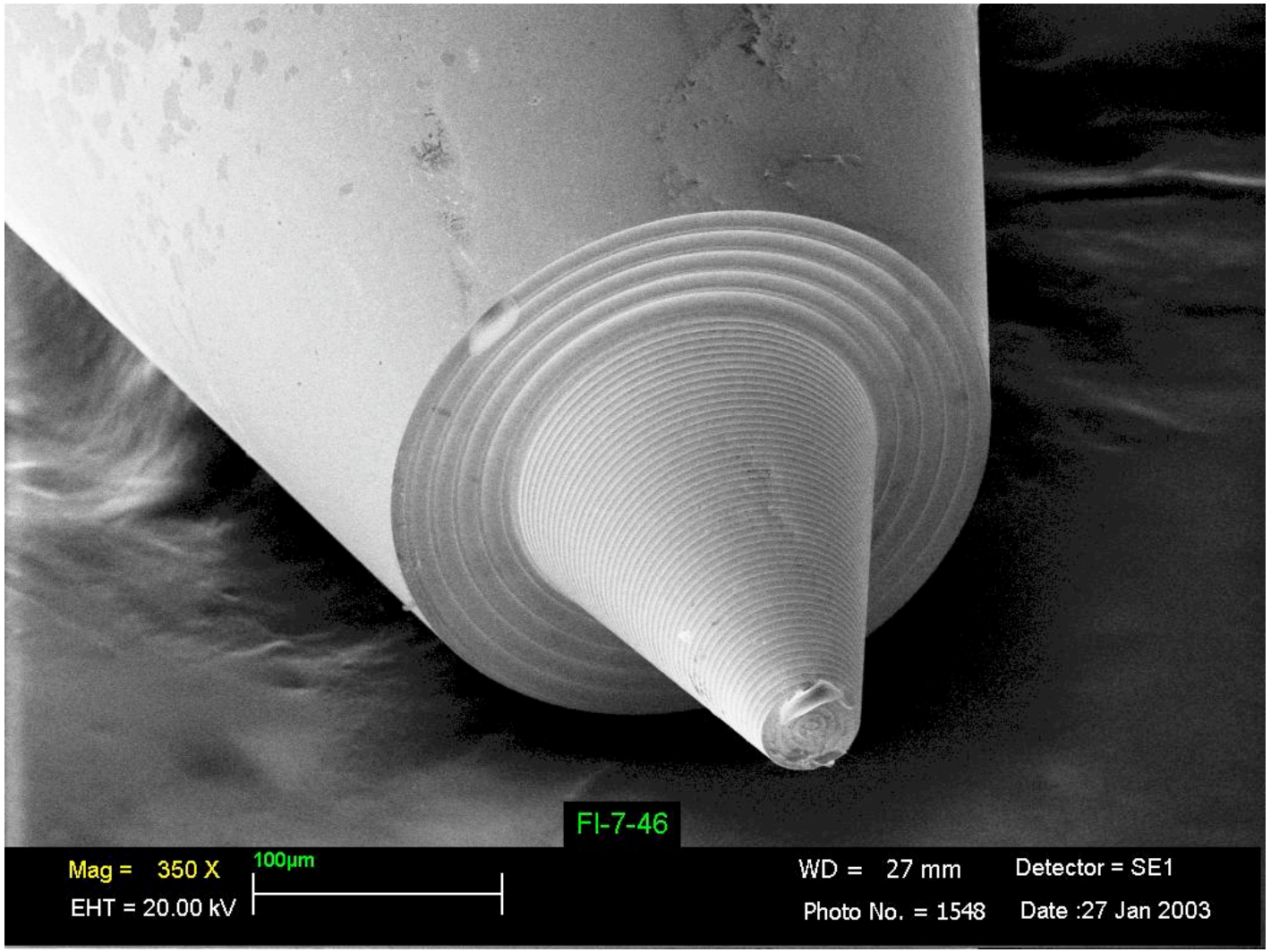
1. Shelf accommodates variations in shell diameter, wall thickness, and hole diameter.

2. Shelf provides fixed depth of penetration for cone tip into shell.

3. Shelf provides a wide base for good glue joint.

4. Cone tip shape can varies between pointed, parabolic, and flat.

SEM Picture of Flat Cone Tip and Shelf



3D Plot of Flat Cone Tip Produced by WYKO Microscope

3-Dimensional Interactive Display

Date: 01/29/2003
Time: 10:58:34

Surface Stats:

Ra: 46.63 nm

Rq: 64.05 nm

Rt: 1.03 um

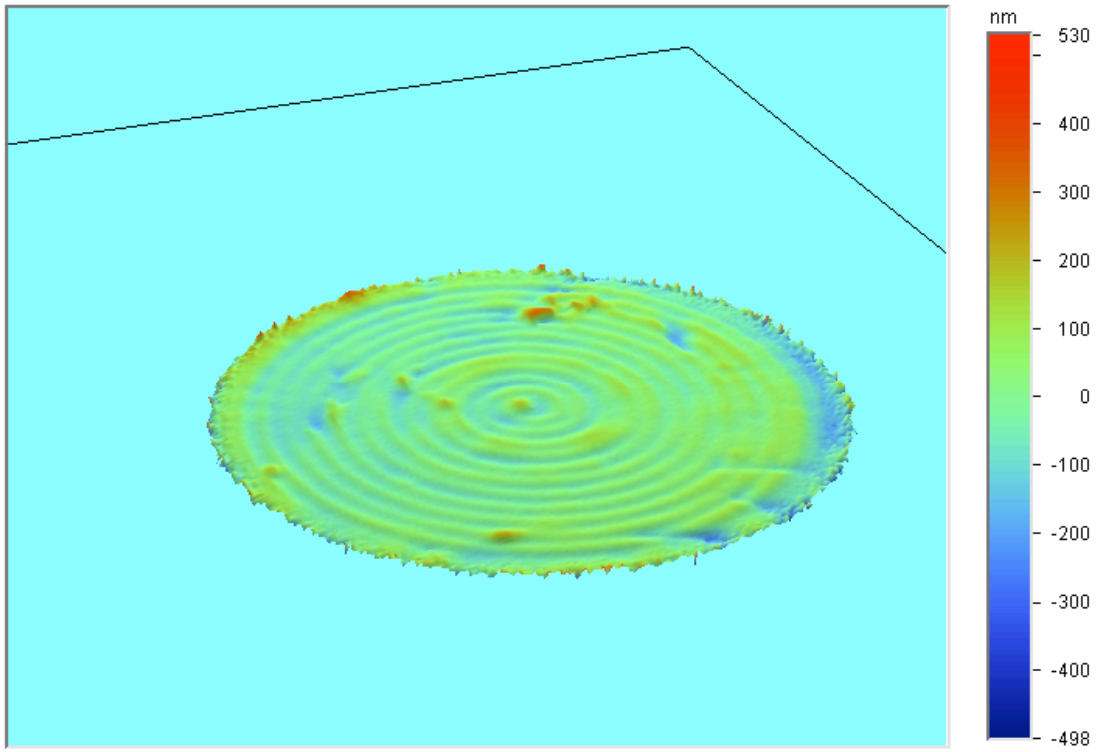
Measurement Info:

Magnification: 50.76

Measurement Mode: VSI

Sampling: 330.98 nm

Array Size: 368 X 240



Title: FI-7-4b Cone #11

Note: Cone Tip after Etch

3D Plot of Parabolic Cone Tip Produced by WYKO Microscope

3-Dimensional Interactive Display

Date: 09/26/2002

Time: 13:34:35

Surface Stats:

Ra: 1.03 um

Rq: 1.47 um

Rt: 9.64 um

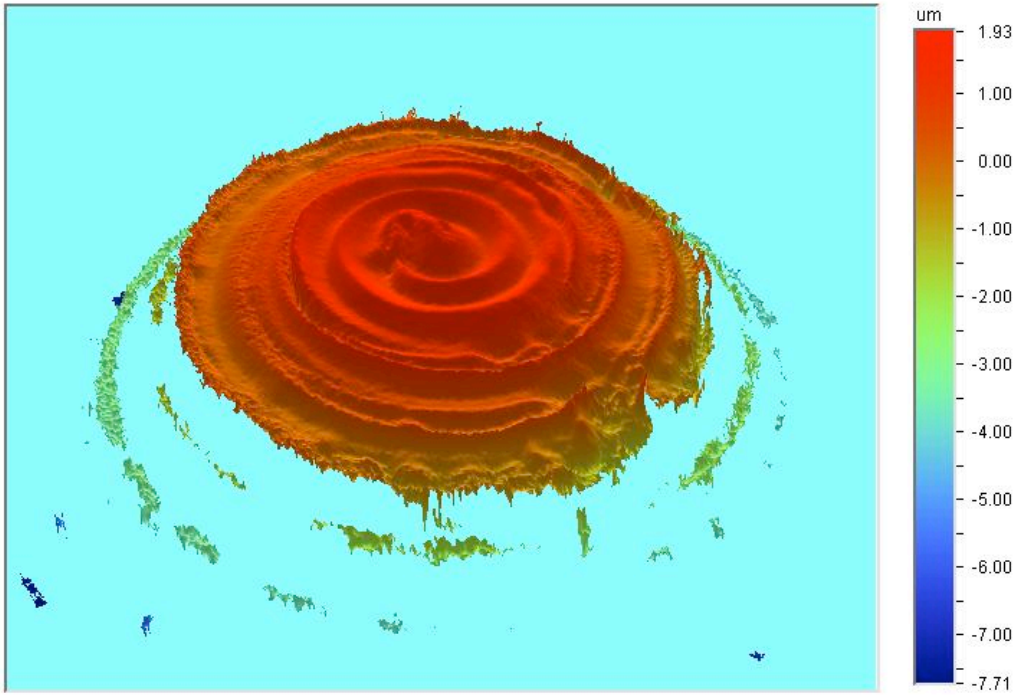
Measurement Info:

Magnification: 101.12

Measurement Mode: VSI

Sampling: 83.07 nm

Array Size: 736 X 480



Title: FI-4

Note: Cone #4

3D Plot of Cone Shelf Produced by WYKO Microscope

3-Dimensional Interactive Display

Date: 01/28/2003
Time: 08:42:03

Surface Stats:

Ra: 160.88 nm

Rq: 237.58 nm

Rt: 3.90 um

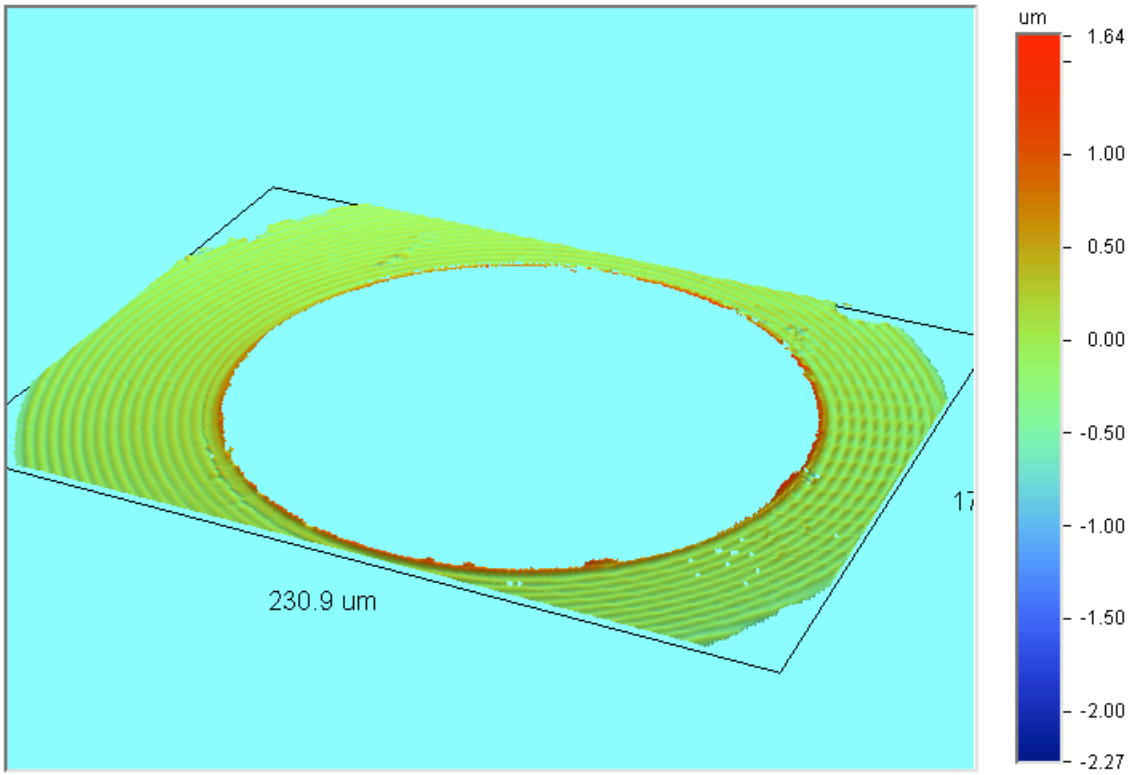
Measurement Info:

Magnification: 26.77

Measurement Mode: VSI

Sampling: 627.56 nm

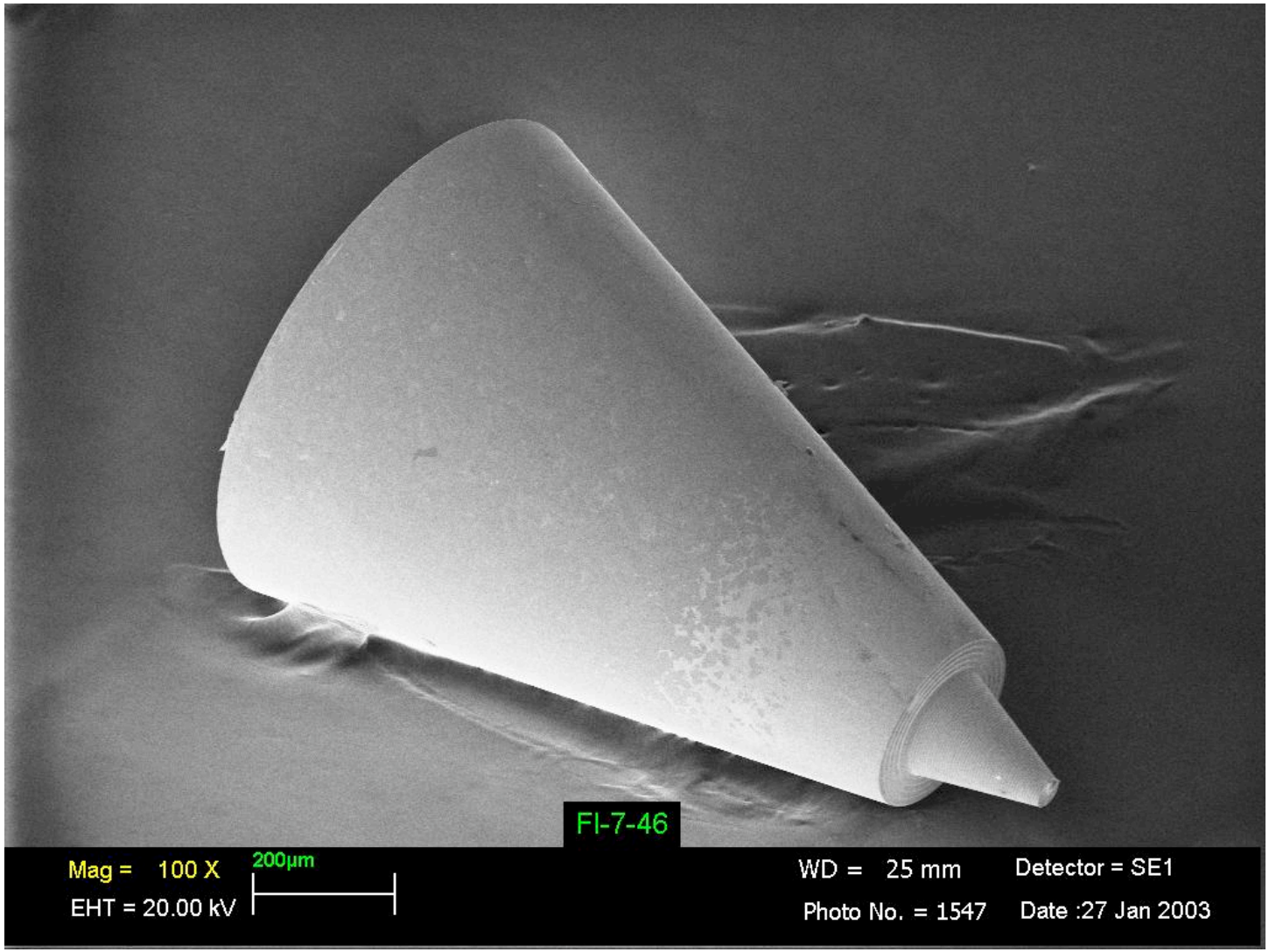
Array Size: 368 X 240



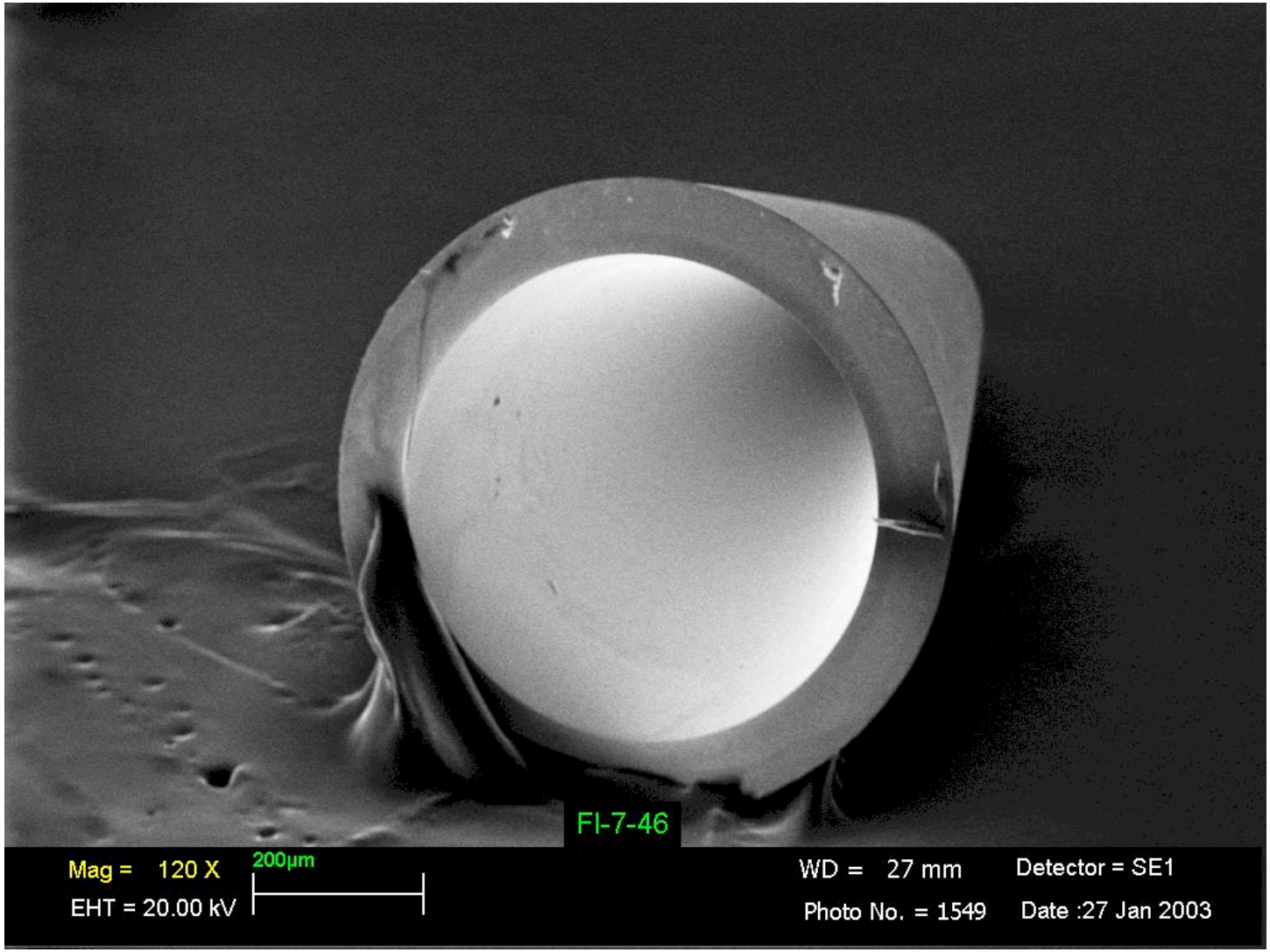
Title: FI-7-4b Cone #4

Note: Cone Shelf after Etch

SEM Picture of Narrow Cone



SEM Picture of Cone Base



Cu-CD Coatings are Needed for Fast Ignition Experiments

Used current systems to produce such coatings

Modified system to allow introduction of copper carrying dopant material

CuAcAc was used as dopant- solid at room temperature

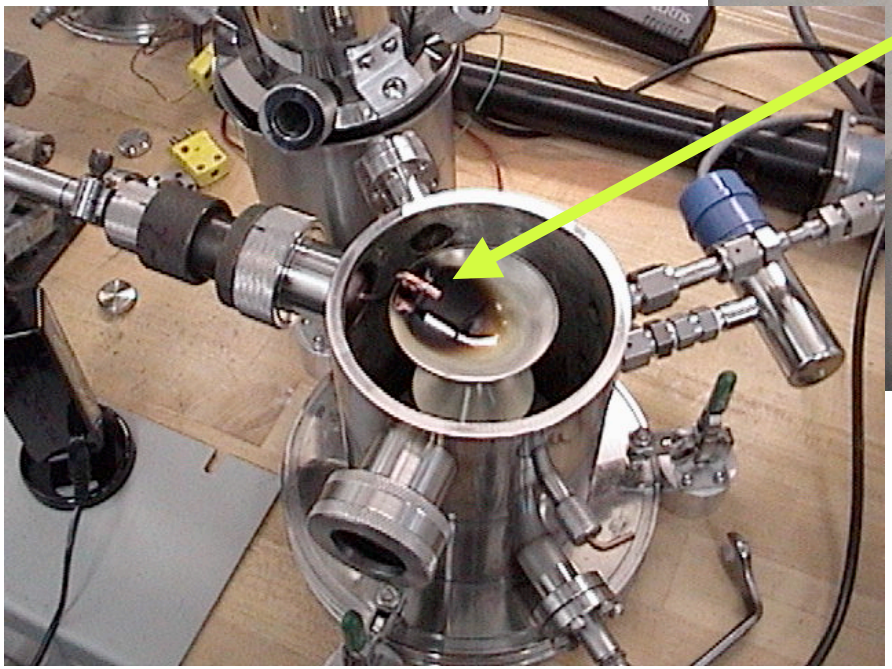
Cu-CD coatings appropriate for fast ignition were made

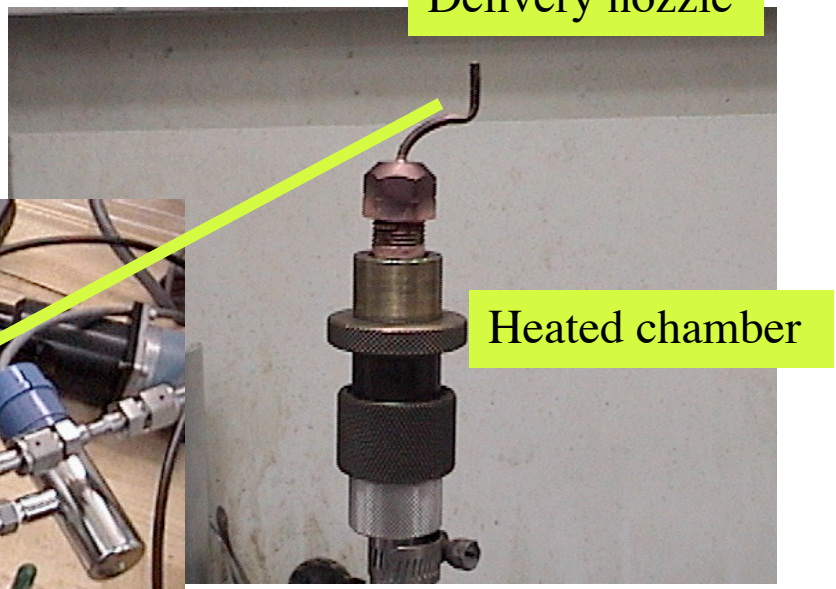
Both intact shells and machined shell targets have been delivered

Problems with reproducibility of Cu atom % - can be reduced

GDP Coater was Modified to Produce Cu-doped CD Coatings

CuAcAC was used as dopant
Solid at room temperature
Heated to 150 C



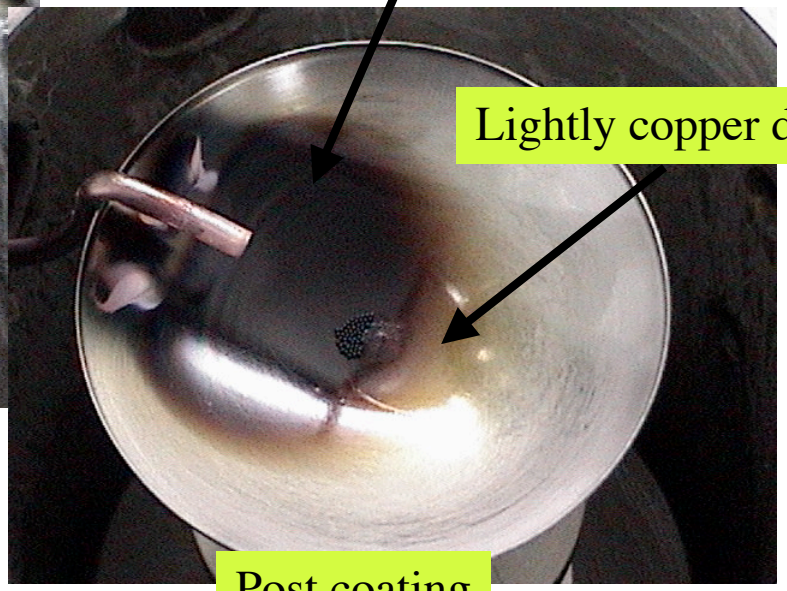


Copper Doping is Not Uniform Laterally in the Coater

Prior to coating

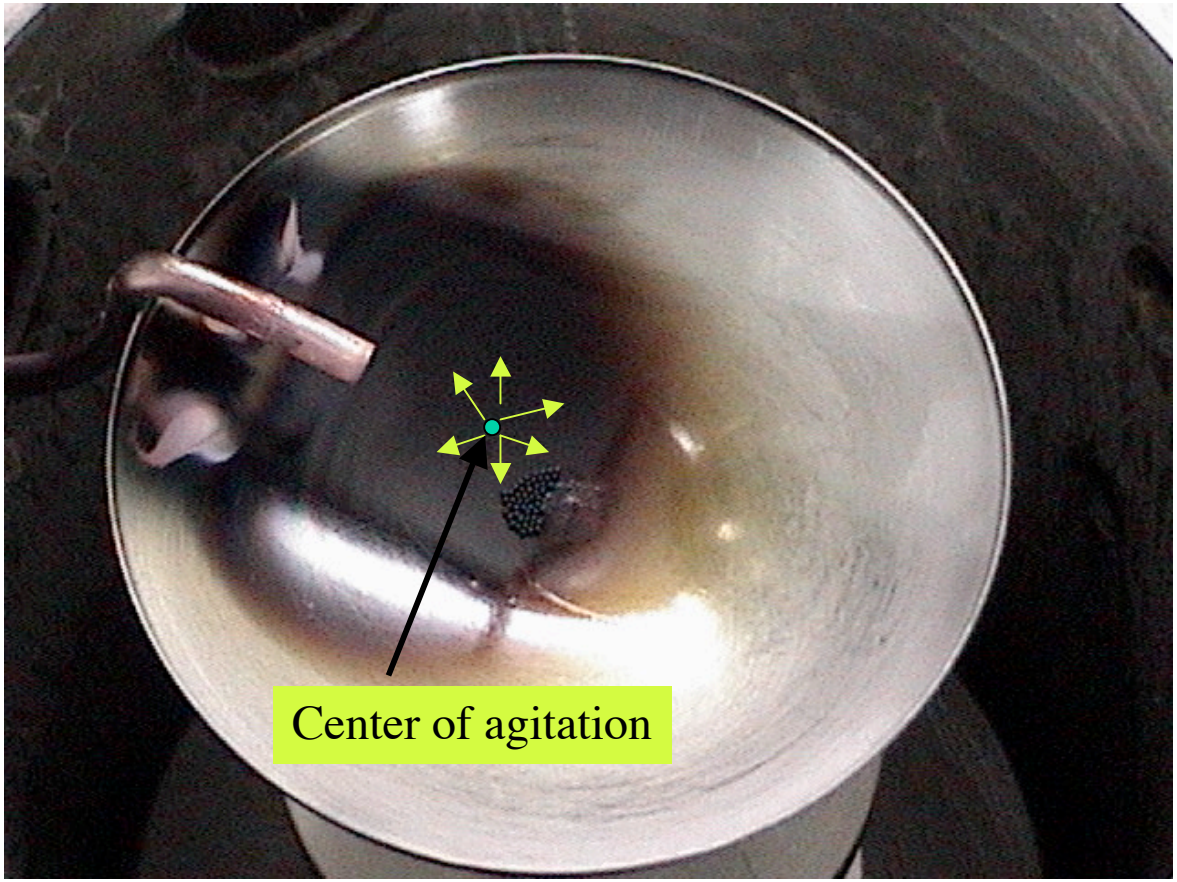
Heavily copper doped

Lightly copper doped

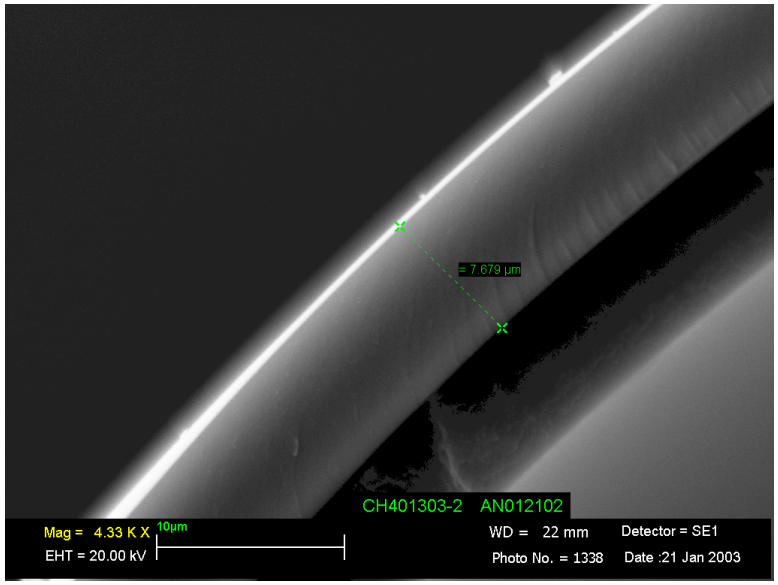


Post coating

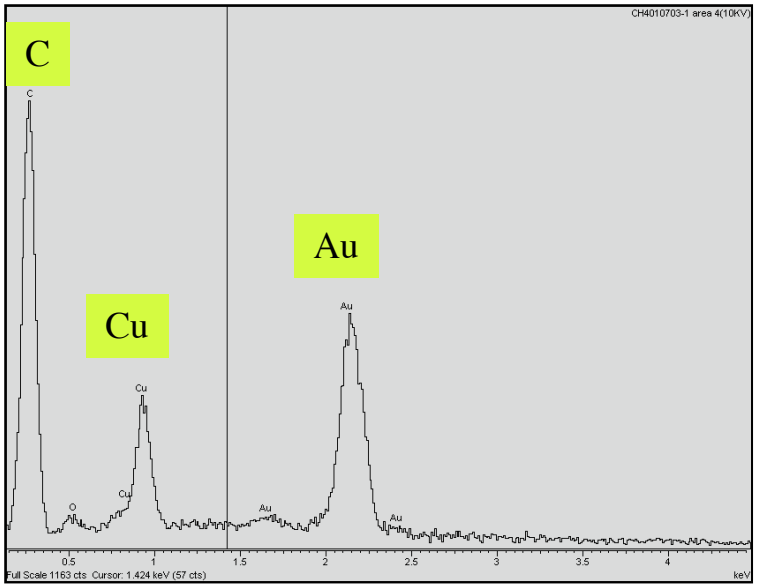
Agitation of Shells Leads to Homogeneous Copper Distribution in Coating



Coatings were Examined by SEM and EDAX

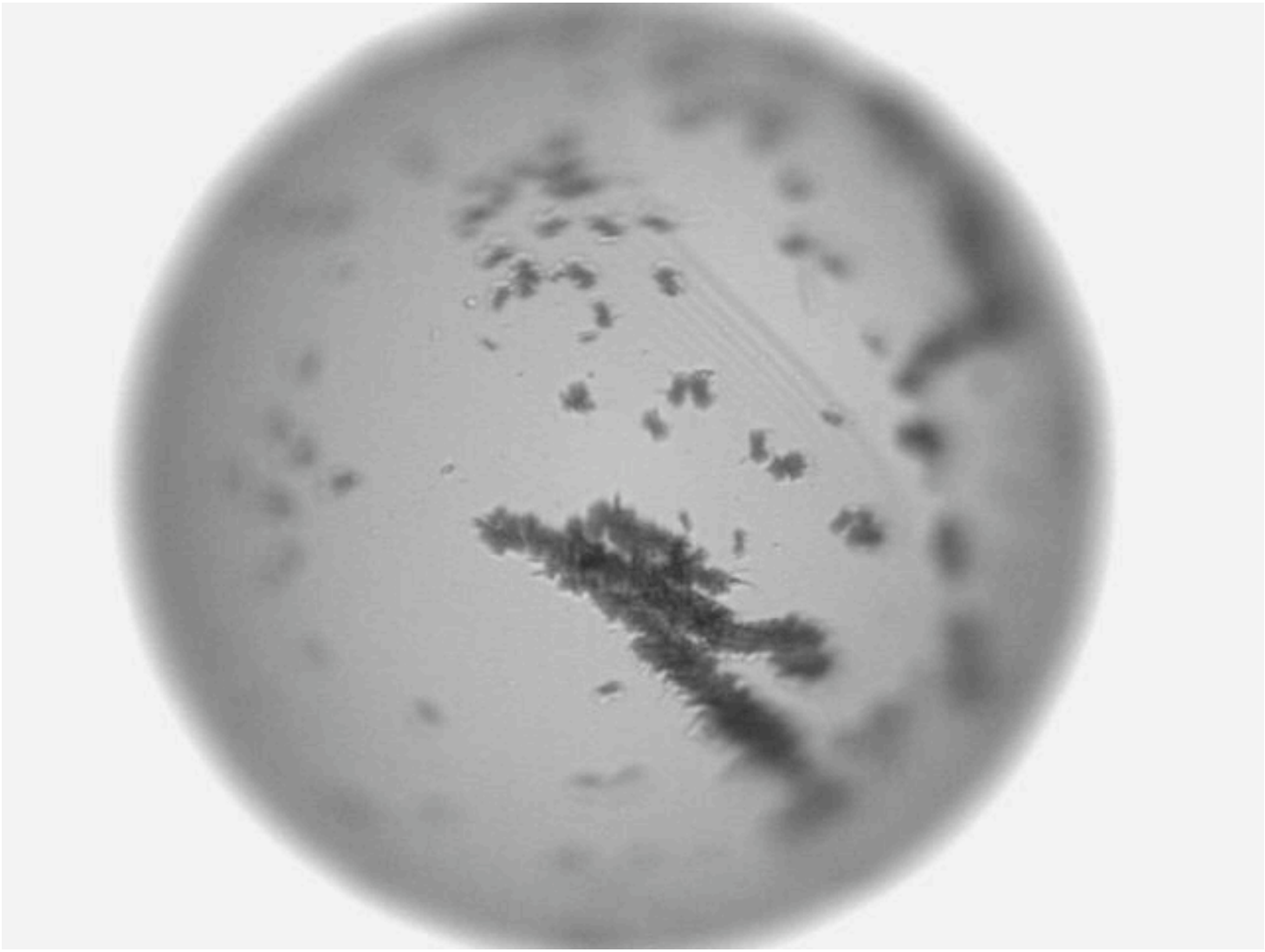


SEM cross section
Backscatter image- Homogeneous Cu

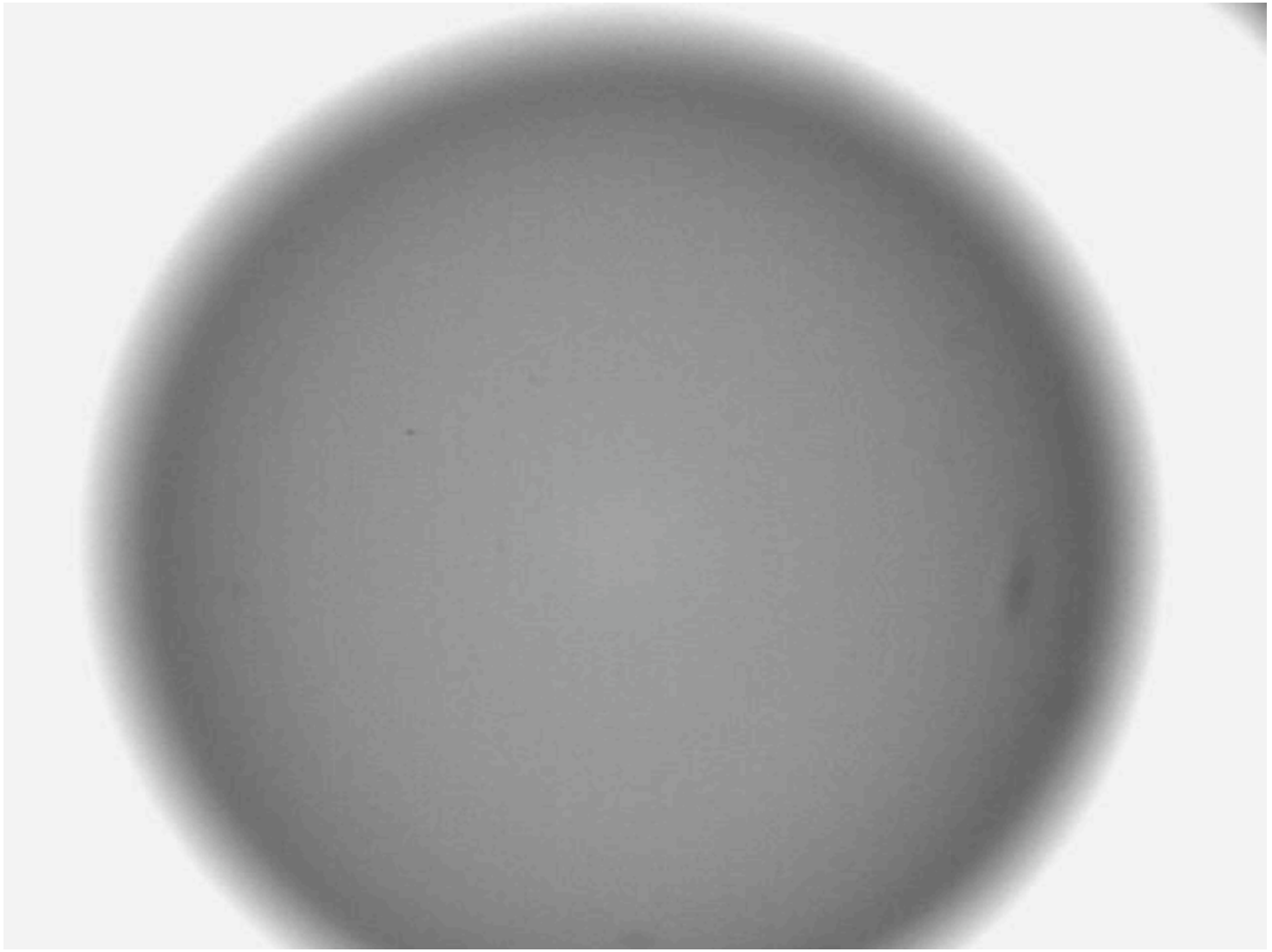


EDAX elemental scan
Also confirmed homogeneity

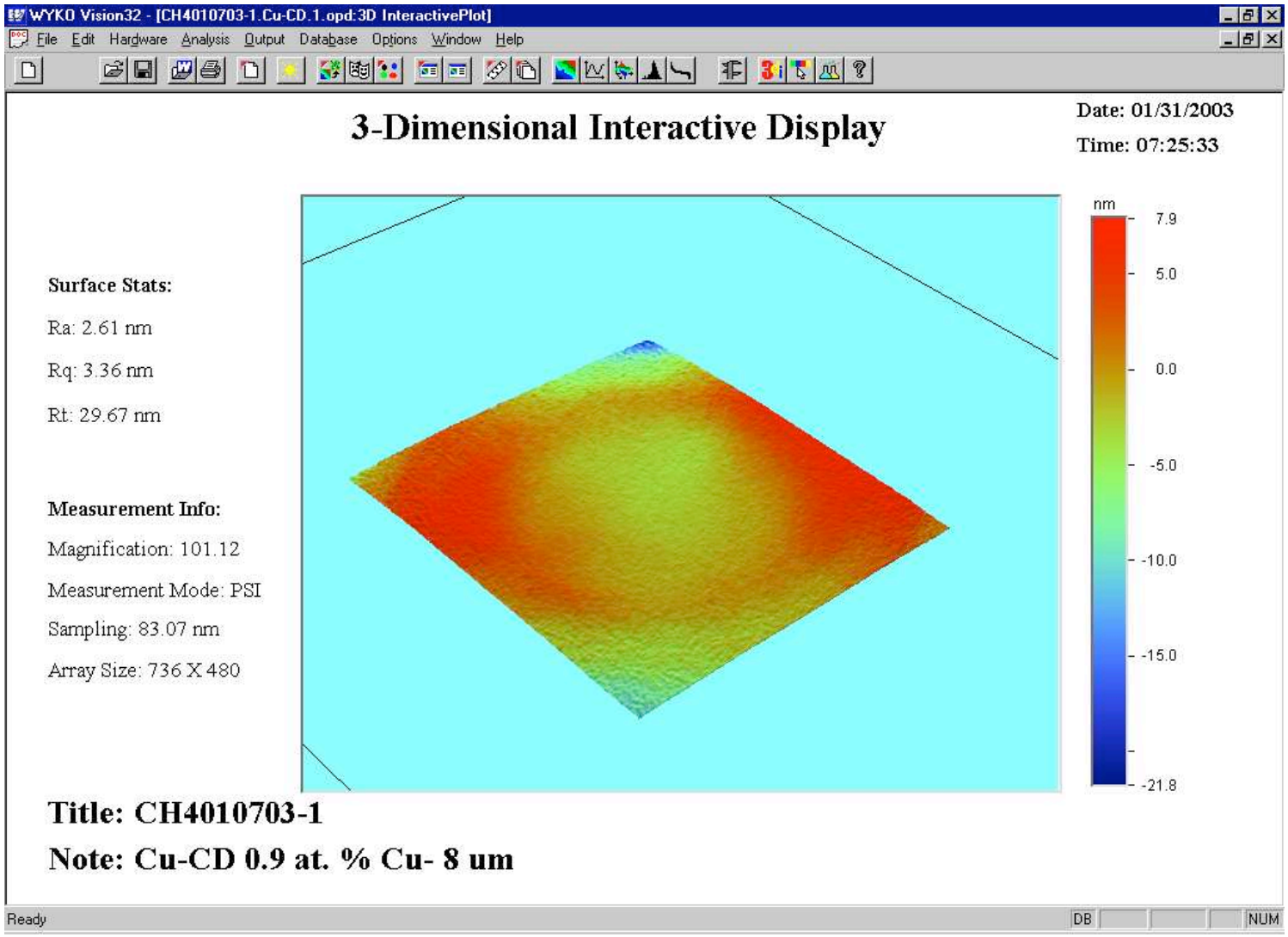
Crystallites Form in Coating when Dopant Added Too Soon or Too Late.



Coating Improves when Doping and Plasma Flow are Well Controlled.



3D Plot of Shell Surface Produced by WYKO Microscope



Cu-CD Coatings for Fast Ignition have been Produced

Coatings with ≈ 0.1 - 3.0 atom % Cu have been made

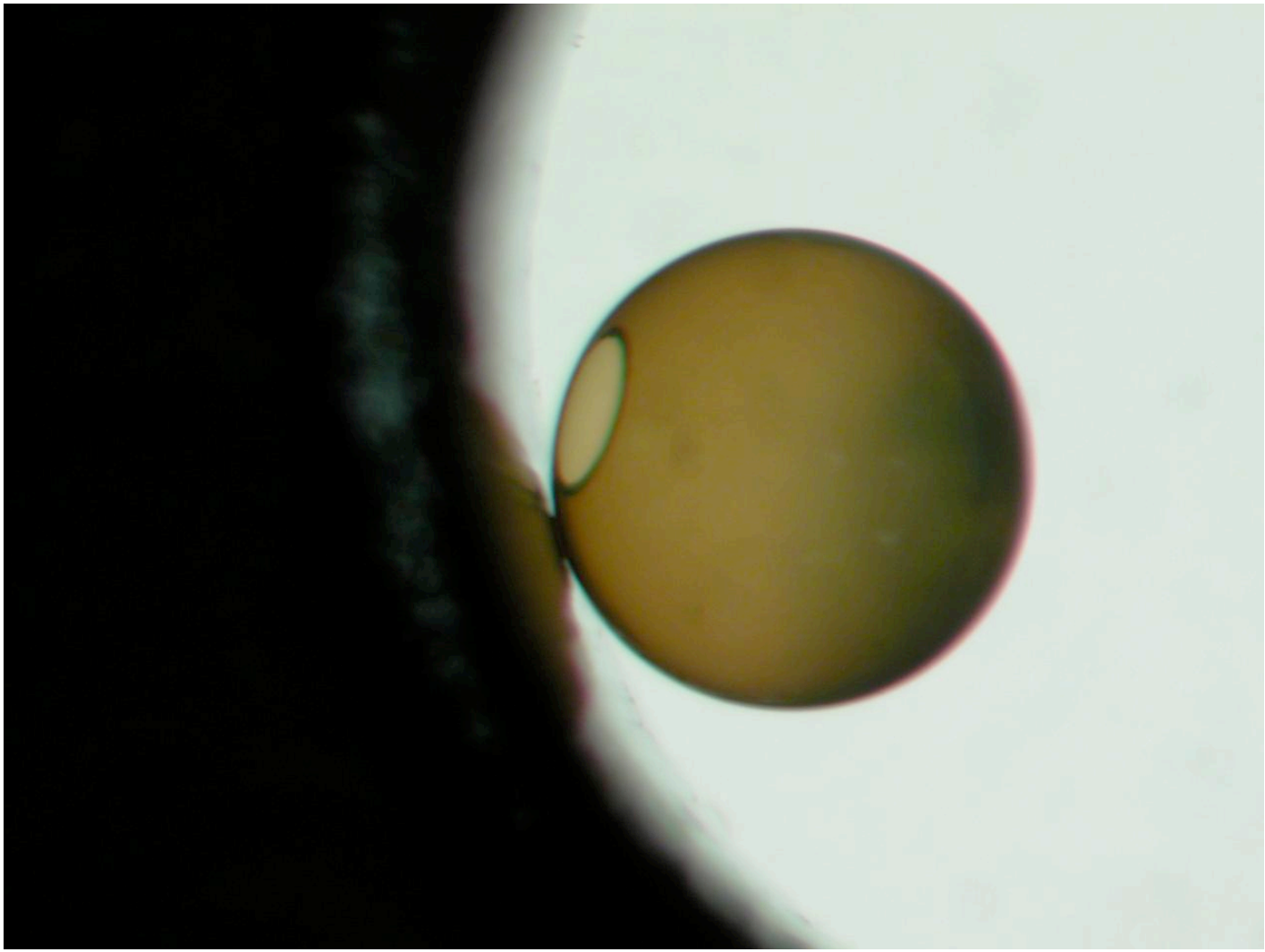
Problems:

Run to run variation in Cu atom percent due to different center of agitation
Can be remedied by more central introduction of CuAcAc

CuAcAc flow without plasma leads to CuAcAc crystallite formation
Need to time plasma and CuAcAc ON times closely

Shells Mounted on Glass Slide after Machining Holes

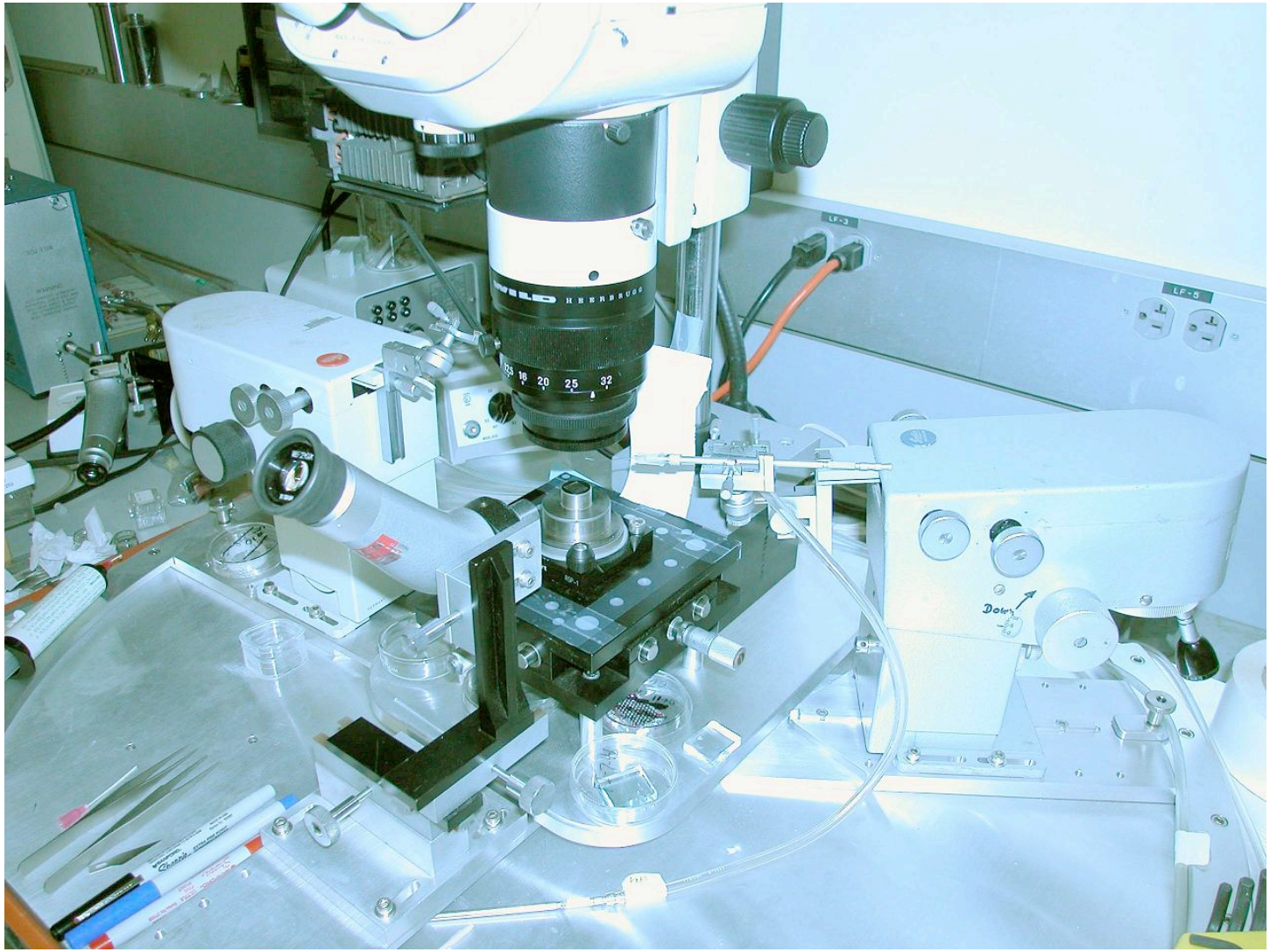
Finished Shell Ready for Mounting on Cone



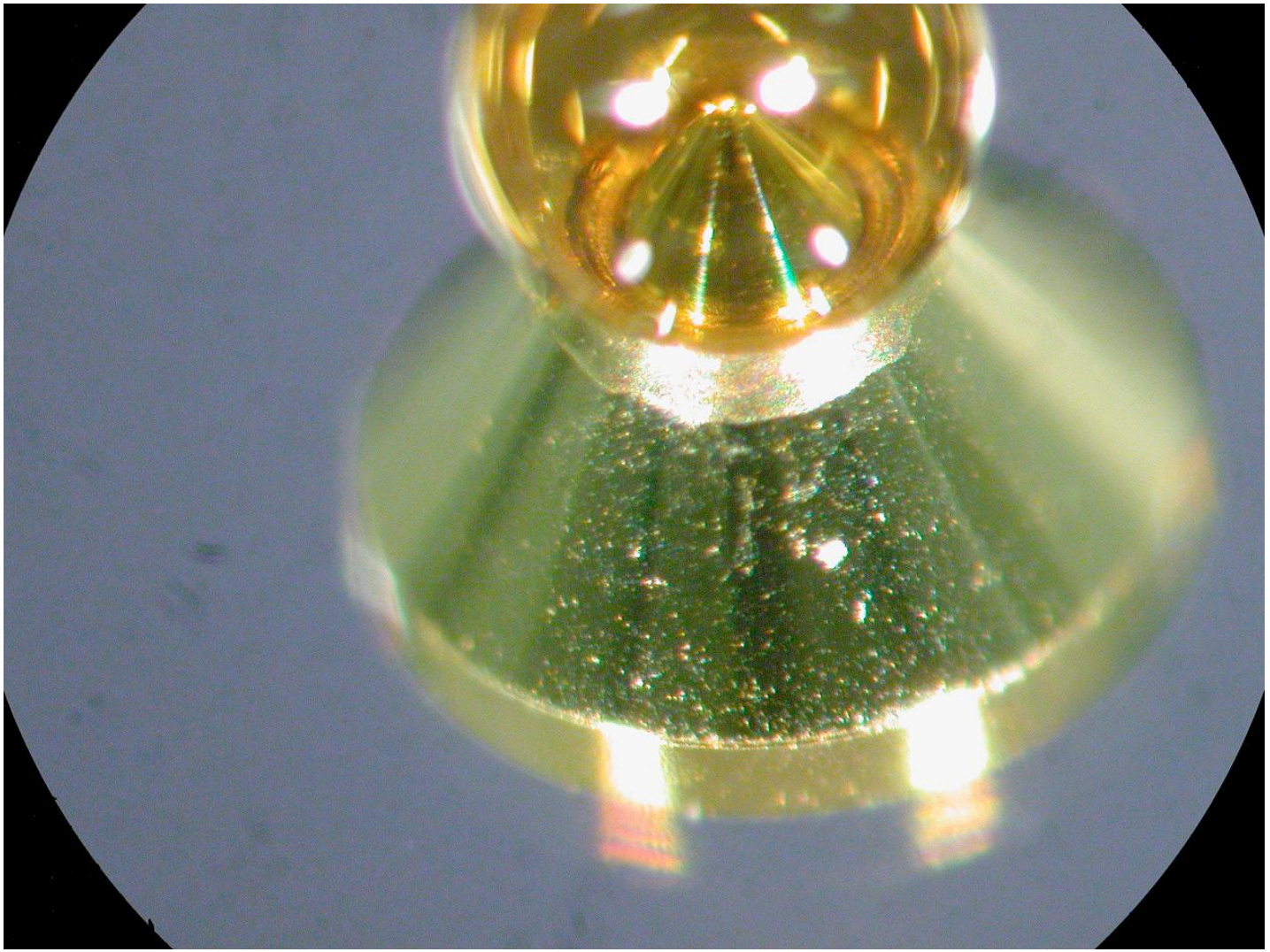
Shell and Cone are Glued Together to Form Target

- Place small glue droplets on cone shelf
- Line up shell and place on cone shelf
- Measure cone tip to shell center offsets
- Adjust shell position and set glue
- Add a bead of glue around joint and set
- Measure final horizontal and vertical offsets

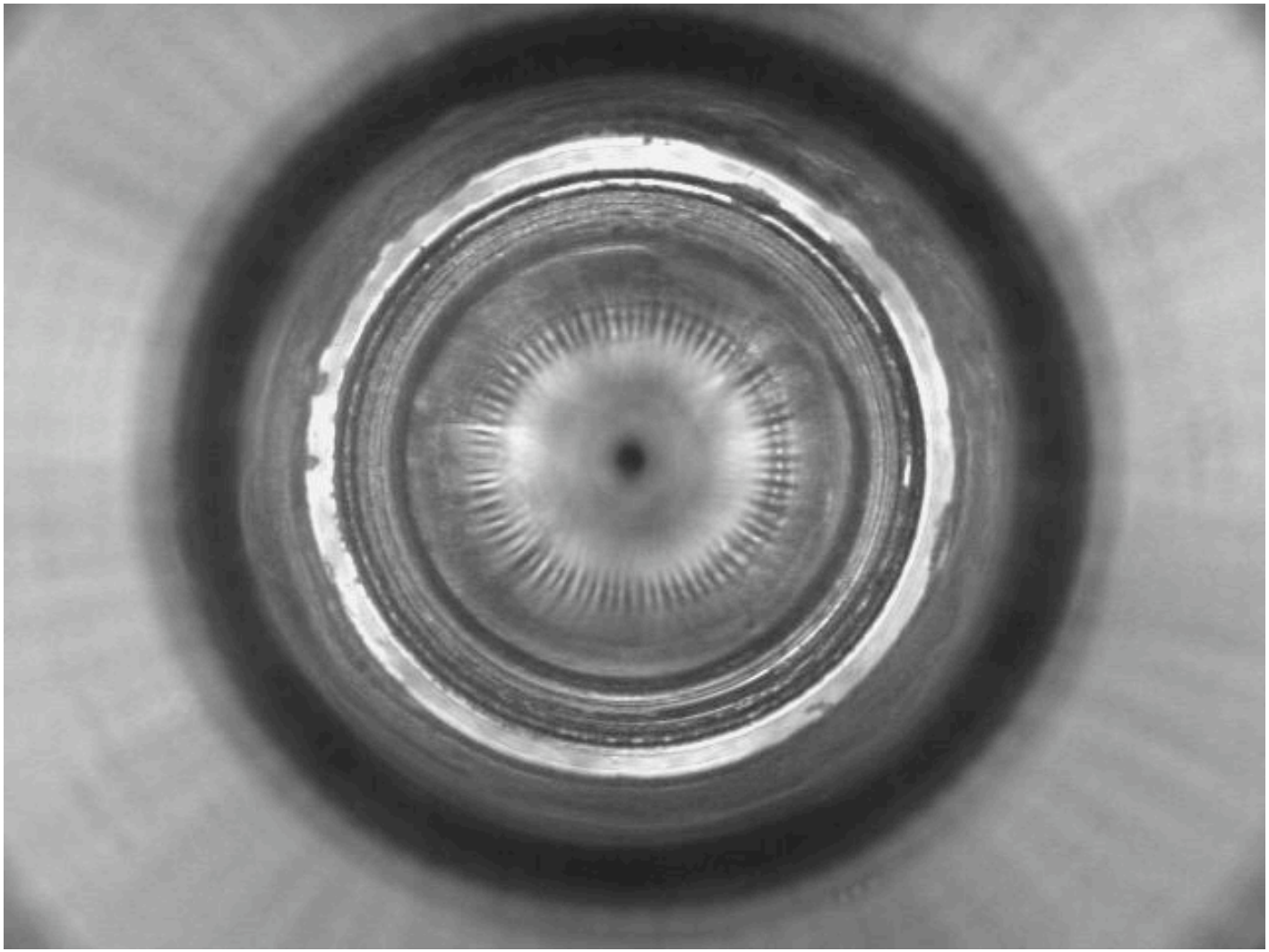
Target Assembly Station



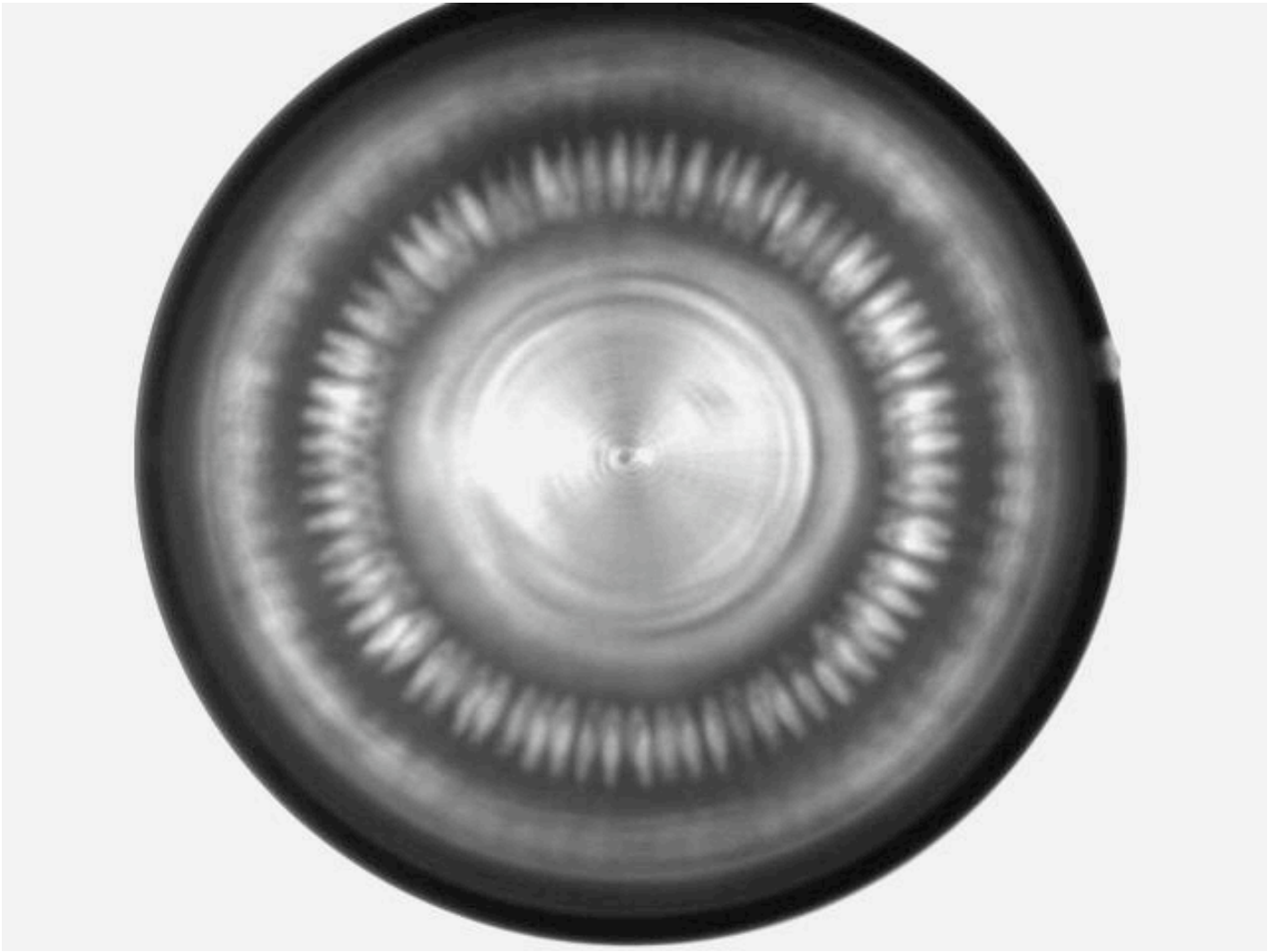
Glue Joint around Shell on Cone Shelf



Wide Glue Joint Provides Gas Tight Seal



Ring Light on Digital Microscope Highlights Shell Wall



Fabrication of Fast Ignition Targets

- Multiple targets with varying coating types and cone, shell, and wall dimensions have been fabricated and delivered.
- Methods for fabricating cones, shells and assembled targets are continually being developed and improved.